Advancing the Science of Sealing™

Garlock Fluid Sealing Products Technical Manual

Compression Packing

Sheet and Cut Gasketing

GYLON® Gasketing

Expansion Joints

Metallic Gaskets

Hydraulic Components

Garlock
SEALING TECHNOLOGIES®

an EnPro Industries company

Environmental Stewardship Efforts

Garlock Receives EPA Clean Air Act Award

Established in 2000 at the recommendation of the EPA Clean Air Act Advisory Committee, the award annually recognizes outstanding efforts toward achieving cleaner air. Winners must reduce pollutant emissions, demonstrate innovation, offer sustainable outcomes, and provide a model for others to follow. Garlock Sealing Technologies received the U.S Environmental Protection Agency's 2008 Clean Air Excellence Award for the VOC Elimination Project which eliminated the use of a VOC/HAP solvent from the high pressure sheet gasket process.

"From the over 120 applications received, Garlock's project was chosen by the EPA's Office of Air and Radiation for its impact, innovation, and replicability," said EPA administrator, Pat Childers, in announcing the award. "Garlock is to be congratulated for its dedication to improving our nation's air quality."

Garlock wins air quality award for VOC elimination

The *Environmental Business Journal* has been published for over 20 years by Environmental Business International. It serves the global environmental industry by delivering market research, financial analysis, business trends and company profiles. EBJ is a recognized source of environmental information to the US Dept. of Commerce. Their data and analysis are published in the *Wall Street Journal, New York Times, The Economist* and other leading trade and business publications.

Garlock Sealing Technologies has been honored with a 2008 Business Achievement Award from the *Environmental Business Journal* for the VOC Elimination Project. This project eliminated a volatile organic compound and listed hazardous air pollutant from the HPS gasket process and replaced it with a more environmentally friendly solvent.

Environmental
Stewardship
Efforts

Garlock wins Rochester Business Journal's Environmental Leadership Award

"The Environmental Leadership Awards were created to honor area companies making great strides to become environmentally sound and helping make our community a healthier place to live," said Susan R. Holliday, president and publisher of the *Rochester Business Journal*. "Garlock was selected this year because of its demonstrated commitment to having a positive impact on environmental issues." Garlock Sealing Technologies was one of three honorees in the category of environmental innovation, based on its conversion to a more environmentally friendly material for gasket production at its Palmyra, N.Y. facility.

ROCHESTER BUSINESS JOURNAL ENVIRONMENTAL LEADERSHIP AWARD 2008

Garlock invested more than $3 million to replace a volatile organic compound (VOC), with a more environmentally friendly material in its production of gasket material, eliminating annual air emissions of 120 tons in the process. Use of the new material also resulted in improved process yields, products that seal 20 percent better and a healthier work environment.

Garlock wins National Pollution Prevention Roundtable's MVP2 Award

Based in Washington, D.C., the National Pollution Prevention Roundtable is the largest membership organization in the U.S. devoted solely to pollution prevention. It provides a national forum for promoting the development, implementation and evaluation of efforts to avoid, eliminate or reduce pollution at the source. Its members comprise preeminent pollution prevention experts from regional resource centers, state and local government programs, small business assistance networks, non-profit groups, industry associations, federal agencies and academia.

The NPPR honored Garlock Sealing Technologies with its MVP2 award for the Best P2 pollution prevention project. The project, which eliminated use of a volatile organic compound (VOC) and hazardous air pollutant (HAP) from production of the company's industrial sheet gaskets.

The MVP2 awards are presented in four categories – MVP2 Project/Program for which Garlock won, Best P2 Publication, P2 Champion and P2 Volunteer of the Year. Recognizing outstanding projects and programs, the awards are judged on the basis of innovation, measurable results, transferability, commitment and optimization of available resources.

Contents

Advancing the Science of Sealing™

Compression Packing Technical Manual

Garlock
SEALING TECHNOLOGIES®

an EnPro Industries company

Garlock Compression Packing

Compression Packing Products were once used to seal visable leakage in valves and control leakage in pumps. Through advancements in materials, design and technology, Garlock is now able to seal the most difficult fugitive emissions and eliminate pump leakage entirely.

The Garlock Compression Packing facility is committed to supplying the highest quality engineered products to industry throughout the world. Garlock packing is designed to give the user the greatest return on initial investment in terms of leakage control, service life, and dependable, cost-effective product.

The facility also houses the Garlock Textile Division, where we continue to research and develop new fiber blends to bring customers a wide array of packings with optimum performance characteristics.

Contents

Graphite Packings

Style G-200

- Style G-200 offers low friction for energy savings
- Excellent sealability against abrasives for improved reliability, temperature and chemical resistance for longer packing life
- G-200 is a good choice for high temperature rotary slurry service

Specifications

Construction:	LATTICE BRAID® graphite filament lubricated with a graphite dispersion
Temperature:	-328°F (-200°C) to +850°F (+455°C) Atmosphere To +1200ºF (650ºC) in Steam
pH range:	0-14 (except strong oxidizers)
Pressure:	To 500 psi (34 bar) rotary
Shaft speed:	To 4,000 fpm (20 m/s)

Style 1300-E

- Our entry level graphite packing, 1300-E handles high temperature rotary and valve service

Specifications

Construction:	LATTICE BRAID® flexible graphite
Temperature:	-328°F (-200°C) to +850°F (+455°C) Atmosphere To +1200ºF (650ºC) in Steam
pH range:	0-14 (except strong oxidizers)
Pressure:	To 500 psi (34 bar) rotary To 3,000 psi (200 bar) valves
Shaft speed:	To 4,000 fpm (20 m/s) rotary

Style 1333-G

- Style 1333-G is braided from graphite fiber reinforced flexible graphite yarns and high purity graphite filament yarns to provide high tensile strength and low friction
- The excellent heat dissipating properties of 1333-G allows our customers to conserve both water and energy
- Since Style 1333-G can be used in clean, high speed, high temperature applications requiring low leakage rates, our customers also realize a significant savings in inventory investment by using this material in both pumps and valves

Specifications

Construction:	Offset square flexible graphite braid reinforced with a graphite dispersion
Temperature:	-328°F (-200°C) to +850°F (+455°C) Atmosphere To +1200ºF (650ºC) in Steam
pH range:	0-14 (except strong oxidizers)
Pressure:	To 500 psi (34 bar) rotary To 4,000 psi (275 bar) valves
Shaft speed:	To 4,800 fpm (23 m/s) rotary

* Style 1333-G Square is available upon request

Expanded PTFE and Graphite

Style 5100 GFO® Packing

- Braided compression packing made from 100% GFO® fiber provides consistently high performance in a wide range of applications
- Unlike other PTFE/graphite packing, only those made with GFO® fiber, with its 20+ year history of trouble-free performance, deliver an unmatched level of assurance, confidence and easy handling
- As a proud Seal of Assurance member, Garlock produces Style 5100 to the exacting standards that allow an operation to benefit from reduced maintenance and inventory costs
- Style 5100 is non-contaminating so it will not contaminate the end product
- Remember, if it does not say Genuine GFO® on the packing, then it is not Genuine GFO®

Specifications

Construction:	GFO® with Silicone lubrication
Temperature:	-200ºF (-130ºC) to +550ºF (+288ºC)
pH range:	0-14**
Pressure:	To 300 psi (20 bar) rotary/centrifugal To 2,000 psi (138 bar) in valves
Shaft speed:	To 4,000 fpm

** Not recommended for Chlorine service
GFO is a registered trademark of WL Gore.

Style 1306

- Style 1333-G is braided from high purity flexible graphite yarns with carbon filament yarns on the corners.
- The combination of materials and construction gives Style 1306 added abrasion resistance over standard flexible graphite yarn packings.

Specifications

Construction:	LATTICE BRAID® graphite filament
Temperature:	-328°F (-200°C) to +850°F (+455°C) Atmosphere To +1200ºF (650ºC) in Steam
pH range:	0-14 (except strong oxidizers)
Pressure:	To 500 psi (34 bar) rotary To 3,000 psi (200 bar) valves
Shaft speed:	To 4,000 fpm (23 m/s) rotary

* Style 1333-G Square is available upon request

Valve Packings for Fugitive Emissions Service

Garlock Style 212-ULE
(Ultra Low Emissions)
VALVE STEM SPOOL PACKING

To learn more, visit www.212ule.com

Simplify your Leak Detection and Repair (LDAR) Program with Garlock Style 212-ULE

Better performance than an engineered set in a convenient spool product. Style 212-ULE is easy to cut and install with color coded instructions. Cut inventory dollars and reduce outage schedules without sacrificing performance. Outage planning is easier than ever now that each 212-ULE box indicates how many typical valves can be repacked by one box.

Specifications

Temperature:	-328ºF (-200ºC) to 1,200ºF (650ºC) steam* 850ºF (455ºC) atmosphere
pH range:	0-14 (except strong oxidizers)
Pressure, Max.:	To 4,500 psig (310 bar)

*NOTE: For applications over 1,000ºF (538ºC), please contact Garlock Applications Engineering

212-ULE Box Ordering Information

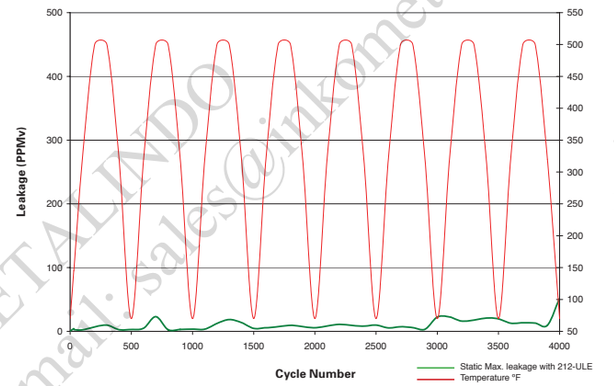
Average Number of Valves Packed						
Packing Cross Section	Style B		Style A		Average Stem Diameter	Avg Number of Valves Packed
Inches	Ft	Lbs	Ft	Lbs		
1/8	65.5	0.8	16.4	0.3	0.375	125
3/16	127.6	3.6	31.9	0.9	0.625	150
1/4	98.2	4.3	24.5	0.9	1	75
5/16	50.7	3.0	12.7	0.8	1.625	25
3/8	45.2	3.5	11.3	1.0	2.5	15
7/16	38.6	4.3	9.7	1.0	3.25	10
1/2	22.3	3.8	5.6	0.7	3.75	5
9/16	26.5	4.9	6.6	1.2	4.5	5
5/8	29.5	7.4	7.4	1.5	5	5

Included with each box of 212-ULE, are enough valve labels to indicate installation date and proper time to retighten packing gland.

Each spool of 212-ULE has a “Low Spool” in-dicator tag that notifies the user to reorder.

Static Leakage Maximum Readings

Leakage and Temperature vs Actuation Cycles

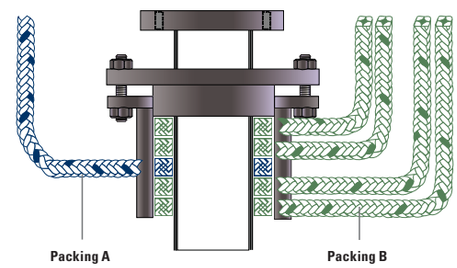


Independent emission testing was performed with die-formed and spool stock 212-ULE with results less than 100ppm in all cases.

How to Install 212-ULE*

When packing a valve, pack 2 rings of “Packing B”, then one ring of “Packing A”, then 2 additional rings of “Packing B”, giving you a B-B-A-B-B configuration (or 212). This minimizes valve emissions and reduces torque actuation forces. For stuffing boxes deeper than 5 rings, please order Garlock Style 1998-EZ Bushing.

Ideal Set Configuration



*NOTE: For more detailed installation instructions, please consult www.garlock.com. Style 1998 is to be used as a bushing material only, not for use as a valve stem seal.

Style 1998 EZ Bushing

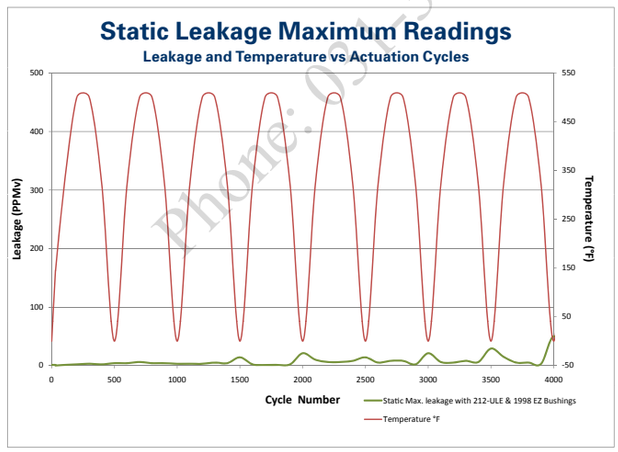
"Bushing on a Spool"

- Style 1998 EZ-Bushing was designed for use as a bushing material with the convenience of being readily available in bulk form and custom cut to length on site
- This not only minimizes downtime but also reduces inventory investment of custom machined bushings
- Low stem friction
- Environmentally friendly packaging
- Pack stuffing boxes without ordering special carbon or stainless bushings
- Easily removed from stuffing box
- Easy to use dispensing box

Specifications

Construction:	INCONEL® reinforced fiberglass wire with graphite finish
Temperature:	-To +850ºF (+455ºC)
pH range:	2-11

*NOTE: Recommended for use as a bushing material only



Style 1303-FEP

- Style 1303-FEP combines the emissions performance of engineered sets with the installation flexibility and speed that comes from braided packing
- Offers the same fire safety and chemical resistance as EVSP
- The wire jacketed construction makes for a long lasting valve packing that requires minimal adjustment and will deliver superior emissions control from turn around to turn around
- The wire reinforcement will not score the stem and doesn't add excessive stem friction
- In a recent independent API-622 test conducted at Yarmouth Research and Technology, Style 1303-FEP not only provided marked improvement in emissions control, but it also required 60% fewer adjustments and resulted in 4% less actuation torque as compared to the next best competitive braided emissions packing

Specifications

Construction:	High-purity GRAPH-LOCK® flexible graphite and 0.004" INCONEL* filament
Temperature:	-328°F (-200°C) to +850°F (+455°C) atmosphere; to +1,200°F (+650°C) steam**
pH range:	0-14 (except strong oxidizers)
Pressure:	To 4,500 psi (310 bar)

*INCONEL® is a registered trademark of Inco Alloys International, Inc.

** For applications over 1,000•F (538ºC), please contact Garlock Applications Engineering

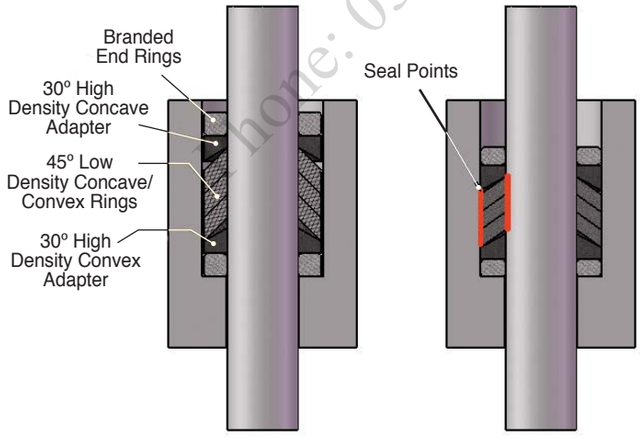
9000-EVSP

- Garlock's Expandable Valve Stem Packing or EVSP is an ideal solution for applications where fugitive emissions have to be less than 100 PPM
- This fire safe, chemically resistant packing preserves our environment while improving process yield
- As compared to traditional flat ring sets, the angled design and radial expansion of EVSP allows for multiple adjustments over the life of the packing
- The low friction design of EVSP allows for easy actuation and results in a more efficient use of instrument air plant resources, saving money and saving energy
- EVSP's superior radial expansion characteristics will seal even older, worn valves

Specifications

Construction:	GRAPH-LOCK® rings of high-purity diamond texturized graphite tape, in cup and cone configuration; end rings made from Garlock Style 98
Temperature:	-328°F (-200°C) to +850°F (+455°C) atmosphere; to +1,200°F (+650°C) steam
pH Range:	0-14 (except strong oxidizers)
Pressure:	To 10,000 psi plus (690 bar)

* Patent #4,328,974



EVSP Uncompressed Section View

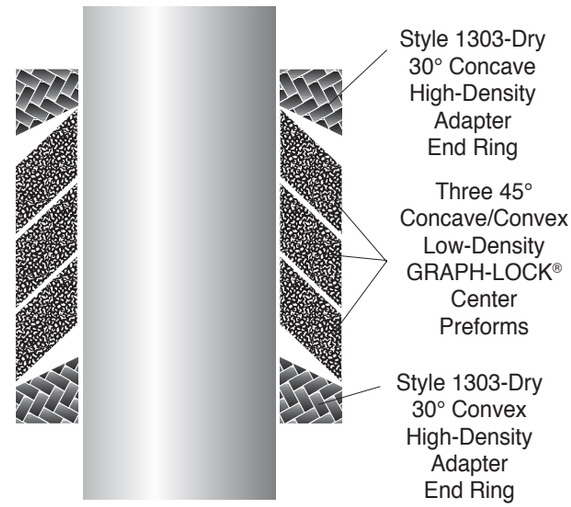
EVSP Compressed Section View

9001-QUICKSET® Emissions Compliant Valve Packing

- A low emissions alternative specifically designed for shallow stuffing boxes
- Like EVSP, QUICKSET offers less than 100 ppm service and exceptionally long life
- Unlike EVSP however, QUICKSET provides low emissions benefits with approximately 20% less stem friction
- This results in a more efficient, and therefore less costly, use of plant air and electricity in controlling actuated valves

Specifications

Construction:	Die-formed cup and cone rings combined with die-formed, high-density Style 1303-Dry end rings with zinc
Temperature:	-328°F (-200°C) to +850°F (+455°C) atmosphere; to +1,200°F (+650°C) steam
pH range:	0-14 (except strong oxidizers)
Pressure:	To 10,000 psi plus (690 bar)



QUICKSET® 9001 Typical Ring Arrangement

Valve Packing Accessories

High Purity Carbon Bushings

Our testing has determined that the optimal number of rings to seal a valve stem is between 5 and 7. Any less than 5 rings increases the chance of leaks, any more than 7 puts too much drag on the stem. Garlock uses high purity carbon bushings or Style 1998 EZ-Bushing to shorten deep stuffing boxes like those that are typically found in older valves. When combined with our radially expanding valve stem solutions, our high purity bushings allow excellent sealing with low actuation force which enables old, manual valves to be fit with air actuators and seal like new. Further, our bushings are made to such exacting material and dimensional standards that they can even be certified for nuclear service.

Bushings can also be made from 1303-DRY. While this approach adds some friction to the stem, it is an ideal choice when the valve stuffing box depth cannot be determined prior to repacking.

Live Loading Hardware

Even with its densified graphite construction, an EVSP set can consolidate by up to 2% over its service life. While this is not an issue for valves that can be easily monitored and adjusted, it does pose a problem for valves that are off the routine maintenance path. Additionally some service conditions, like severe temperature swings or frequent opening and closing, can accelerate consolidation. Garlock's solution for those types of applications is Live Loading.

Live Loading can compensate for packing consolidation of up to 3% and, when used with EVSP, can virtually eliminate the need for adjustment. It does not however, put a constant compressive force on the seal. If you use live loading with a braided packing like 1303-FEP, it will significantly extend the time between adjustments but adjustments will still be required.

We stock a wide range of spring washers so we can respond to most needs within 48 hours.

Necessary when the following conditions exist:

- Valves with difficult access
- High degree of thermal cycling
- "Critical" to operation of facility
- Frequently actuated
- Control valves
- Reduction in maintenance
- Controlled emissions levels
- High levels of packing consolidation

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.

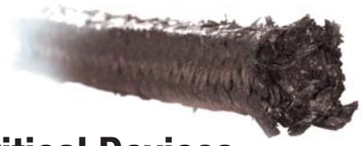
Performance data published in this brochure has been developed from field testing, customer field reports and/or in-house testing.

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.

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

Nuclear Applications

Style G-700



The Choice for Critical Devices

- When used as end rings together with high purity GRAPH-LOCK® rings, G700 is ideal for critical valve applications** in nuclear and power generation industries
- Tested by independent laboratories; compliant with:
  - MIL-P-24583B (SH)
  - General Electric Spec. D50YP12 Rev. 2
- Contains no PTFE or other lubricants
- Non-abrasive; very low coefficient of friction
- Will not fray

Specifications

Construction:	Highest grade graphite filament with an exclusive graphite dispersion, in LATTICE BRAID® construction
Temperature:	-328°F (-200°C) to +1200°F (+650°C) in steam; +1625°F (+900°C) in free oxygen-exclusive environments such as nitrogen and carbon dioxide; +850°F (+455°C) atmosphere
pH range:	0-14 (except strong oxidizers)
Pressure:	To 4,000 psi (275 bar) plus, when used with GRAPH-LOCK® center rings

* INCONEL® is a registered trademark of Inco Alloys International, Inc.
** Used as end rings ONLY. Not designed to be a stand alone packing, must incorporate flexible graphite packing center rings.

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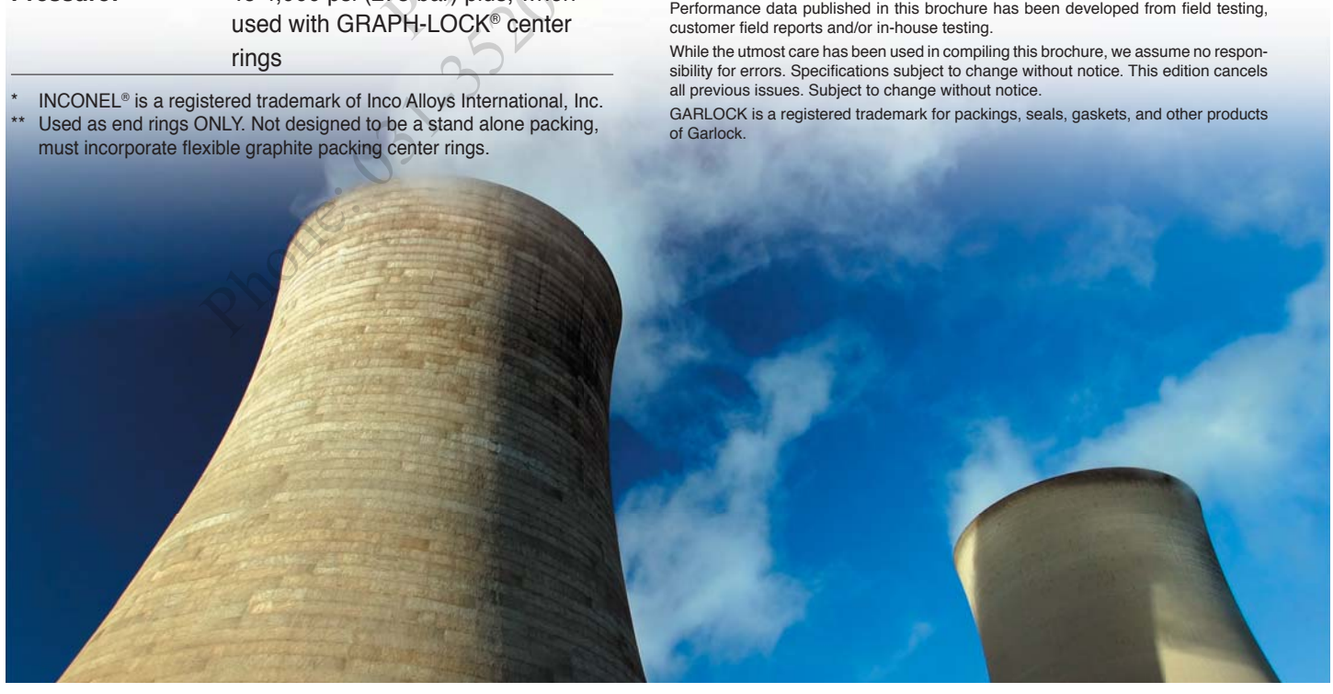


Seals for Rotating Service

Style 8091

Hydra-Just™

Engineered Sealing System

—the leak-free, no dilution sealing system designed to replace mechanical seals in industrial pumping applications.

The Best Option for Slurry Service

Garlock has created a long life seal that will increase reliability and process yield while conserving water and energy. Hydra-Just™ combines the best of both worlds; like a mechanical seal, Hydra-Just provides leak free, no dilution service and saves energy and water because of the low friction design. Like conventional packing, Hydra-Just can accommodate system upsets and is not subject to catastrophic failure.

The Choice for Water Reduction

Until now, mechanical seals were the most water efficient rotary seal on the market. As a rule of thumb, a mechanical seal requires 1 US gallons per minute per inch of shaft diameter. **Hydra-Just runs with 98% less water than mechanical seals** requiring as little as 3 US gallons per hour. To put this in context, replacing a mechanical seal that requires 2 USGPM of flush with Hydra-Just will save over 1,000,000 US gallons of water per pump.

Designed For Outage-to-Outage Performance

This robust seal enables users to increase profitability through improved process yield. The process exclusive design of the Hydra-Just ensures a seal with the versatility to handle a wide range of system upsets and excel in abrasive slurries.

Easy to Install

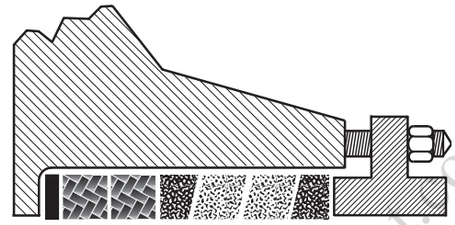
Hydra-Just customers can realize production increases by getting back on line faster. The components of the Hydra-Just allow the seal to be installed without uncoupling the motor.

To learn more, visit www.hydrajust.com

Style 8093 DSA

The Best Option for Clean Service

Garlock's DSA seal is the best available sealing technology for clean media. This leak free seal saves water in that it runs without a flush, improves output by lasting longer than conventional packings and saves money in that it is significantly less expensive than a mechanical seal. Combining these attributes make the Garlock DSA the ideal choice for condensate, water or boiler feed pumps.



- Gasket spacer (Style 3530 or G-9900)
- Braided ring (Style 98, 5000 or 8921-K)
- Low density GRAPH-LOCK® preforms
- High density GRAPH-LOCK® adapters

The Right Choice for Water Savings

DSA enables customers to save millions of gallons of water every year. The unique design completely eliminates the need for flush water.

Easy to Install

DSA customers can realize production increases by getting back on line faster. The split design of the seal enables installation in under an hour.

Specifications

Construction:	Typical set: gasket spacer, braided rings, flexible graphite adapters and preforms
Media:	Condensate, boiler feed water, light paper stock, white water, feed water
Temperature:	To +500°F (+260°C)
pH range:	0-14* (except strong oxidizers)
Shaft speed:	To 4,000 fpm plus (20 m/s)
Pressure:	To 500 psi (35 bar)

* Depends on braid choice

Carbon Packings

Style 98

The best choice for high-temperature service

- Low coefficient of friction for longer equipment life
- High thermal conductivity means process runs cooler, and packing lasts longer
- Withstands wide variety of chemicals
- Low chloride certification available

Specifications

Construction:	LATTICE BRAID® carbon fiber
Media:	Acids, strong caustics, hot oils, solvents, boiler feed, condensate water
Equipment:	Centrifugal pumps, agitators, ball, globe, gate and plug valve stems, oil drilling and down-hole tools
Temperature:	-328°F (-200°C) to +850°F (+455°C) atmosphere; to +1,200°F (+650°C) steam
pH range:	0-14 (except strong oxidizers)
Shaft speed:	To 4,000 fpm plus (20 m/s)
Pressure:	To 500 psi (35 bar) rotary/centrifugal; To 2,500 psi (173 bar) valves

Style 5000

The best choice for non-contaminating slurry service

- Low abrasion and high chemical resistance for long service
- Ideal where contamination is prohibited, as in pulp and paper industry
- Low chloride certification available
- Style 5000-PBI* offers extra abrasion resistance
- Excellent for low friction valve stem requirements

Specifications

Construction:	LATTICE BRAID® carbon fiber impregnated with PTFE, hi-temp break-in lube
Media:	Acids, strong caustics, slurries
Equipment:	Slip joints, mixers, agitators, reactors, autoclaves, centrifugal pumps, turbines
Temperature:	-328°F (-200°C) to +600°F (+315°C)
pH range:	0-14 (except strong oxidizers)
Shaft speed:	To 3,000 fpm plus (15 m/s)
Pressure:	To 500 psi (35 bar) rotary/centrifugal

CARBAE™ 105 & 108

High performance, low cost

- Excellent cost / use ratio
- Ideal for most industrial equipment
- Compatible with a wide range of chemicals
- Easy to install and remove

Style 105 Specifications

Construction:	95% carbon assay fiber with PTFE coating
Media:	Acids, caustics, slurries
Equipment:	Centrifugal pumps, mixers, agitators
Temperature:	-328°F (-200°C) to +600°F (+316°C) atmosphere; to +1,200°F (+650°C) steam
pH range:	0-14 (except strong oxidizers)
Shaft speed:	To 3,000 fpm (15 m/s)
Pressure:	To 500 psi (35 bar) rotary/centrifugal

Style 108 Specifications

Construction:	95% carbon assay fiber with graphite dispersion
Media:	Acids, caustics, hot oils, solvents, boiler feed, condensate water
Equipment:	Centrifugal pumps, valves, agitators
Temperature:	-328°F (-200°C) to +850°F (+455°C) atmosphere; to +1,200°F (+650°C) steam
pH range:	0-14 (except strong oxidizers)
Shaft speed:	To 4,000 fpm (20 m/s)
Pressure:	To 500 psi (35 bar) rotary/centrifugal; To 2,500 psi (173 bar) valves†

† No pressure limits have been determined when CARBAE™ 108 is combined as end ring material with die-formed GRAPH-LOCK® center rings in valve installations.

Note: CARBAE™ 108 can be certified to contain less than 200 ppm leachable chlorides on request.

Soot Blower Sets

Exceptional reliability

- Rugged materials for extended service life
- INCONEL†† wire reinforcement withstands high temperatures and pressures
- Die-formed rings ensure accurate fit and simple installation
- Efficient conical design allows outstanding sealing at low gland loads
- Standard sizes for Diamond Power, Copes Vulcan and other soot blowers

TORNADO PACK™ F1

Construction:	Style 127-AFP: INCONEL wire reinforced carbon over homogeneous core
Temperature:	To +650°F (+345°C) atmosphere, +1,200°F (+650°C) steam

TORNADO PACK™ F3

Construction:	Style 1298: INCONEL wire reinforced PBI††† over carbon yarn core
Temperature:	To +850°F (+455°C) atmosphere, +1,200°F (+650°C) steam

TORNADO PACK™ F5

Construction:	Style 1303-FEP: INCONEL wire reinforced flexible graphite
Temperature:	To +850°F (+455°C) atmosphere, +1,200°F (+650°C) steam

GRAPH-LOCK® Sets

Construction:	Premium density GRAPH-LOCK® center rings (87.5 lbs/ft^3 [1,400 kg/m^3]) with 1303-FEP or 98 end rings
Temperature:	To +850°F (+455°C) atmosphere, +1,200°F (+650°C) steam

General Service Packings

SYNTHEPAK® Packings

Superior performance

- Unique spun synthetic fiber; ideal replacement for asbestos
- Excellent for pumps, valves, rods, plungers, rams, expansion joints
- Reduction in shaft and sleeve wear lowers operational costs
- Versatile, multi-use packing means lower inventory stocking costs
- See Styles 8909, 8913, 8921-K, 8922, 8922-PBI on pages A-16, A-17 for specifications

Style 1925

Premium performance

- Innovative blend of two yarns:
  - Fiber-infused PTFE yarns offer abrasion resistance and thermal stability
  - Exclusive SYNTHEPAK®* yarns retain flexibility and resilience; ensure even load distribution
- Longer packing and equipment life mean significant cost savings

Specifications

Construction:	LATTICE BRAID® fiber-infused PTFE yarns and SYNTHEPAK® yarns with PTFE dispersion and snow-white petrolatum break-in lube
Equipment:	Pumps
Temperature:	-450°F (-270°C) to +500°F (+260°C)
pH range:	1-13
Shaft speed:	To 2,500 fpm (12 m/s)
Pressure:	To 300 psi (20 bar) rotary/centrifugal

* Patent #4,994,303

Style 1965

Superb flexibility & easy handling

- Protects machinery's critical components from abrasive media
- Lowers maintenance and sealing element expenditures
- Product does not extrude and lasts longer in service
- Material flexibility and easy handling mean faster change-out times
- Non-contaminating components keep end product and pump area clean
- Shock resistant withstanding cavitation, pressure surges and other system upsets
- Increased thermal stability conserves water

Specifications

Construction:	LATTICE BRAID® fiber-infused PTFE yarns* with Graphite and SYNTHEPAK® yarns, PTFE dispersion and snow white petrolatum
Equipment:	Pumps
Temperature:	-450°F (-270°C) to +500°F (+260°C)
pH range:	1-13
Shaft speed:	To 2,500 fpm (10 m/s)
Pressure:	To 300 psi (20 bar) rotary/centrifugal

* Patent #4,994,303

PTFE Packings

Style 5888

Valve stem packing with superior chemical resistance

- High density, dimensionally stable—very little water absorption
- Ideal for valve and slower shaft speed applications
- PTFE dispersion ensures a low friction finish and prevents leakage through the braid
- Resistant to most chemicals

Specifications

Construction:	LATTICE BRAID® continuous filament PTFE braid with PTFE dispersion
Equipment:	Check and needle valve stems, reciprocating rods, rams and plungers, and rotary applications
Temperature:	-450°F (-270°C) to +500°F (+260°C)
pH range:	0-14
Shaft speed:	To 1,000 fpm plus (5 m/s)
Pressure:	To 300 psi (20 bar) rotary / centrifugal; To 2,000 psi (138 bar) valves

Note: For oxygen service, specify Style 5898.

Style 5889

Chemically resistant packing for pumps and rotary equipment

- Preshrunk to avoid packing wear and shaft scoring
- Soft, flexible but very nonporous
- Excellent choice for rotary shaft service

Specifications

Construction:	LATTICE BRAID® continuous filament PTFE braid with PTFE dispersion and inert break-in lube
Equipment:	Expansion joints, reciprocating rods, rams, plungers, rotary service
Temperature:	-450°F (-270°C) to +500°F (+260°C)
pH range:	0-14*
Shaft speed:	To 1,500 fpm plus (8 m/s)
Pressure:	To 300 psi (20 bar) rotary/centrifugal

* Not recommended for chlorine service

Style 5904

Food grade packing

- Ideal for food processing applications
- Pliable, wear-resistant and dimensionally stable
- Resists most caustic media
- Rugged and non-toxic
- Ingredients conform to USDA requirements and meet FDA Title 21 CFR 172.878, 177.1550, 178.3570 and 178.3620(a)

Specifications

Construction:	LATTICE BRAID® PTFE filament
Equipment:	Pumps, dryers, cookers, blenders, mixers, and other centrifugal rotary food processing equipment
Temperature:	-450°F (-270°C) to +500°F (+260°C)
pH range:	0-14
Shaft speed:	To 1,500 fpm plus (8 m/s)
Pressure:	To 300 psi (20 bar) rotary/centrifugal

Specialty Synthetic Fiber Packings

Style 5200

- The problem with most aramid fiber packings is that they are designed for strength, not sealability
- That's what makes our style 5200 different from other aramid packings; we incorporate a PTFE lubrication system that makes a better pump shaft seal
- The result is that less abrasive material makes it into the stuffing box so that pumps packed with 5200 can stay in service longer and help our customers realize the benefits that come from increased process yield and improved reliability

Specifications

Construction:	LATTICE BRAID® Aramid filament lubricated with a PTFE
Temperature:	-420ºF (-250ºC) to +500ºF (+260ºC)
pH range:	2 – 12
Pressure:	To 500 psi (35 bar) rotary
Shaft speed:	To 2500 fpm

Style 1850

- Style 1850 is produced from KYNOL* fibers by blending continuous KYNOL filaments with KYNOL staple fibers on the surface of each yarn
- The yarns as well as the finished braid are impregnated with PTFE dispersion via Garlock's single-end coating process to make a tough, chemically resistant pump packing
- The finished braid is also coated with a high temperature break-in lubricant

Specifications

Construction:	LATTICE BRAID®
Temperature:	-170ºF (-110ºC) to +550ºF (+290ºC)
pH range:	1 - 13
Pressure:	To 500 psi (20 bar) rotary/centrifugal
Shaft speed:	To 2,000 fpm

* KYNOL is a trademark of American KYNOL, inc.

Style 1947

- Style 1947 is produced from continuous filament NOMEX* fibers, impregnated with PTFE dispersion via Garlock's single-end coating process
- The result is a tough, chemically resistant pump packing with good abrasion resistance
- A surface break-in silicone lubricant is added

Specifications

Construction:	LATTICE BRAID®
Temperature:	-170ºF (-110ºC) to +550ºF (+290ºC)
pH range:	1 - 13
Pressure:	To 300 psi (20 bar) rotary/centrifugal
Shaft speed:	To 2,000 fpm

* NOMEX is a trademark of DuPont.

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

Mild Service Packing

PACKMASTER® 1

- The combination of resilient non-asbestos fibers and PTFE offers a true non-contaminating general service packing - ideal where a clean, reliable packing is required
- Lattice braided synthetic yarns are coated with a PTFE dispersion and a surface coating of break-in lubricant
- Typical applications are rotary, centrifugal, and reciprocating pumps for such services as mild acids and alkalis, air and dry industrial gases, petroleum and synthetic oils, aromatic and aliphatic solvents, and fluids where non-contamination is required

Specifications

Construction:	LATTICE BRAID®
Temperature:	To 500°F (+260°C)
pH range:	4 - 10
Pressure:	To 300 psi (20 bar) rotary/centrifugal
Shaft speed:	To 1,500 fpm

For maximum life out of Packmaster 5, use it in conjunction with our Crown Bush throat bushing.

PACKMASTER® 2

- A combination of petroleum lubricants and graphite permeate the spun synthetic yars to produce a packing ideally suited for services in hot and cold water, alcohol, very mild acids and alkalis, and steam
- Typical services include rotary and centrifugal pumps, reciprocating pumps, and gasketing applications or other non-critical static sealing services

Specifications

Construction:	LATTICE BRAID®
Temperature:	To +500°F (+260°C)
pH range:	4 - 10
Pressure:	To 300 psi (20 bar) rotary/centrifugal
Shaft speed:	To 1,500 fpm

For maximum life out of Packmaster 5, use it in conjunction with our Crown Bush throat bushing.

PACKMASTER® 3

- PACKMASTER 3 is a soft and resilient spun synthetic packing saturated throughout with petrolatum and graphite which offers added sealability
- This product is particularly suitable for older or worn equipment or scored shafts; the construction is more readily deformable to meet these conditions
- PACKMASTER 3 is commonly used for distallation units, cooling water systems, diesel and lubricating oils where low to medium pressures are encountered

Specifications

Construction:	Square braid
Temperature:	To +500°F (+260°C)
pH range:	4 - 10
Pressure:	To 200 psi (14 bar) rotary/centrifugal
Shaft speed:	To 1,000 fpm

PACKMASTER® 5

- This packing is made from aramid fibers that are stronger than steel and will stand up to the toughest abrasive slurries
- This style is internally lubricated with silicone making it an economical alternative to other aramid based products.

Specifications

Construction:	LATTICE BRAID® Aramid filament lubricated with silicone
Temperature:	-420°F (-250°C) to +500°F (+260°C)
pH range:	2 – 12
Pressure:	To 500 psi (35 bar) rotary
Shaft speed:	To 2500 fpm

For maximum life out of Packmaster 5, use it in conjunction with our Crown Bush throat bushing.

PACKMASTER® 6

- This flexible shock resistant packing has excellent chemical resistance and can stand up in a wide range of rotary applications
- This universal applicability will translate into better cash flow from reduced inventory and lower training and installation costs.

Specifications

Construction:	Expanded PTFE with graphite and a silicone lubrication
Temperature:	-200ºF (-130ºC) to +550ºF (+288ºC)
pH range:	0 - 14
Pressure:	To 300 psi (20 bar) rotary/centrifugal
Shaft speed:	To 3000 fpm

PACKMASTER® 7

- PACKMASTER 7 is dimensionally stable and firm, has high density, and is constructed from PTFE continuous filament
- It's PTFE dispersion provides a low friction surface and prevents leakage through the body of the braid
- Although designed for slower shaft speeds, it is an excellent valve stem packing; resistant to almost all chemicals (except molten uranium salts), completely free of asbestos and with very little water absorption

Specifications

Construction:	LATTICE BRAID®
Temperature:	To +500ºF (+260ºC)
pH range:	0 - 14
Pressure:	To 300 psi (20 bar) rotary/centrifugal
Shaft speed:	To 1,000 fpm

PACKMASTER® 8

- Constructed from continuous PTFE filament, PACKMASTER 8 is dimensionally stable; however it remains relatively soft an very flexible
- PACKMASTER 8 is treated throughout with PTFE dispersion and an inert high-temperature lubricant
- This packing is an excellent choice for high speed centrifugal and rotary services in marine and waste/water trreatment

Specifications

Construction:	LATTICE BRAID®
Temperature:	To +500ºF (+260ºC)
pH range:	0 - 14
Pressure:	To 300 psi (20 bar) rotary/centrifugal
Shaft speed:	To 1,500 fpm

*Not recommended for chlorine service

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Flush Water Products

Style 1004 Lantern Ring Coil*

Economical and easy to handle

- Easily cut with knife or saw, and short lengths splice together, eliminating waste
- Easy to install** and remove from stuffing box—reduces costly downtime
- High-purity PTFE offers chemical resistance in a broad range of rotary services

Specifications

Construction:	Wear-resistant high-grade PTFE
Equipment:	Pumps
Temperature:	To +500°F (+260°C)
pH range:	0-14 (except strong oxidizers)

FLUSH-GARD™ Seal

Reduces flush water

- Throat cavity bushing reduces flush water consumption
- Extends equipment life by protecting sleeve and packing from media attack
- Split design installs easily, without equipment disassembly

Specifications

Construction:	Graphite-filled PTFE
Temperature:	-250°F (-157°C) to +450°F (+232°C)
Surface speed:	To 2,500 fpm (12.7 m/s)†
pH range:	0-14 (except strong oxidizers)

* U.S. Patent #4,498,681; Canada Patent #1,271,788

** For maximum strength and density, install with slots toward shaft; for maximum gland water flow, install with slots away from shaft.

† Above 2,500 fpm, consult Garlock.

†† INCONEL is a registered trademark of Inco Alloys International, Inc.

††† PBI is a registered trademark of Celanese Corporation.

Crown Bush Pump Sealing System

Lower your operating costs

- Significantly reduce flush water usage
- Extend packing life
- Reduce sleeve wear
- Flush water distribution optimised to keep contaminants away from the gland packing
- Stainless Steel Crown Bush flow control device resists erosion from abrasive contaminants
- Non-metallic construction available for non-abrasive duties
- Split version available

Applications

- Pulp and paper
- Mining
- Mineral Sands
- Alumina Refining
- Coal Washing

Style Index

Style	Material Classification	Lubrication	Construction	Rotary	Service Recip	Valve
18	Flax roving	Petrolatum & paraffin	Square braid	X	X	
90	Flax roving	Marine & petro wax/graphite	Square braid	X	X	
98	Carbon filament	Graphite dispersion	LATTICE BRAID®	X	X	X
98-PBI[1]	Carbon filament	Graphite dispersion	LATTICE BRAID®	X	X	
105 (CARBAE™)	Carbon filament	PTFE & snow-white petrolatum	LATTICE BRAID®	X		
108 (CARBAE™)	Carbon filament	Graphite dispersion	LATTICE BRAID®	X	X	X
127-AFP	INCONEL[3] wire-reinforced spun carbon over homogeneous core	Graphite	Braid over core			X
G-200	Graphite filament	Graphite dispersion	LATTICE BRAID®	X		
G-700[4]	Graphite filament	Graphite	LATTICE BRAID®			X
740	Flax roving	Petrolatum & marine wax	LATTICE BRAID®	X	X	
745	Flax roving	Petrolatum, marine wax, & graphite	LATTICE BRAID®	X	X	
1298	INCONEL wire-reinforced PBI over carbon yarn core	Graphite & tungsten disulfide	Braid over core			X
1300-E	Flexible graphite	None	LATTICE BRAID®	X		X
1303-FEP	INCONEL filament-reinforced flexible graphite	Graphite dispersion	Square braid			X
1333-G	Graphite filament-reinforced flexible graphite	Graphite	Square braid	X		X
1812	Spun NOMEX[5] / synthetic	PTFE & snow-white petrolatum	LATTICE BRAID®	X	X	
1850	KYNOL[6]	PTFE & snow-white petrolatum	LATTICE BRAID®	X	X	
1925	Fiber-infused PTFE	PTFE suspensoid and snow-white petrolatum	LATTICE BRAID®	X		
1947	NOMEX[5] fiber	PTFE & silicone	LATTICE BRAID®	X		
1965	Fiber-infused PTFE	Graphite	LATTICE BRAID®	X		
5000	Carbon filament	PTFE & snow-white petrolatum	LATTICE BRAID®	X	X	
5000-PBI	Carbon filament w/ PBI corners	PTFE & snow-white petrolatum	LATTICE BRAID®	X	X	
5100	GFO[7]	Silicone	LATTICE BRAID®	X		X
5200	Aramid filament	PTFE dispersion	LATTICE BRAID®	X	X	
5413	Flax roving	PTFE & snow-white petrolatum	Square braid	X	X	
5450	Fiberglass	None—Graphite on request	LATTICE BRAID®			
5481	Fiberglass	None—Graphite on request	Round braid			

1. PBI is a registered trademark of Celanese Corporation.
2. VITON is a registered trademark of DuPont Dow Elastomers
3. INCONEL is a registered trademark of Inco Alloys International, Inc.
4. To be used as end ring material only with GRAPH-LOCK® center rings.
5. NOMEX is a registered trademark of DuPont.
6. KYNOL is a trademark of American Kynol, Inc.
7. GFO is a trademark of WL Gore.

* 0-14 except strong oxidizers

Style Index (cont'd)

Style	Temperature		Pressure (psi)		Pressure (bar)		Shaft Speed		pH
	Fahrenheit	Centigrade	Rotary	Valve	Rotary	Valve	fpm	m/s	
18	To +220°	To +105°	150		10		1,200	6	5-9
90	To +220°	To +105°	300		20		1,200	6	5-9
98	-328° to +850° atm +1,200° steam	-200° to +455° atm +650° steam	500	2,500	35	173	4,000	20	0-14*
98-PBI[1]	To +650° atm	To +345° atm	500		35		4,000	20	1-12
105 (CARBAE™)	-328° to +600° atm	-200° to +316° atm	500		35		3,000	15	0-14*
108 (CARBAE™)	-328° to +850° atm +1,200° steam	-200° to +455° atm +650° steam	500	2,500	35	173	4,000	20	0-14*
127-AFP	+850° atm +1,200° steam	+455° atm +650° steam		1,200		82			1-12
G-200	-328° to +850° atm +1,200° steam	-200° to +455° atm +650° steam	500		35		4,000	20	0-14*
G-700[4]	To +850° atm +1,200° steam	To +455° atm +650 steam		4,000		275			0-14*
740	To +220°	To +105°	150		10		1,200	6	5-9
745	To +220°	To +105°	250		17		1,200	6	5-9
1298	To +850° atm +1,200° steam	To +455° atm +650° steam		4,500		310			1-12
1300-E	-328° to +850° atm +1,200° steam	-200° to +455° atm +650° steam	500	3,000	35	200	4,000	20	0-14*
1303-FEP	-328° to +850° atm +1,200° steam	-200° to +455° atm +650° steam		4,500		310			0-14*
1333-G	-328° to +850° atm +1,200° steam	-200° to +455° atm +650° steam	500	4,000	35	275	4,000	23	0-14*
1812	-170° to +500°	-110° to +260°	300		20		2,000	10	1-12
1850	-170° to +500°	-110° to +260°	500		35		2,000	10	1-13
1925	-450° to +500°	-270° to +260°	300		20		2,500	12	1-13
1947	To +500°	To +290°	300		20		2,000	10	1-13
1965	-450° to +500°	-270° to +260°	300		20		2,500	12	1-13
5000	-328° to +600°	-200° to +315°	300		35		3,000	15	0-14*
5000-PBI	-328° to +600°	-200° to +315°	500		35		3,000	15	1-12
5100	-200° to +550°	-130° to +288°	300	2,000	20	138	4,000	20	0-14*
5200	-420° to +500°	-250° to +260°	500		35		2,500	12	2-12
5413	To +250°	To +120°	200		14		1,200	6	5-9
5450	To +1000°	To +540°		10		1			2-11
5481	To +1000°	To +540°		10		1			2-11

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Style Index (cont'd)

Style	Material Classification	Lubrication	Construction	Rotary	Service Recip	Valve
5888	PTFE filament	PTFE suspensoid	LATTICE BRAID®	X	X	X
5889	PTFE filament	PTFE dispersion & silicone	LATTICE BRAID®	X		
5898	PTFE filament	PTFE dispersion	LATTICE BRAID®		X	X
5904	PTFE filament—FDA	PTFE dispersion / mineral oil	LATTICE BRAID®	X		
8091 HYDRA-JUST™	Dynamic Rotary Sealing Solution	N/A	GYLON® & Graphite Braid with Graphite Cup & Cone	X		
8093 DSA	Flexible graphite	N/A	Die-formed sets	X		
8094 DSA	Flexible graphite / Model 26	N/A	Die-formed sets	X		
8909	Spun synthetic	Graphite & petrolatum	Square braid	X		
8913	Spun synthetic	Graphite & petrolatum	LATTICE BRAID®	X		
8921-K	Spun synthetic—aramid filament corners	PTFE suspensoid & snow-white petrolatum	LATTICE BRAID®	X	X	X
8922	Spun synthetic	PTFE suspensoid & snow-white petrolatum	LATTICE BRAID®	X	X	X
8922-PBI	Spun synthetic / PBI corners	PTFE suspensoid & snow-white petrolatum	LATTICE BRAID®	X	X	
9000 EVSP	Flexible graphite	N/A	Die-formed sets			X
QUICKSET® 9001	Flexible graphite	N/A	Die-formed sets			X
F1	INCONEL[3] wire-reinforced spun carbon over homogeneous core	Graphite & zinc	Die-formed sets		Soot blower	
F3	INCONEL wire-reinforced PBI[1] over carbon yarn core	Graphite & tungsten disulfide	Die-formed sets		Soot blower	
F5	INCONEL wire-reinforced spun flexible graphite	Graphite dispersion	Die-formed sets		Soot blower	
GRAPH-LOCK®	Flexible graphite	N/A	Die-formed sets, tape	X		X
PM†-1	Spun synthetic	PTFE suspensoid & snow-white petrolatum	LATTICE BRAID®	X		
PM-2	Spun synthetic	Petroleum oils & graphite	LATTICE BRAID®	X		
PM-3	Spun synthetic	Petroleum oils & graphite	Square braid	X		
PM-5	Aramid filament	Silicone	LATTICE BRAID®	X	X	
PM-6	Expanded PTFE/graphite	Silicone	LATTICE BRAID®	X		
PM-6K	Expanded PTFE filament—aramid filament corners	Silicone	LATTICE BRAID®	X	X	
PM-7	PTFE filament	PTFE suspensoid	LATTICE BRAID®	X	X	X
PM-8	PTFE filament	Silicone	LATTICE BRAID®	X		

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3. INCONEL is a registered trademark of Inco Alloys International, Inc.
4. To be used as end ring material only with GRAPH-LOCK® center rings.
5. NOMEX is a registered trademark of DuPont
6. KYNOL is a trademark of American Kynol, Inc.

* 0-14 except strong oxidizers
** Should not be used in chlorine
*** Pressure and shaft speeds controlled by types of braid used in conjunction with the GRAPH-LOCK® product
† PM = PACKMASTER®

Style Index (cont'd)

Style	Temperature		Pressure (psi)		Pressure (bar)		Shaft Speed		pH
	Fahrenheit	Centigrade	Rotary	Valve	Rotary	Valve	fpm	m/s	
5888	-450° to +500°	-270° to +260°	300	2,000	20	138	1,000	5	0-14
5889	-450° to +500°	-270° to +260°	300		20		1,500	8	0-14**
5898	-450° to +500°	-270° to +260°	300	2,000	20	138	1,000	5	0-14
5904	-450° to +500°	-270° to +260°	500		20		1,500	8	0-14
8091 HYDRA-JUST™	To 500ºF	200ºC	500		35		4,000	20	0-14
8093 DSA	To 500ºF	To +260°	300		35		4,000	20	0-14*
8094 DSA	To +200°	To +93°	300		20		4,000	20	2-12
8909	-170° to +500°	-110° to +260°	300		20		1,500	8	4-10
8913	-170° to +500°	-110° to +260°	500		20		1,500	8	4-10
8921-K	-170° to +500°	-110° to +288°	500	2,500	35	173	2,250	11	0-12
8922	-170° to +500°	-110° to +288°	500	2,500	35	173	2,250	12	0-12
8922-PBI	-170° to +500°	-110° to +288°			35		2,250	11	1-12
9000 EVSP	-328° to +850° atm +1,200° steam	-200° to +455° atm +650° steam		10,000		690			0-14*
QUICKSET® 9001	-328° to +850° atm +1,200° steam	-200° to +455° atm +650° steam		10,000		690			0-14*
F1	To +650° atm +1,200° steam	To +345° atmosphere +650° steam							1-12
F3	To +850° atm +1,200° steam	To +455° atmosphere +650° steam							1-12
F5	To +850° atm +1,200° steam	To +455° atmosphere +650° steam							0-14
GRAPH-LOCK®	-328° to +850° atm +1,200° steam	-200° to +455° atm +650° steam	***	***	***	***	***	***	0-14*
PM†-1	170° to +500°	-110° to +260°	300		20		1,500	8	4-10
PM-2	170° to +500°	-110° to +260°	300		20		1,500	8	4-10
PM-3	170° to +500°	-110° to +260°	200		14		1,000	5	4-10
PM-5	-420° to +500°	-250° to +260°	500		35		2,500	12	2-12
PM-6	-200° to +550°	-130° to +288°	300		20		3,000	15	0-14**
PM-6K	-200° to +550°	-130° to +288°	500		35		1,900	10	3-12
PM-7	-450° to 500°	-270° to +260°	300	2,000	20	138	1,000	5	0-14
PM-8	-450° to 500°	-270° to +260°	300		20		1,500	8	0-14**

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Packing Materials

Aramid

These fibers are aromatic polyamides that were given the generic name “aramid.” With excellent resistance to high temperatures and exceptional tensile strength, aramid filaments are considered to be stronger, pound for pound, than steel. Garlock utilizes a variety of these fibers including spun and filament versions. Filament yarns are added to the corners of pump packings for greater resistance to abrasive media.

Carbon/Graphite Filament Packings

Garlock carbon filament products are made from carbon yarns having a 95% minimum carbon assay. Premium products (Styles 98, 98-VC and 5000) use pitch-based yarns, while CARBAE™ Styles 105 and 108 are made from P.A.N.* base yarns. Low friction coefficients are standard for less shaft wear and lower maintenance and replacement costs. Garlock carbon fibers also offer more value per pound than other packings.

Garlock graphite filament products are braided from high-purity graphite filaments with a minimum carbon assay of 99%. They have excellent chemical resistance, are thermally conductive and can be used in extreme temperature and pressure conditions.

Fiberglass

Glass fibers exhibit superior thermal properties, dimensional stability and tensile strength. Glass fibers will not burn, and they dissipate heat more rapidly than organic fibers. The glass fibers most commonly used in compression packings are “E” grade (electrical) and “S” grade (strength). Common solvents, oils, petroleum distillates, bleaches and most organic chemicals do not affect fiberglass.

Flax

Garlock carefully selects quality long-fiber roving yarns, braids them, and then thoroughly impregnates them with the required lubricating agents. They are designed for optimum service in waste and dilute aqueous solutions up to +250°F (+121°C) at low to medium pressures. Industries such as mining, milling, steel, waste/water treatment, marine, and pulp and paper regularly specify these packings for their operations.

GRAPH-LOCK® Products

Made of extremely pure graphite, Garlock GRAPH-LOCK® packing products offer unmatched service in industrial environments where searing temperatures and crushing pressures cause constant failure of conventional packings.

Flexible Graphite Tape Products

GRAPH-LOCK® is self-lubricating, dimensionally stable, impervious to gases and fluids, and corrosion-resistant. GRAPH-LOCK® products offer excellent sealing capabilities under extreme conditions for longer equipment life and less maintenance. It is available in tape and die-formed rings from Garlock Compression Packing and in sheet form from Garlock Sheet Products.

Garlock Compression Packing offers two purity levels of our GRAPH-LOCK® products—commercial grade of 95% and nuclear grade of 99.5%. The nuclear grade material meets General Electric Spec. D50YP12, Rev. 2 dated Oct. 1992; MIL-P-24503B (SH); and can be certified for oxygen service.

Flexible Graphite Braided Products

Garlock offers a variety of high-purity braided flexible GRAPH-LOCK® products as well. We offer a plain braided graphite version (1300), INCONEL** wire-reinforced versions (1303-FEP, 1398, 1399), an aramid-reinforced version (1304), and a graphite filament-reinforced version (1333-G).

MILL-RIGHT® Products

The experience gained over 100 years as a manufacturer has enabled Garlock to develop “Tough Technology” for the MILL-RIGHT® family of packings. Fiber-infused technology starts with yarns produced at our own facility. With the addition of an exclusive blocking and lubricating system, Garlock non-contaminating packings can resist abrasion without being abrasive to equipment and perform successfully throughout a broad range of industries and applications.

* P.A.N.: poly-acrylo-nitrile

** INCONEL is a registered trademark of Inco Alloys International, Inc.

PBI

PBI is a registered trademark of Celanese Corporation, and is an acronym for the term “polybenzimi-dazole”, a high performance organic fiber. PBI fibers maintain dimensional stability at high temperatures and are compatible in a wide range of chemicals and solvents. Garlock incorporates wire-reinforced PBI yarns in valve stem packings as well as adding spun filament yarns to the corners of pump packings for added strength and abrasion resistance.

PTFE Packings

Garlock starts with the advantage of PTFE—excellent chemical resistance, a wide temperature range, flexibility with toughness—and combines them with the superior LATTICE BRAID® construction to form adaptable, effective packings. High in quality and consistently uniform, they are used extensively in the food processing, chemical, agricultural and petroleum processing industries.

SYNTHEPAK® Products

SYNTHEPAK® packings are a family of remarkable spun synthetic fiber packings created and developed by Garlock for low-cost general industrial service. Since they undergo the same braiding and treatment process as asbestos packings, SYNTHEPAK® packings make an excellent replacement for asbestos. This extremely adaptable fiber has proved superior to many types of conventional packings.

XPG

The expanded PTFE/Graphite (XPG) yarn system is a unique blend of expanded PTFE filament with a blend of micronized graphite powder. The yarn utilizes a high temperature silicone oil lubricant. It can be used through an extremely wide range of applications in-cluding acids, alkalies, aromatic and aliphatic solvents, alcohols, esters, petroleum and synthetic oils, steam, water and aqueous solutions, and air and dry industrial gases.

XPG features good thermal conductivity, speed capability, chemical resistance, low coefficient of friction and low coefficient of thermal expansion, making it excellent for use in pumps, mixers and agitators.

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Construction

Compression packings are made in a variety of shapes, sizes and constructions, from a wide range of materials. The following describes the most commonly-used constructions, and the advantages of each.

Braid-Over-Braid (Figure 1)

Round braiding machines braid tubular jackets using yarns, rovings, ribbons and various other materials, either alone or in combination. Size is obtained by braiding jackets one over the other (braid-over-braid). Finished packings can be supplied in round, square or rectangular cross section. Braid-over-braid packings, also known as round braid or multiple braid packings, are relatively dense and are recommended for high-pressure, slow-speed applications such as valve stems, expansion joints, groove gasketing, etc.

Braid-Over-Core (Figure 2)

Finished product is produced by round braiding one or more jackets of yarns, rovings, ribbons or other forms of various materials over a core, which may be extruded, twisted, wrapped or knitted. This construction allows for a wide range of densities and different cross sectional shapes.

Square Braid (Figure 3)

Yarns, rovings, ribbons and other various materials, either alone or in combination, are processed on equip-ment where strands pass over and under strands running in the same direction. Resulting packings are usually supplied in square cross section, but rectangular sizes can also be braided by this method. The packing is usually soft and can carry a large percentage of lubricant. Square braided packings are easy on equipment and are generally used for high-speed rotary service at relatively low pressure. The packing's softness makes it ideal for old or worn equipment.

LATTICE BRAID® (Figure 4)

Yarns, rovings, ribbons and other forms of various materials, either alone or in combination, are processed on equipment where the strands crisscross from the surface diagonally through the body of the packing. Each strand is strongly locked by other strands to form a solid integral structure that cannot easily ravel or come apart in service. There are no jackets to wear through, and no plaits to come loose. LATTICE BRAID® packing has a more even distribution of yarn density throughout and has the potential for improved lubricant retention. The finished packing is relatively dense, but flexible.

Figure 1

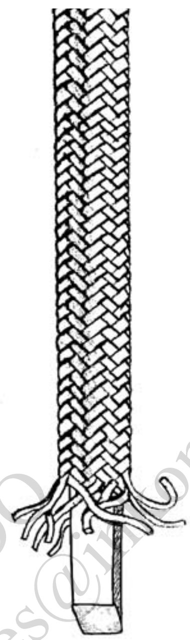


Figure 2

Figure 3

Figure 4

LATTICE BRAID® packings are suitable for applications on both reciprocating and centrifugal pumps, agitators, valves, expansion joints and in grooves.

Die-Formed

Many compression packing materials can be supplied in a pre-compressed ring form, which provides controlled density and size.

Mandrel Cut

Rings formed by wrapping braided stock of the required cross section on a mandrel or shaft with a diameter equal to the desired I.D.

Graphite Tape

Flexible graphite tape (ribbon) is manufactured by exfoliating (expanding) and then compressing natural graphite flakes to a specific density. Graphite has almost universal chemical inertness and is naturally lubricious, compactible and resilient, as well as nuclear radiation resistant.

Flexible graphite tape can be die-molded or com-pressed to form endless true labyrinth rings. Graphite tape packings have a low coefficient of friction, a pH range of 0-14 and are noted for their excellent thermal properties enabling them to be used in applications to 5500°F (3000°C) in non-oxidizing atmospheres. Due to their temperature resistance and density, they make ideal valve packings in steam, VOC, hydrocarbons or chemical applications when used in combination with braided end rings such as Styles 1303-FEP, 98 or G-700.

Lubricants

Lubricants are usually added to compression packings when the packings are to be used on rotary equipment where frictional heat is generated. The lubricants provide a resiliency that allows the packing to deform and recover under slight mechanical deficiencies such as shaft deflection. They may also provide interfiber lubricity that reduces frictional heat.

Blocking Agents

Lubricants that act as a fluid barrier by closing the voids that are present in braided materials to prevent leakage through the cross section of the packing.

Single End Coating

A proprietary Garlock process that coats each yarn used in packing prior to the braiding process. This provides a more consistent coating of packing materials for better sealing.

Material Selection

The proper selection of packing materials is dependent on the operating conditions of the equipment. Six parameters of the equipment must be determined before a proper packing recommendation can be made. The acronym “STAMPS” is commonly used to designate these parameters:

S = Size — cross section
T = Temperature — of media being sealed
A = Application — type of equipment (i.e., pumps, valves, mixers, etc.)
M = Media — material being sealed
P = Pressure — of media being sealed
S = Speed — shaft speed in fpm (pumps only)

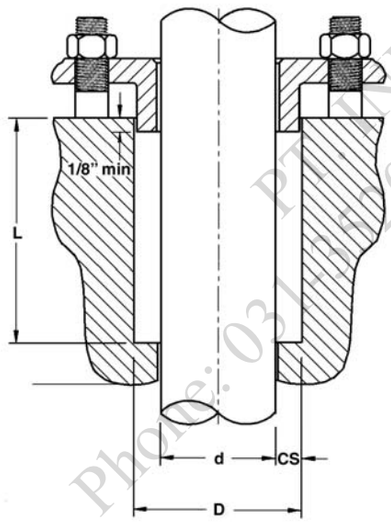
Equipment Condition

No matter what type of equipment you are trying to seal, the condition of the equipment is critical to the success of the packing. Garlock recommends:

Valves

- **Longitudinal scores** on the valve stem are not to exceed 1/32" depth and/or a depth-to-width ratio greater than 1.00.
- **Stem finish** no greater than 32 (micro inches) AARH.
- **Stuffing box finish** is recommended to be 125 (micro inches) AARH.
- **Valve stem warpage / runout** must be checked and found not to exceed:

Stem Diameter	Runout (TIR / ft)
Up to and including 1.500" (38.1 mm)	±0.010"
1.501" to 3.000" (38.1 mm to 76.2 mm)	±0.020"
3.001" (76.2 mm) and above	±0.040"



Stuffing box dimensions

- The bottom of the gland follower should be flat. If box bottom is beveled, Garlock recommends the use of a system-compatible braided packing ring to be installed before the bushing.
- Stuffing box should contain no burrs on the stem and/or box bore walls.

Pumps

- **Runout**: TIR (Total Indicator Runout) not to exceed 0.005".
- **Longitudinal scores**: none should be present on pump shaft or sleeve.

Shaft Diameter		Recommended Cross Section (CS)	
Inches	mm	Inches	mm
5/8" to 1-1/8"	(15.8 to 28.6)	5/16"	(7.9)
Over 1-1/8" to 1-7/8"	(28.6 to 47.6)	3/8"	(9.5)
Over 1-7/8" to 3"	(47.6 to 76.2)	1/2"	(12.7)
Over 3" to 4-3/4"	(76.2 to 120.7)	5/8"	(15.8)
Over 4-3/4" to 12"	(120.7 to 304.8)	3/4"	(19.0)

D = d + (2 x CS)

- **Recommended box depth** (L) = (5.5 to 7.5) x CS
- **Recommended surface finishes**:
  Stem / Sleeve: 16 to 32 (micro inches) AARH
  Box Bore: 125 (micro inches) AARH

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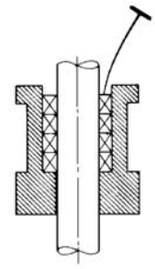
Installation Instructions

Valve Stem Packing

1. Remove all of the old packing from the stuffing box. Clean box and stem thoroughly and examine stem for wear and scoring. Replace stem if wear is excessive. Recommended surface finishes are 32 (micro inches) AARH on the stem, and 125 (micro inches) AARH maximum on the box bore.
2. Measure and record stem diameter, stuffing box bore and box depth. To determine the correct packing size, measure the diameter of the stem (inside the stuffing box area if possible), and the diameter of the stuffing box bore. Subtract the I.D. measurement from the O.D. measurement, and divide the difference by two. This is the required cross-sectional size.
3. Always cut the packing into individual rings. Never wind the packing into a coil in the stuffing box. Rings should be cut with a butt joint. Cut rings by using a spare stem, a mandrel with the same diameter as the stem or a packing cutter. The illustration shows how to use a mandrel to cut packing.

   Hold the packing tightly on the mandrel, but do not stretch excessively. Cut the ring and insert it into the stuffing box, making certain that it fits the packing space properly. Each additional ring can be cut in the same manner.
4. Install one ring at a time. Make sure it is clean, and has not picked up any dirt in handling. Seat each ring firmly, making sure it is fully seated before the next ring is installed. Joints of successive rings should be staggered and kept at least 90° apart. When enough rings have been individually seated so that the nose of the gland follower will reach them, individual tamping of the rings should be supplemented by the gland follower. Bring down the gland follower and apply load with the gland bolts.
5. After the last ring is installed, bring down the gland follower and apply 25% to 35% compression to the entire packing set. If possible, record the gland nut torque values and actuate the valve through five (5) complete cycles (ending with the stem in the down position). Retighten the gland bolt nuts to the pre-viously recorded torque value after each full actuation.

Step 1



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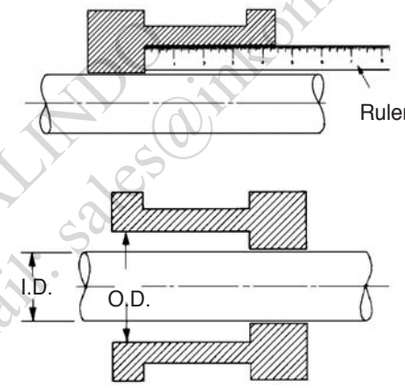
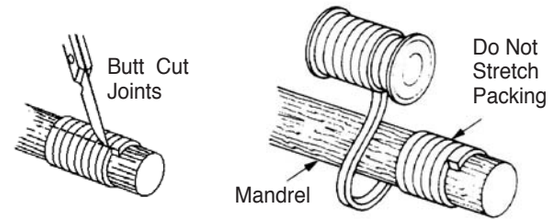
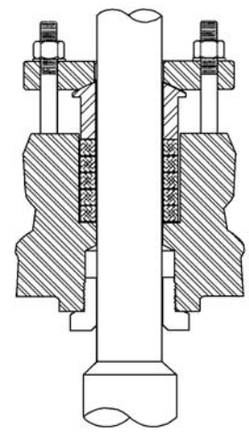


Step 3



Steps 4 and 5

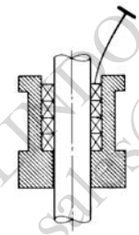


Pump Packing

1. Remove all the old packing with packing hooks, being careful not to damage the shaft or sleeve. This means all rings, even the lantern ring and the rings below the lantern. Clean the stuffing box and examine the shaft and sleeve. Replace any worn parts that are scored or deeply grooved.
2. Measure and record shaft diameter, stuffing box bore and box depth. To determine the correct packing size, measure the diameter of the shaft and the stuffing box bore. Subtract the shaft diameter from the bore diameter and divide the difference by two. This is the required cross-sectional size.
3. Always cut the packing into individual rings. Never wind the packing into a coil in the stuffing box. Rings should be cut with a butt joint. Cut rings by using a mandrel with the same diameter as the shaft in the stuffing box area. If there is no wear, rings can be cut on the shaft outside the stuffing box.

   Hold the packing tightly on the mandrel, but do not stretch excessively. Cut the ring and insert it into the stuffing box, making certain that it fits the packing space properly. Each additional ring can be cut in the same manner.
4. Install one ring at a time. Make sure it is clean, and has not picked up any dirt in handling. Lubricate the I.D. of each ring lightly. Start one end and then the other, butted closely. Work around circumference from either or both directions. Joints of successive rings should be staggered and kept at least 90° apart. Each individual ring should be firmly seated with a tamping tool. When enough rings have been individually seated so that the nose of the gland follower will reach them, individual tamping should be supplemented by the gland.
5. If a lantern ring is provided, make sure the lantern ring is installed under the pipe tap hole.
6. After the last ring is installed, bring the follower down on the packing and finger-tighten the gland nuts. Do not jam the packing by excessive gland loading. Start pump, and tighten the bolts until leakage is decreased to a tolerable minimum. Make sure gland bolts are tightened evenly. Stopping leakage entirely at this point will cause the packing to burn up.
7. Allow packing to leak freely upon startup after repack. Gradually reducing leakage during the first hour of operation will result in a better seal over a longer period of time. Tighten the gland nuts one flat at a time until the desired leakage is obtained, and the pump is running cool.

Step 1



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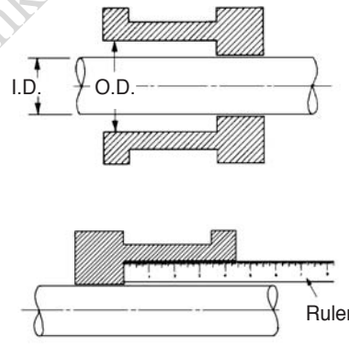

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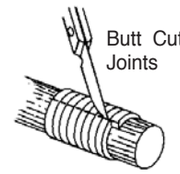
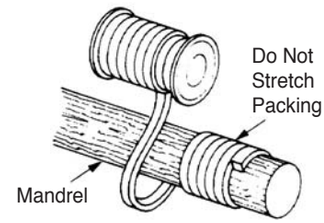
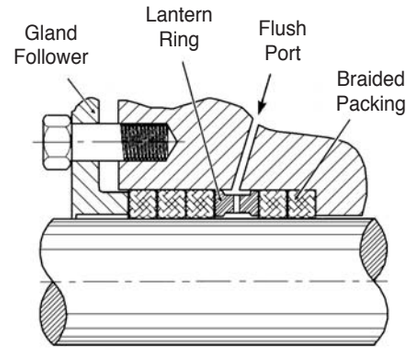




Steps 5 and 6



Testing

Functional Testing

Pump Test Fixtures

Garlock Compression Packing has three different pump test fixture designs used for evaluating pump packing set types and arrangements.

Media: Ambient temperature water

Note: The end suction pump system, due to the dynamics of a closed loop system, can produce water temperatures as high as 160°F (70°C).

Abrasives: Can be introduced into the end suction pump system

Shaft Speeds: From 367 fpm to 2,100 fpm (1.63 m/s to 9.33 m/s)

Packing cross sections: Typically 3/8" (9.5 mm) cross section, but modifications can be made to test up to 5/8" (15.8 mm) cross section.

Stuffing box pressures: 2 psi to 120 psi (0.1 to 8.3 bar)

Note: Pressures above 60 psi (4.1 bar) are achieved by throttling down the discharge flow in the end suction pump.

Stuffing box depths: 1.500" to 2.250" (38.1 mm to 57.2 mm)

High Temperature/Pressure Valve Test Fixtures

The basic design layout for this fixture was produced by Dayton T. Brown (an independent test laboratory in Bohemia, New York) for sanctioned qualification testing by the U.S. Military. Of four test valve positions, two use custom-made valve bonnets in MOV-type test scenarios, and two are standard production block valve bonnets that are hand-actuated.

Garlock Valve Test Fixture

Material Testing

Material Testing Laboratory

The various testing capabilities are often used to check conformance to ISO material and processing specification requirements.

The Garlock Compression Packing facility has the capability to perform a range of in-house chemical and physical testing exercises. These tests are used to qualify or to check the conformance of incoming raw materials as an aid to in-process checks, or as a final qualification check to ensure that finished products meet the customer's agreed-upon specifications. Whenever possible and practical, Garlock performs its testing programs in conformance with existing ASTM procedures.

Examples of testing capabilities are:

- Wet chemical testing
- Weight loss determination
- Exposure—radiation, argon, etc.
- Yields—braid, ring
- Tensile strength
- Density determinations

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

Gasket Spacers

Gasket spacers are used in conjunction with braided packing rings to:

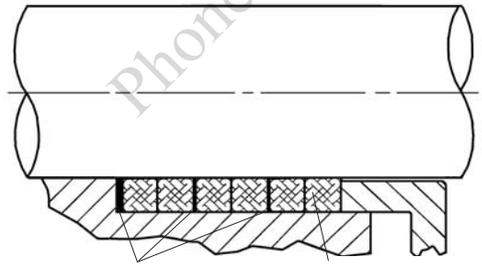
- Close up the clearances around the inside diameter of the packing set, keeping solid particles from progressing through the packing set along with the liquid leakage
- Act as a throttle bushing and reduce the pressure on the outboard side of the spacer, in applications where the leakage rate is relatively high
- Keep the packing from extruding beyond the stuffing box bottom, where there are excessive clearances between the I.D. of the stuffing box bottom and the shaft O.D. (This problem may occur through wear, corrosion, or simply the way a piece of equipment is manufactured)

In applications involving high stuffing box pressures (particularly reciprocating pumps) gasket spacers are also used to:

- Reduce the amount of leakage that occurs through the body of the braid, by forcing leakage to the I.D. of the packing set and eliminating O.D. leakage
- Keep the packing square, restrict packing movement, and prevent packing rollover and premature failure caused by excessive frictional forces

Stealth Packing Set Option

- Optimal dry running situation—eliminate flush and lantern ring
- Combines Garlock Style 3530 GYLON® spacers with 1333-G cut rings
- Contact Applications Engineering for details



Stealth Packing Set Spacer and Ring Arrangement

Gland Load

Garlock recommends using one of these two methods to determine the proper gland load on a valve packing set.

Percent Compression Method

This method simply determines the distance the set should be compressed in order to achieve a seal. The recommended percent compression varies with packing style.

- 9000-EVSP Simplified — 30% compression
  QUICKSET® 9001 — 30% compression
- 70# / ft³ density GRAPH-LOCK® — 25% compression
  70# / ft³ density #98 sets — 25% compression
- 90# / ft³ density GRAPH-LOCK® — 20% compression
  90# / ft³ density #98 sets — 20% compression
- Garlock braided packing only — 25% compression

In cases where the system pressure is very high (over 2,500 psi or 172 bar), higher compression may be required to achieve a seal.

Predetermined gland bolt torque method

This method determines a more precise gland load. The bolt torque depends upon packing size, gland bolt size, packing style system pressure, and the number of bolts. The gland studs and nuts must be in good condition, cleaned with a wire brush and well-lubricated with a suitable grease.

Use the following equation to determine the appropriate bolt torque:

$$\text{Bolt torque} = \frac{(\text{Bore dia.}^2 - \text{Stem dia.}^2) \times (\text{Gland bolt dia.}) \times (\text{Load factor})}{76.39 \times (\text{No. of bolts})}$$

Where: Bolt torque is in ft. lbs.
Bore, stem, and bolt diameters are in inches
Load factor is in psi

The load factor is determined by the following:

- For a 9000-EVSP Simplified set, a 9001 QUICKSET® or a Style #98 and GRAPH-LOCK® set:

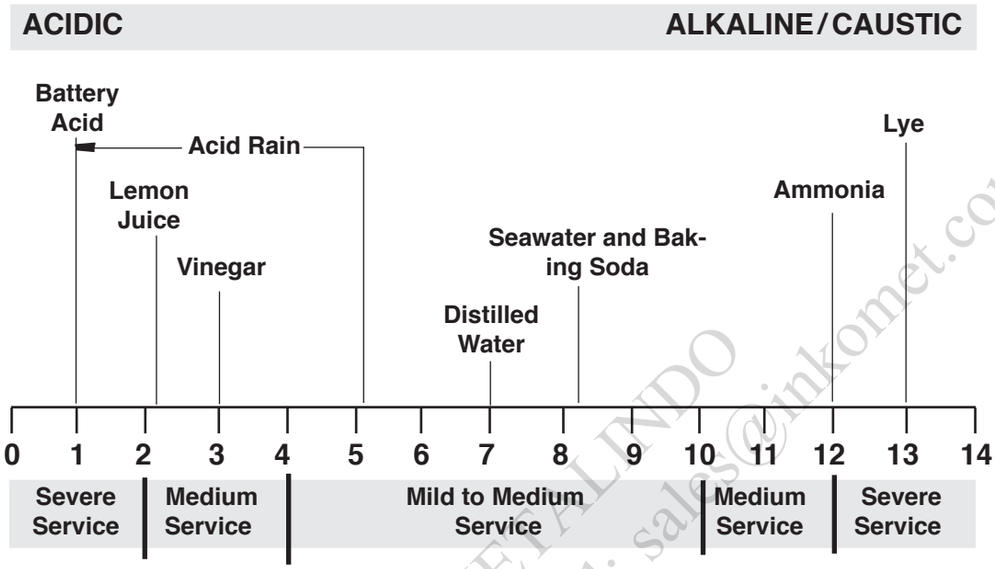
LF = 1.5 system pressure or 3,800 psi (whichever is greater)

- When using any other Garlock packing:

LF = 1.5 system pressure or 5,500 psi (whichever is greater)

pH Values

The scientific shorthand for indicating the level of acidity or alkalinity of a substance is the pH value. The scale is logarithmic, making lye, at 13, ten times as alkaline as ammonia at 12.



Common Oxidizers

Oxidizers act as a catalyst and cause hydrocarbons to combine with oxygen and cause breakdown of the fiber. Here is a partial listing of the most commonly used strong oxidizers. (A complete listing is available from Garlock Applications Engineering.)

(a) Fluorine, used as an oxidizer or rocket fuel.
(b) Sulfur Trioxide, used to make sulfuric acid.
(c) Aqua Regia (nitric and hydrochloric acid), used to dissolve metals.
(d) Sodium Peroxide, used in dyeing, paper and oxy-gen generation.
(e) Oleum (fuming sulfuric), used in detergent and explosive manufacturing.
(f) Perchloric Acid, used in the manufacturing of explosives, esters and medicine.
(g) Sulfuric Acid, greater than 75% and over 250°F, the most widely-used industrial chemical.
(h) Chloric Acid, greater than 10% and over 200°F, ignites organic materials on contact.
(i) Ferric Chloride, greater than 50% and over 200°F, used for sewage treatment, photography, medicine, etching, feed additives and oxidizing disinfectant.
(j) Nitric Acid, used in fertilizer, explosives, etching, medicine, dyeing and drugs.
(k) Chlorous Acid, greater than 10% and over 200°F.
(l) Iodine, greater than 5% and over 200°F, used in soaps, medicine, some lubricants, dyes and salt.
(m) Hydrofluoric Acid, greater than 40% and over 200°F, used for pickling, purification, dissolving ores, cleaning castings, etching, cleaning stone and brick, and fermentation.
(n) Sodium Hypochlorite, greater than 5%, used in textiles, water purification and bleaching pulp and paper.
(o) Sodium Chlorate, greater than 5%, used as bleach for paper pulp, medicine and leather textiles.
(p) Calcium Chlorate, greater than 5%, used in pyrotechnics and photography.

Bolt Torques for Die-Formed Graphite Sets

Stem Diameter (inches)

Bore Diameter (inches)

	0.375	0.438	0.500	0.563	0.625	0.688	0.750	0.813	0.875	0.938	1.000	1.063	1.125	1.188	1.250	1.313	1.375	1.438	1.500	1.563	1.625	1.688	1.750	1.813	1.875	1.938	2.000	2.063	2.125	2.188	2.250	2.313	2.375	2.438	2.500
0.625	6	5	3	2																															
0.688	8	7	6	4	2																														
0.750	10	9	8	6	4	2																													
0.813	13	12	10	9	7	5	2																												
0.875	16	14	13	11	9	7	5	3																											
0.938	18	17	16	14	12	10	8	5	3																										
1.000	21	20	19	17	15	13	11	8	6	3																									
1.063	25	23	22	20	18	16	14	12	9	6	3																								
1.125	28	27	25	24	22	20	17	15	12	10	7	3																							
1.188	32	30	29	27	25	23	21	19	16	13	10	7	4																						
1.250	35	34	33	31	29	27	25	22	20	17	14	11	7	4																					
1.313	39	38	37	35	33	31	29	26	24	21	18	15	11	8	4																				
1.375	44	42	41	39	37	35	33	31	28	25	22	19	16	12	8	4																			
1.438		47	45	44	42	40	37	35	32	30	27	23	20	16	13	9	4																		
1.500			50	48	46	44	42	40	37	34	31	28	24	21	17	13	9	5																	
1.563				53	51	49	47	44	42	39	36	33	29	26	22	18	14	9	5																
1.625				58	56	54	52	49	47	44	41	38	34	31	27	23	19	14	10	5															
1.688					61	59	57	54	52	49	46	43	39	36	32	28	24	19	15	10	5														
1.750						64	62	60	57	54	51	48	45	41	37	33	29	25	20	15	10	5													
1.813							68	65	63	60	57	54	50	47	43	39	35	30	26	21	16	11	6												
1.875							73	71	68	66	63	59	56	52	49	45	40	36	31	27	22	17	11	6											
1.938								77	74	72	68	65	62	58	55	51	46	42	37	33	28	23	17	12	6										
2.000								80	78	75	71	68	64	61	57	52	48	44	39	34	29	23	18	12	6										
2.063									84	81	78	74	71	67	63	59	54	50	45	40	35	30	24	18	12	6									
2.125									90	87	84	81	77	73	69	65	61	56	52	47	41	36	31	25	19	13	7								
2.188										94	91	88	84	80	76	72	68	63	58	53	48	43	37	32	26	20	13	7							
2.250											98	94	91	87	83	79	75	70	65	60	55	50	44	38	33	26	20	14	7						
2.313												102	98	94	90	86	82	77	72	67	62	57	51	46	40	34	27	21	14	7					
2.375												109	105	101	97	93	89	84	80	75	69	64	59	53	47	41	34	28	21	14	7				
2.438													113	109	105	101	96	92	87	82	77	72	66	60	54	48	42	35	29	22	15	7			
2.500														117	113	108	104	99	95	90	85	79	74	68	62	56	50	43	36	30	22	15	8		
2.563															120	116	112	107	103	98	92	87	82	76	70	64	58	51	44	37	30	23	16	8	
2.625															129	124	120	115	111	106	101	95	90	84	78	72	66	59	52	45	38	31	24	16	
2.688																133	128	124	119	114	109	103	98	92	86	80	74	67	61	54	47	39	32	24	
2.750																	137	132	127	122	117	112	106	101	95	89	82	76	69	62	55	48	40	33	
2.813																		141	136	131	126	121	115	109	103	97	91	84	78	71	64	56	49	41	
2.875																		150	145	140	135	129	124	118	112	106	100	93	87	80	73	65	58	50	
2.938																			154	149	144	138	133	127	121	115	109	102	96	89	82	74	67	59	
3.000																				158	153	148	142	136	130	124	118	112	105	98	91	84	76	68	
3.063																					162	157	152	146	140	134	127	121	114	107	100	93	85	78	
3.125																					172	167	161	155	150	143	137	131	124	117	110	103	95	87	
3.188																						177	171	165	159	153	147	140	134	127	120	112	105	97	
3.250																							181	175	169	163	157	150	144	137	130	122	115	107	
3.313																								185	180	173	167	161	154	147	140	133	125	117	
3.375																								196	190	184	177	171	164	157	150	143	136	128	
3.438																									201	194	188	182	175	168	161	154	146	138	
3.500																										205	199	192	186	179	172	164	157	149	
3.563																											210	203	197	190	183	175	168	160	
3.625																											221	215	208	201	194	187	179	171	
3.688																												226	219	212	205	198	190	183	
3.750																													231	224	217	209	202	194	
3.813																														236	229	221	214	206	
3.875																														248	240	233	226	218	
3.938																															253	245	238	230	
4.000																																258	250	242	

Torque in ft-lbs per inch of bolt diameter

To estimate stud torque required for 3,800 psi gland load, multiply gland stud diameter by the number in the table corresponding to the correct stem and bore diameters.

Notes:

1. This table yields ft.-lb. torque values corresponding to a 3,800 psi gland load. This is not a suitable gland load for **all** styles of packing.
2. The values in this table are given for a valve with **two gland studs**. The values are not valid for valves with screw type packing nuts, or for valves with more than two gland studs.
3. These torque values are valid only if gland studs are in good condition and well-lubricated.

Ordering Information

Braided Packing

Sizes

Inches	mm	Inches	mm
1/8	3 x 3	—	12 x 12
—	4 x 4	1/2	12.7 x 12.7
3/16	5 x 5	9/16	14 x 14
—	6 x 6	5/8	16 x 16
1/4	6.5 x 6.5	11/16	18 x 18
5/16	8 x 8	3/4	19 x 19
3/8	9.5 x 9.5	13/16	20 x 20
—	10 x 10	7/8	22 x 22
7/16	11 x 11	1	25 x 25

Note: Additional cross-sections available on request.

Die-Formed Rings

Garlock can produce die-formed rings in more than 5,000 sizes. When placing your order, specify the I.D., the O.D., the ring/set height (and density if necessary).

RPM / FPM Conversion Table

Shaft Diameter (in)	Shaft Rotary Speed (RPM)												
	100	300	500	1,000	1,500	1,750	2,000	2,500	3,000	3,600	4,000	4,500	5,000
0.500	13	39	65	131	196	229	262	327	393	471	524	589	654
0.750	20	59	98	196	295	344	393	491	589	707	785	884	982
1.000	26	79	131	262	393	458	524	654	785	942	1,047	1,178	1,309
1.250	33	98	164	327	491	573	654	818	982	1,178	1,309	1,473	1,636
1.500	39	118	196	393	589	687	785	982	1,178	1,414	1,571	1,767	1,963
1.750	46	137	229	458	687	802	916	1,145	1,374	1,649	1,833	2,062	2,291
2.000	52	157	262	524	785	916	1,047	1,309	1,571	1,885	2,094	2,356	2,618
2.500	65	196	327	654	982	1,145	1,309	1,636	1,963	2,356	2,618	2,945	3,272
3.000	79	236	393	785	1,178	1,374	1,571	1,963	2,356	2,827	3,142	3,534	3,927
3.500	92	275	458	916	1,374	1,604	1,833	2,291	2,749	3,299	3,665	4,123	4,581
4.000	105	314	524	1,047	1,571	1,833	2,094	2,618	3,142	3,770	4,189	4,712	5,236
5.000	131	393	654	1,309	1,963	2,291	2,618	3,272	3,927	4,712	5,236	5,890	
6.000	157	471	785	1,571	2,356	2,749	3,142	3,927	4,712	5,655			
7.000	183	550	916	1,833	2,749	3,207	3,665	4,581	5,498				
8.000	209	628	1,047	2,094	3,142	3,665	4,189	5,236					
9.000	236	707	1,178	2,356	3,534	4,123	4,712	5,890					
10.000	262	785	1,309	2,618	3,927	4,581	5,236						

Compression Packing Application Data Form

Customer _____ Submitted by _____

_____ _____

_____ Date _____

Phone _____ Fax _____

Email _____

Service Conditions

Shaft speed _____ rpm (or) _____ fpm

Temperature _____ °F (or) _____ °C

Pressure _____ psi (or) _____ bar

Media (What is being sealed) _____ pH _____

Equipment

Specify pump, valve, mixer, etc. _____

_____

Shaft dia. _____ Bore dia. _____ Box depth _____

General condition of equipment and environment _____

_____

_____

Packing

What is presently being used? _____

Any problems with this material? _____

_____

_____

Comments _____

_____

_____

Advancing the Science of Sealing™

Expansion Joints Technical Manual

Garlock
SEALING TECHNOLOGIES®

an EnPro Industries company

Garlock Expansion Joints

In service to world industries since 1887, Garlock has lead the production and implemention of the latest Expansion Joint Technology for over fifty years.

Just a few of the “firsts” developed by Garlock:

- Development of high temperature elastomers to the levels now considered the industry standard
- Developing the patented construction with bonded rectangular body rings
- Creation of fused FEP liners designed specifically for chemical use
- Abilities to combine fabric, FEP and elastomers effectively
- Design of spool type joints to over 10 foot (120" or 3m) I.D.’s
- Development of the flowing arch design
- Fully tested and field engineered. All Garlock expansion joint styles have been rigorously lab and field-tested, and engineered to ensure long life and reliable service.

Contents

Expansion Joint Styles

Engineering Data

Introduction

An expansion joint is a specially engineered product inserted in a rigid piping system to achieve one or more of the following:

- Absorb movement
- Relieve system strain due to thermal change, load stress, pumping surges, wear or settling
- Reduce mechanical noise
- Compensate for misalignment
- Eliminate electrolysis between dissimilar metals

At Garlock, the range of our engineering emphasis extends from the selection of the fabric used for reinforcement to the choice of materials used in actual expansion joint construction.

Rigid laboratory and field tests of Garlock expansion joints are what back up our assurances of long life and reliable service. An important word on safety: all Garlock expansion joints carry safety ratings **exceeding** product specifications in such areas as pressure and movement.

Garlock nonmetallic expansion joints and flexible couplings are ideally suited for hundreds of applications in a wide range of industries, including:

- Power generating stations
- Pulp and paper
- Chemical and industrial process piping
- Waste water and sewage disposal
- Marine applications
- Heating, ventilating and air conditioning

Joint Selection

To select the proper expansion joint, consider:

- Pipe size
- Pumped medium: type of liquid, gas, or vapor in system
- Temperature range
- Pressure/vacuum range
- Movements needed
- Environment: degree of exposure to:
  - Weathering
  - Sunlight
  - Liquids
  - Gases
  - Vapors
  - Oil
  - Open flame
  - Chemicals
  - Other
- Installed face-to-face dimensions
- Degree of pipe misalignment
- Drilling: if other than standard 125 lb. ANSI, determine:
  - Flange O.D.
  - Bolt circle
  - Number of bolt holes
  - Diameter of hole
- Need for retaining rings
- Need for control units
  - Recommended for use with most expansion joints
  - Must be used in cases of insufficient pipe support
- Need for special construction

Garlock Recommendations

	200	200HP	204 204HP	206	207 208	214 215	306	104GS	8100	9394	8400
Standard Piping— High Pressure		★	★	★					★		
Standard Piping— Low Pressure					★			★		★	★
Chemical Piping	★	★				★	★				
Standard Ducts										★	★
Nuclear			★	★	★						
Naval and Coast Guard			★	★					★		

GUARDIAN® 200 and 200HP

Garlock GUARDIAN® 200 expansion joints consist of a chemically-resistant FEP* liner mechanically bonded to an abrupt arch. A chlorobutyl cover and blue protective coating add resistance to environmental effects. (Alternate cover materials available.)

Benefits

- High-density FEP liner reduces permeation and offers optimal chemical resistance
- Mechanically bound liner reduces delamination; no glue to be vulnerable to chemical attack
- High pressure and vacuum resistance ensures suitability for broad range of applications
- Available with GYLON® 3545 gasket face for raised face flange connections

Design

- **Tube**
  - Seamless FEP lining extends to the outer edge of the flange; completely fused to the joint body
  - Abrupt arch design used for maximum movement capabilities
- **Body**
  - Chlorobutyl/Polyester construction with welded, treated metal body rings for dimensional stability
- **Cover**
  - Homogeneous layer of chlorobutyl elastomer is standard
  - Elastomer extends to the outside diameter of the flange

Temperature

	Max. Temp.
Standard Chlorobutyl/Polyester	+250°F (+120°C)
Chlorobutyl/Fiberglass/Kevlar** with EPDM cover	+300°F (+150°C)
Fluoroelastomer w/ Fiberglass/Kevlar	+400°F (+205°C)

* Fluorinated Ethylene Propylene

** Kevlar is a registered trademark of DuPont.

Pressure & Vacuum Rating

	Pipe I.D. Inch	Pipe I.D. mm	Pressure psi	Pressure bar	Vacuum in. Hg	Vacuum mm Hg
GUARDIAN® 200†	2-4	50-100	165	11	29.9	750
	5-12	125-300	140	10	29.9	750
	14	350	85	6	29.9	750
	16-24	400-600	65	5	29.9	750
	26-30	650-750	55	4	29.9	750
GUARDIAN® 200HP†	2-4	50-150	200	14	29.9	750
	5-12	200-300	190	13	29.9	750
	14	350	130	9	29.9	750
	16-20	400-500	110	8	29.9	750
	22-24	550-600	100	7	29.9	750
	26-30	650-750	90	6	29.9	750

Made in the U.S.A.

Movement Capabilities

Please refer to table on pages 18 & 19.

† Higher pressure designs are available. Call Garlock with application details.

Styles 204 and 204HP

Styles 204 and 204HP spool-type expansion joints can be constructed as single or multiple arch types. They connect pipe flanges in concentric or eccentric tapers, to join piping of unequal diameters.

Benefits

- Fully laboratory and field tested for long life and exceptional reliability
- Seamless flange face eliminates need for gaskets
- High pressure and vacuum resistance increases safety and ensures suitability for wide range of applications
- Can be custom designed for greater movement capability and easier installation
- Variety of elastomer and fabric combinations meet the demands of temperature, pressure and media

Design

- **Tube**
  - Chlorobutyl resists cracking due to high temperatures, weathering, oxidation and chemicals
  - Abrupt arch configuration provides maximum movement, and pressure and vacuum resistance
  - Seamless tube creates a positive flange seal without gaskets

	Pipe I.D. Inch	Pipe I.D. mm	Pressure Rating psi	Pressure Rating bar	Vacuum in. Hg	Vacuum mm Hg
Style 204†	1/2-4	13-100	165	11	29.9	750
	5-12	125-300	140	10	29.9	750
	14	350	85	6	29.9	750
	16-24	400-600	65	4.5	29.9	750
	26-66	650-1,650	55	3.8	29.9	750
	68-96	1,700-2,400	45	3	29.9	750
	98-108	2,450-2,700	40	2.8	29.9	750
	110-120	2,750-3,000	30	2	29.9	750
Style 204HP†	1/2-4	13-100	200	14	29.9	750
	5-12	125-300	190	13	29.9	750
	14	350	130	9	29.9	750
	16-20	400-500	110	8	29.9	750
	22-24	550-600	100	7	29.9	750
	26-40	650-1,000	90	6	29.9	750
	42-66	1,050-1,650	80	5.5	29.9	750
	68-96	1,700-2,400	70	5	29.9	750
	98-108	2,450-2,700	60	4	29.9	750
	110-120	2,750-3,000	50	3.5	29.9	750

† Higher pressure designs are available. Call Garlock with application details and to inquire about larger sizes.

Please refer to table on pages 18 & 19.

- **Body**
  - Chlorobutyl/polyester construction with welded, treated metal body rings for dimensional stability
- **Cover**
  - Chlorobutyl extends to outside flange diameter
  - Durable coating resists weathering and oxidation

Special Liner and Cover Materials

- Hypalon**
- Nitrile
- Natural Gum
- EPDM
- Neoprene
- FDA materials available
- Flouroelastomer

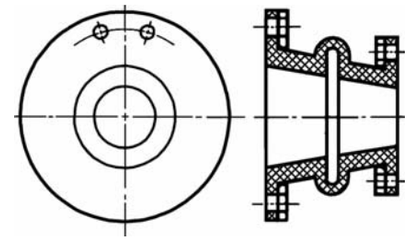
Temperature

Max. Temp.

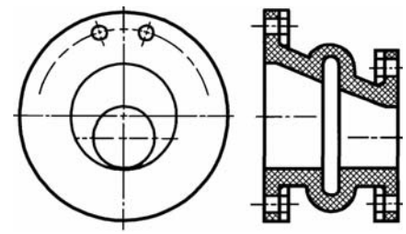
Chlorobutyl/Polyester w/Natural Gum .+180ºF (82ºC)
Standard Chlorobutyl/Polyester..... +250°F (+120°C)
Chlorobutyl/Fiberglass/Kevlar**
with EPDM tube and cover..... +300°F (+150°C)
Fluoroelastomer
w/ Fiberglass/Kevlar ..... +400°F (+205°C)

** Kevlar is a registered trademark of DuPont; Hypalon is a registered trademark of DuPont Dow Elastomers.

Optional Configurations



Concentric Tapered



Eccentric Tapered

Style 204EVS
(Extreme Vacuum Service)

Benefits

- Arch support ring reduces risk of arch collapse during vacuum service and system start-up
- Single open arch provides full range of movement
- The chlorobutyl cover and sealed bolt holes help to eliminate O_2 intrusion
- Unique combination of rubber and fabric reinforcement, combined with metal body rings, ensure best adhesion and dimensional stability
- Offset configurations available to accommodate misaligned piping and equipment, eliminating realignment
- Ideal for the dual challenges of extreme vacuum and aggressive systems dynamics
- Condensate pump applications with less than ideal support and/or long cantilevered pipe runs

Specifications

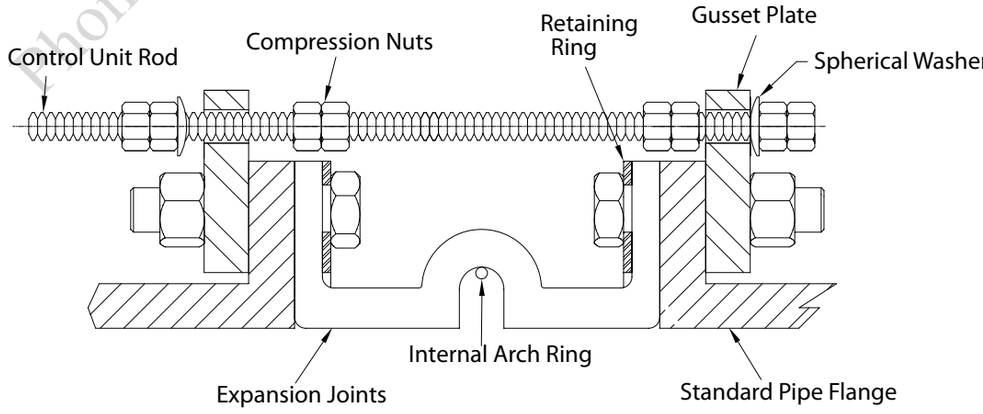
Temperature, max.	180°F (82°C)
Pressure, max.	55 psig (3.8 bar)
Vacuum:	29.9" Hg
Safety Factor Burst Rating:	3:1
Available sizes:	14" through 48" ID

Contact Garlock Customer Service for pricing and delivery. Use of control units with compression sleeves are recommended.

Movement Capabilities

	Pipe I.D. Inch	Pipe I.D. mm	Movement Inch	Movement mm
Compression	14-18	350-450	3/4	19
	20-24	500-600	7/8	22
	26-40	650-1,000	1	25
	42-48	1,050-1,200	1-1/8	29
Elongation	14-18	350-450	3/8	9
	20-24	500-600	7/16	11
	26-40	650-1,000	1/2	12
	42-48	1,050-1,200	1/2	12
Lateral	14-18	350-450	1/2	12
	20-24	500-600	1/2	12
	26-40	650-1,000	1/2	12
	42-48	1,050-1,000	1/2	12

* Movements listed are non-concurrent.
For concurrent movements, contact Garlock.



GUARDIAN® 306 EZ-FLO®

Garlock GUARDIAN® 306 EZ-FLO® spool-type expansion joints feature an FEP lining that is fused to the body of the expansion joint.

This product is designed for the chemical processing and pulp & paper industries, where its ability to resist corrosive attack at normal or elevated temperatures and pressures is unequaled.

Benefits

- FEP liner is non-contaminating and suits a wide range of applications
- Flowing arch design prevents media buildup and reduces turbulence and vibration
- 250 psig (17 bar) pressure rating ensures longer service life and consolidates inventory
- Liner extends to outer diameter of flange to prevent chemical attack on expansion joint flanges
- Mechanically bonded liner resists delamination

Design

- **Tube**
  - Seamless FEP lining extends to the outer edge of the flange; completely fused to the expansion joint body
  - Incorporates a flowing arch design to resist product build-up
- **Body**
  - Impregnated nylon tire cord fabric cross-wrapped in bias-ply construction
- **Cover**
  - Homogeneous layer of chlorobutyl elastomer extends to the outside edge of the flange
  - Coated with a weather-resistant protectant
- **Special Designs**
  - Non-standard face-to-face dimensions (pressure / vacuum ratings may be affected)
  - Non-standard drill patterns
  - Blind flanges (no drilling)
  - Lightweight designs available for low pressure and non-metallic pipe applications
  - Available with GYLON® 3545 gasket face for raised face flange connections

Pressure and Vacuum Rating*

	Pipe I.D. Inch	Pipe I.D. mm	Pressure psi	Pressure bar	Vacuum in. Hg	Vacuum mm Hg
Style 306 EZ-FLO®	3-10	75-250	250	17	26	650
	12	300	250	17	17	425
	14	350	130	9	17	425
	16-20	400-500	110	8	15	375

* Pressure and vacuum ratings are for neutral FF dimensions only. Consult Garlock for alternate sizes and corresponding pressure/vacuum ratings. Consult Garlock for larger sizes. Metric sizes available on request.

Listed pressure ratings are based on a 4:1 safety factor at max. design temp.

Movement Capabilities

	Pipe I.D. Inch	Pipe I.D. mm	Movement Inch	Movement mm
Compression	3-5	75-125	3/8	9
	6-20	150-500	1/2	12
Elongation	3-5	75-125	3/16	5
	6-20	150-500	1/4	6
Lateral	3-5	75-125	1/4	6
	6-20	150-500	1/4	6

* Movements listed are non-concurrent. For concurrent movements, contact Garlock.

Temperature

Max. Temp.

Chlorobutyl/Nylon Tire Cord .....+250°F (+120°C)
Chlorobutyl/Kevlar** Tire Cord
with EPDM cover.....+300°F (+150°C)

** Kevlar is a registered trademark of DuPont.

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.

Style 206 EZ-FLO®

EZ-FLO® expansion joints contain a single wide flowing arch, eliminating the need for filled arches on slurry services. Garlock EZ-FLO® expansion joints have successfully served all major industries, including pulp and paper, steel, waste and water, HVAC, power generation, chemical, petrochemical and marine.

Benefits

- Self-flushing design eliminates media buildup and reduces fluid turbulence
- High pressure- and vacuum-resistance ensures longer life and reduces inventory requirements
- Lightweight design installs easily, costs less to ship

Design

- **Tube**
  - Standard chlorobutyl liner extends to outer edge of the flange for excellent chemical resistance
  - Flowing arch design adds pressure resistance and reduces product buildup
- **Body**
  - Rubber impregnated tire cord and polyester cross-wrapped in bias-ply construction
- **Cover**
  - Homogeneous layer of chlorobutyl elastomer extends to the outside edge of the flange
  - Coated with a weather-resistant protectant

Special Liner* and Cover Materials

- Neoprene
- EPDM
- Hypalon**
- FDA materials available
- Nitrile
- Natural Gum
- Fluoroelastomer

Temperature

	Max. Temp.
Chlorobutyl/Nylon Tire Cord w/Natural Gum	+180°F (+82°C)
Chlorobutyl/Nylon Tire Cord	+250°F (+120°C)
Chlorobutyl/Kevlar** Tire Cord/ EPDM tube and cover	+300°F (+150°C)

* When EZ-FLO® expansion joints are furnished with special liners, temperature ratings may change.

** Kevlar is a registered trademark of DuPont; Hypalon is a registered trademark of DuPont Dow Elastomers.

Pressure and Vacuum Rating*

Pipe Size I.D. Inches	Pipe Size I.D. mm	Pressure psi	Pressure bar	Vacuum In. Hg	Vacuum mm Hg
2-10	50-250	250	17	26	650
12	300	250	17	12	300
14	350	130	9	12	300
16-20	400-500	110	8	12	300
22-24	550-600	100	7	12	300
26-40	650-1000	90	6	12	300
42-66	1050-1650	80	5.5	12	300
68-96	1700 -2400	70	5	12	300
98-108	2450-2700	60	4	12	300
110-120	2750-3000	50	3.5	12	300

* Pressure and vacuum ratings at neutral FF dimension. Extended face-to-face dimensions result in reduced pressure and vacuum ratings for Style 206 EZ-FLO® expansion joints.

Listed pressure ratings are based on a 4:1 safety factor at max. design temp.

Movement Capabilities

Please refer to table on pages 18 & 19.

Styles 214 and 215

These PTFE concentric spool-type flexible couplings are designed to reduce noise and compensate for expansion, contraction and minor piping misalignment in chemical processing, air conditioning and heating systems.

Style 214

- Two convolutions
- Temperature: -100°F (-70°C) to +450°F (+230°C)
  Pressure: To 178 psig (12 bar),
  Full vacuum to +350°F (+180°C)

Style 215

- Three convolutions
- Temperature: -100°F (-70°C) to +450°F (+230°C)
  Pressure: To 132 psig (9 bar),
  Full vacuum to +180°F (+80°C)

Benefits

- Convolution shape provides extra-long flex life at high temperatures
- Proprietary contour molding process ensures consistent wall thickness for blowout resistance
- PTFE body withstands corrosion, water, steam, and most chemicals and gases
- Preset restriction bolts prevent over-extension
- Available silicone-free

Design

- Complete assembly includes fluorocarbon resin PTFE body, plated ductile iron flanges, polyethylene-covered restriction bolts and corrosion-resistant reinforcing rings
- Standard sizes from 1" (25 mm) through 8" (200 mm) pipe I.D.

Pressure and Vacuum Rating

Garlock PTFE expansion joints and couplings have pressure ratings high enough to handle most applications. As the pipe size gets larger, Garlock increases the bellows thickness and the strength of the reinforcing rings to compensate for the change in internal forces. This permits the same high pressure rating for all sizes.

Temperature		214 Pressure		215 Pressure	
		psi	bar	psi	bar
50°F	10°C	178	12	132	9
100°F	50°C	165	11	120	8
150°F	65°C	150	10	103	7
200°F	90°C	130	9	90	6
250°F	120°C	110	8	75	5
300°F	150°C	92	6	60	4
350°F	180°C	78	5	50	3.5
400°F	205°C	65	4.5	42	3
450°F	230°C	60	4	35	2

WARNING:
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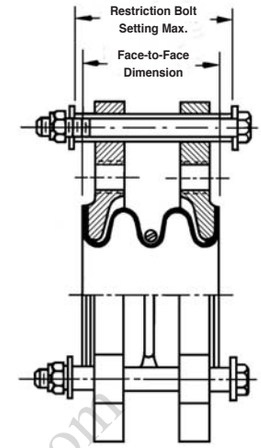
Movement Capabilities

Style 214 PTFE Flexible Couplings

Pipe Size (Inches)	1	1-1/2	2	2-1/2	3	4	5	6	8
Nominal Installed Face to-Face	1-3/8	1-3/8	1-9/16	2-1/4	2-1/4	2-5/8	3-1/4	2-3/4	4
Max. Restriction Bolt Setting	1-1/4	1-5/16	1-15/32	2-7/32	2-1/4	2-23/32	3-5/16	2-3/4	4
Max. Axial Movement + or -	1/4	1/4	1/4	5/16	3/8	1/2	1/2	1/2	1/2
Max. Transverse Deflection, + or -*	1/8	1/8	1/8	1/8	3/16	1/4	1/4	1/4	1/4

Maximum angular movement aproximately 7°.

* Based on unit being in normal installed position with no axial movement or angular deflection.

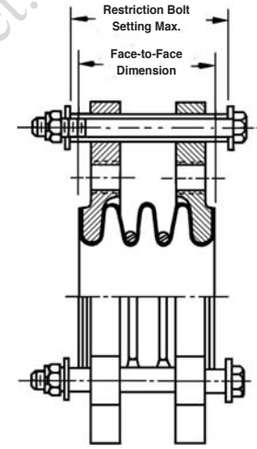


Style 215 PTFE Flexible Couplings

Pipe Size (Inches)	1	1-1/2	2	2-1/2	3	4	5	6	8
Nominal Installed Face to-Face	1-3/4	2	2-3/4	3-3/16	3-5/8	3-5/8	4	4	6
Max. Restriction Bolt Setting	1-7/8	2-5/32	3-5/32	3-9/16	4-1/4	4-1/4	4-9/16	4-5/8	6-5/8
Max. Axial Movement + or -	1/2	1/2	3/4	3/4	1	1	1	1-1/8	1-1/8
Max. Transverse Deflection, + or -*	1/4	1/4	3/8	3/8	1/2	1/2	1/2	9/16	9/16

Maximum angular movement aproximately 14°.

* Based on unit being in normal installed position with no axial movement or angular deflection.



PTFE Control Units and Flanges

All PTFE joints and couplings are furnished with ductile iron flanges and control units ready for immediate installation on the job site. Flanges in other alloys are available by special order.

Flanges are protected to resist atmosphere corrosion and are tapped to 150 lbs. ANSI Standard drilling.

Control units are assembled with flanges to prevent joints from excessive axial elongation. They are designed to accept the static pressure thrust in the piping system.

Tie rods are set at the factory at the maximum face-to-face working limits, with lock nuts as insurance against overextension of the expansion joint. The tie rods are covered with polyethylene to eliminate metal-to-metal contact between the rods and flanges—the most frequent cause of noise transmission and electrolysis.

Flange Dimensions and Drilling

Pipe Size (Inches)	1	1-1/2	2	2-1/2	3	4	5	6	8
Flange Dimensions									
Outside Diameter	5-13/16	6-11/16	7-7/16	8-7/16	9-3/16	10-11/16	11-11/16	13-1/4	15-3/4
Thickness	3/8	3/8	1/2	5/6	5/8	11/16	11/16	11/16	11/16
ANSI Std. Drilling									
Bolt Circle Dia.	3-1/8	3-7/8	4-3/4	5-1/2	6	7-1/2	8-1/2	9-1/2	11-3/4
No. Bolt Holes	4	4	4	4	4	8	8	8	8
Bolt Hole Thread	1/2-13	1/2-13	5/8-11	5/8-11	5/8-11	5/8-11	3/4-10	3/4-10	3/4-10

Style 104GS

General service elastomeric expansion joint

General service expansion joints must withstand a variety of different operating conditions across multiple industries. The 104GS from Garlock is designed to handle these most common requirements, and more. Although competitively priced, the 104GS has been rigorously tested to insure it provides the same quality and consistency you expect from Garlock products.

Benefits & Design

- The versatility of the neoprene tube ❶ and cover ❹ make the 104GS ideally suited for most general service industrial applications.
- Reinforcement materials of nylon fabric ❺ combined with carbon steel body wire ❸ and support rings ❷ allow the 104GS to withstand significant operating pressures and 26" Hg vacuum for all sizes.
- The wide, single arch ❻ design allows for greater movements and helps to reduce the affects of moderate sediment transfer.
- Available in 2" thru 36" and sold complete ❼ with galvanized carbon steel retaining rings simplifying the order process.

Specifications - 200ºF Maximum Temperature Rating

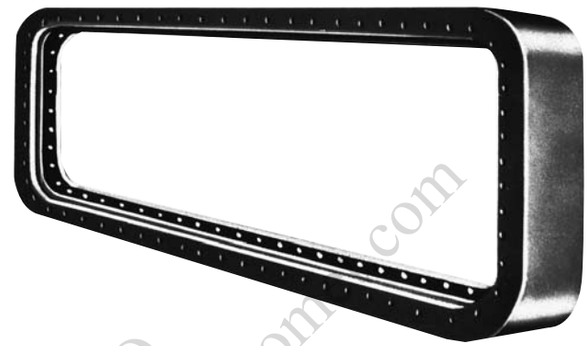
Expansion Joint				Application Data				Movement Ratings							
Size I.D.		Face-to-Face		Pressure		Vacuum		Compression		Lateral		Elongation		Angular Degrees	Tortional Degrees
Inch	mm	Inch	mm	psi	bar	Inch Hg	mm Hg	Inch	mm	Inch	mm	Inch	mm		
2	50	6	150	195	13	26	660	1-1/4	32	3/4	19	1/2	13	10	3
3	75	6	150	195	13	26	660	1-1/4	32	3/4	19	1/2	13	8	3
4	100	6	150	195	13	26	660	1-1/4	32	3/4	19	1/2	13	6	3
5	125	6	150	165	11	26	660	1-3/8	35	1	25	5/8	16	8	3
6	150	6	150	165	11	26	660	1-3/8	35	1	25	5/8	16	7	3
8	200	6	150	165	11	26	660	1-3/8	35	1	25	5/8	16	5	3
10	250	8	200	165	11	26	660	1-3/8	35	1	25	5/8	16	5	3
12	300	8	200	165	11	26	660	1-1/2	38	1	25	3/4	19	5	3
14	350	8	200	100	7	26	660	1-1/2	38	1	25	3/4	19	4	2
16	400	8	200	75	5	26	660	1-1/2	38	1	25	3/4	19	4	2
18	450	8	200	75	5	26	660	1-1/2	38	1	25	3/4	19	3	1
20	500	8	200	75	5	26	660	1-1/2	38	1	25	3/4	19	3	1
24	600	10	250	75	5	26	660	1-3/4	44	1	25	1	25	4	1
30	750	10	250	75	5	26	660	1-3/4	44	1	25	1	25	2-1/2	1
36	900	10	250	75	5	26	660	1-3/4	44	1	25	1	25	2	1

Expansion Joint Size I.D.		ANSI Class 150 Flange Drilling						No. of Bolt Holes	Spring Rates						Bolt Torque
		OD		Bolt Circle		Bolt Hole Diameter			Compression		Lateral		Elongation		
Inch	mm	Inch	mm	Inch	mm	Inch	mm		lb/Inch	kg/mm	lb/Inch	kg/mm	lb/Inch	kg/mm	Ft-Lbs
2	50	6	152	4-3/4	121	3/4	19	4	450	18	340	13	560	22	40
3	75	7-1/2	191	6	152	3/4	19	4	670	26	500	20	828	15	65
4	100	9	229	7-1/2	191	3/4	19	8	900	35	730	29	1104	20	45
5	125	10	254	8-1/2	216	7/8	22	8	1120	44	900	35	1376	25	50
6	150	11	279	9-1/2	241	7/8	22	8	1400	55	1060	42	1652	30	55
8	200	13-1/2	343	11-3/4	298	7/8	22	8	1510	59	1180	46	1837	33	85
10	250	16	406	14-1/4	362	1	25	12	1900	75	1460	57	2296	41	80
12	300	19	483	17	432	1	25	12	2300	91	1740	69	2755	50	115
14	350	21	533	18-3/4	476	1-1/8	29	12	2010	79	1570	62	2755	50	145
16	400	23-1/2	597	21-1/4	540	1-1/8	29	16	2300	91	1740	69	2755	50	135
18	450	25	635	22-3/4	578	1-1/4	32	16	2570	101	1960	77	3101	56	140
20	500	27-1/2	699	25	635	1-1/4	32	20	2860	113	2180	86	3440	62	135
24	600	32	813	29-1/2	749	1-3/8	35	20	3420	135	2630	104	4130	74	190
30	750	38-3/4	985	36	915	1-3/8	35	28	3532	63	4150	74	4594	82	180
36	900	46	1170	42-3/4	1090	1-5/8	42	32	4240	76	6330	113	5510	98	235

Pressure ratings are based on a minimum 3 to 1 safety factor at maximum design temperature.

Styles 207 and 208

Styles 207 and 208 are U-type expansion joints constructed of specialty rubber and fabric. Available in round or rectangular configurations, they are often used as flexible connectors between a turbine and condenser, or other shorter full face applications.



Style 207

- Internally flanged for full vacuum and low pressure applications
- Temperature: To +250°F (+120°C)*
  Pressure: 29.9"Hg to 15 psig (1.0 bar)

Style 208

- Externally flanged, primarily for vacuum service
- Temperature: To +250°F (+120°C)*
  Pressure: 29.9"Hg to 25 psig (1.7 bar)
- Available in very narrow face-to-face dimensions; staggered drilling facilitates installation
- Also recommended to reduce vibration and noise on lightweight piping, i.e. those carrying coal-laden air to pulverized coal burners

Note: For recommendations for specific applications, including range of available elastomers, consult Garlock.

Alternate Tube and Cover Materials

- Neoprene
- Nitrile
- Hypalon**
- EPDM
- Fluoroelastomer
- Natural Gum

Movement Capabilities

	Type Movement	Pipe I.D. Inch	Pipe I.D. mm	Movement Inch	Movement mm
	Compression	2-20	50-500	1/2	12
		22 & Up	550 & Up	3/4	19
	Elongation	2-20	50-500	1/4	6
		22 & Up	550 & Up	1/4	6
	Lateral	2-20	50-500	1/2	12
		22 & Up	550 & Up	1/2	12

* For higher temperature capabilities, consult Garlock.

** Hypalon is a registered trademark of DuPont Dow Elastomers.

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

GARFLEX® 8100

GARFLEX® expansion joints feature rugged yet flexible nylon cord reinforcement in a molded, spherical bellows design that ensures an exceptional burst pressure rating. The streamlined flowing arch design reduces turbulence and allows smooth, quiet flow—no need to fill the arch and restrict its movement.

Benefits

- Flowing arch design prevents sediment buildup and reduces turbulence
- Floating flanges can be rotated to accommodate torsional misalignment
- Molded spherical bellows accommodate up to one inch of axial movement and transverse deflection
- Nylon-reinforced nitrile tube earns high pressure rating without sacrificing flexibility; resists most hydrocarbons, oils and gasoline
- Can be installed against raised face pipe flanges

Design

- **Tube**
  - Nitrile bellows with rugged nylon tire cord reinforcement ensure strength yet flexibility
  - Incorporates a flowing arch design to eliminate product buildup
- **Cover**
  - Homogeneous layer of neoprene coated with a protectant withstands weathering and ozone
- **Flanges**
  - Metal flanges with rust resistant coating

Note:
Style 8100 expansion joints are supplied with rotating flanges drilled to ANSI Class 150# specifications.

Bellow Sizes

	Nominal	Nominal Bellow I.D. (inch)								
	F-F (in.)	2	2.5	3	4	5	6	8	10	12
Series 50	5	■	■	■	■	■	■	■	■	■
Series 60	6	■	■	■	■	■	■	■	NA	NA
Series 80	8	NA	NA	NA	NA	NA	NA	NA	■	■

NA = Not available

Temperature / Pressure

Nylon-Reinforced Nitrile

Operating Temperature °F	Operating Temperature °C	Pressure psi	Pressure bar
To 120°F	To 50°C	232	16
120°F to 160°F	50°C to 70°C	174	12
160°F to 195°F	70°C to 90°C	139	9.5
195°F to 210°F	90°C to 100°C	70	5
210°F to 230°F	100°C to 110°C	25	1.7

Listed pressure ratings are based on a 4:1 safety factor

Vacuum Rating* — Nitrile

Pipe I.D. Inch	Pipe I.D. mm	Vacuum in. Hg	Vacuum mm Hg
2 to 2-1/2	50 to 63	23	575
3	75	20	500
4	100	17	425
5 to 6	125 to 150	11	275
8	200	8	200
10 to 12	250 to 300	5	125

* At nominal FF dimensions only.

Movement Capabilities

Type Movement	Movement Inch	Movement mm
Compression	1	25
Elongation	1	25
Transverse Deflection (at recommended installed position)	± 1	± 25

Movements are non-concurrent.

Type Movement	Pipe I.D. Inch	Pipe I.D. mm	Max. Allowed
Angular Deflection (at recommended installed position)	2	50	35°
	2-1/2 to 3	63 to 75	30°
	4	100	25°
	5 to 6	125 to 150	20°
	8	200	15°
	10 to 12	250 to 300	10°

Style 9394

This multi-convoluted, lightweight expansion joint is designed for lower pressure applications that require significant amounts of movement, axially and/or laterally. Its low spring rates make it ideal for load cell applications.

Benefits

- Lightweight design installs easily, costs less to ship
- Can be custom-designed for even greater movement capability
- Choice of construction materials suitable for wide range of temperatures
- Available in flanged or sleeve type design, up to 48" max. (1,219 mm) I.D. *Contact Garlock for larger ID sizes

Note: Flanged designs require retaining rings for an effective seal. Sleeve type requires clamps; the overall length of the expansion joint should include an additional 4" (101.6 mm) for clamping space.

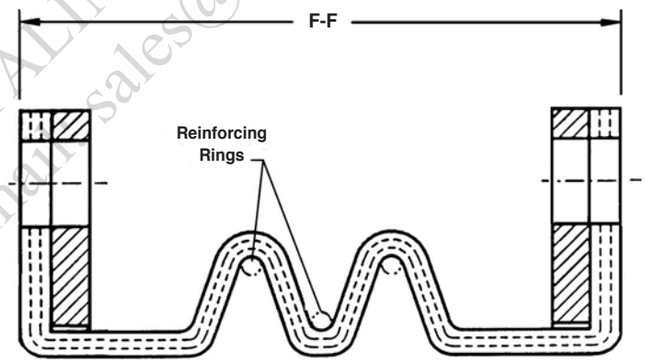
Pressure

- Without external reinforcing rings: up to 3 psi (0.2 bar)
- With external reinforcing rings: up to 15 psi (1.0 bar)

Vacuum

- Without internal reinforcing rings: up to 3 inches (75 mm) Hg
- With internal reinforcing rings: up to 15 inches (381 mm) Hg

Contact Garlock if higher vacuum or pressure ratings are required.



Cross Section of Style 9394 with Reinforcing Rings

Movement Capabilities

Type Movement	Pipe Size Inch	Pipe Size mm	Movement Inch	Movement mm
Compression	2-6	50-150	3/4	19
	8-10	200-250	7/8	22
	12-18	300-450	1-1/8	28
	20-Up	500-Up	1-5/8	41
Elongation	2-6	50-150	5/8	16
	8-10	200-250	3/4	19
	12-18	300-450	1	25
	20-Up	500-Up	1-1/4	31
Lateral	2-6	50-150	5/8	16
	8-10	200-250	3/4	19
	12-18	300-450	1	25
	20-Up	500-Up	1-1/4	31

Movements listed are per convolution

Alternate Tube and Cover Materials

- Neoprene
- Nitrile
- Hypalon**
- EPDM
- Fluoroelastomer
- Natural Gum

Temperature

Standard Materials	Max. Temp.
Chlorobutyl/Polyester w/ Natural Gum	+180°F (+82°C)
Chlorobutyl/Polyester	+250°F (+120°C)
Chlorobutyl/Fiberglass/Kevlar* EPDM cover and tube	+300°F (+150°C)
Fluoroelastomer/Fiberglass/Kevlar	+400°F (+205°C)

* Kevlar is a registered trademark of DuPont;
** Hypalon is a registered trademark of DuPont Dow Elastomers.

Style 8400 Flue Ducts

Garlock offers a wide range of flue duct type expansion joints for lightweight applications, especially for scrubbers, precipitators, baghouses, and fans in air handling systems. Style 8400 flue ducts are available in round, rectangular or square configurations, as belt type (without flanges) or U-type (flanged), with virtually no size restrictions.

Garlock also provides on-site vulcanization for flue ducts that require splicing into position due to obstructions or interferences that prevent continuous construction installations.

Rectangular / Square

- Face-to-face dimensions: typically 6" (152 mm), 9" (229 mm) or 12" (305 mm)
- If any leg is smaller than 30" (762 mm), joint will be built on a metal form with column corners
- Consult factory for movement capabilities

Note: Other sizes also available.
If more movement is required, please contact Garlock.

Round

- Supplied in any size, with or without flanges or arch
- Variety of materials available: neoprene, chlorobutyl, fluoroelastomer, nitrile, EPDM, Hypalon*, FDA neoprene, FDA EPDM or natural/gum rubber.
- Movement capabilities depend on expansion joint size and arch configuration

Belt Type

- Supplied in any size, without flanges, with or without an arch
- Available in the same materials as round flue ducts
- Movement capabilities depend on installation width and arch configuration
- Supplied open-ended (wraparound), or continuous to fit over ducting

Temperature

Style No.	Standard Robus Materials	Max. Temp.
8400-250	Neoprene/Fiberglass/Kevlar**	+250°F (+120°C)
8400-300	Chlorobutyl/Fiberglass/Kevlar	+300°F (+150°C)
8400-400	Fluoroelastomer/Fiberglass/ Kevlar	+400°F (+205°C)

Made in the U.S.A.

* Hypalon is a registered trademark of DuPont Dow Elastomers.
** Kevlar is a registered trademark of DuPont.

Style 8400-HT / High Temperature Flue Ducts

In typical Garlock fashion, the 8400-HT will be custom designed to meet or exceed the individual requirements of each application or system design specifications. The 8400-HT is available in a multitude of configurations and material combinations, complimenting our existing 8400 family of lower temperature products (8400-250, 8400-300, 8400-400). The 8400-HT is able to accommodate operating temperatures as low as -75ºF (-60ºF) and up to 2200ºF (1200ºC).

Benefits

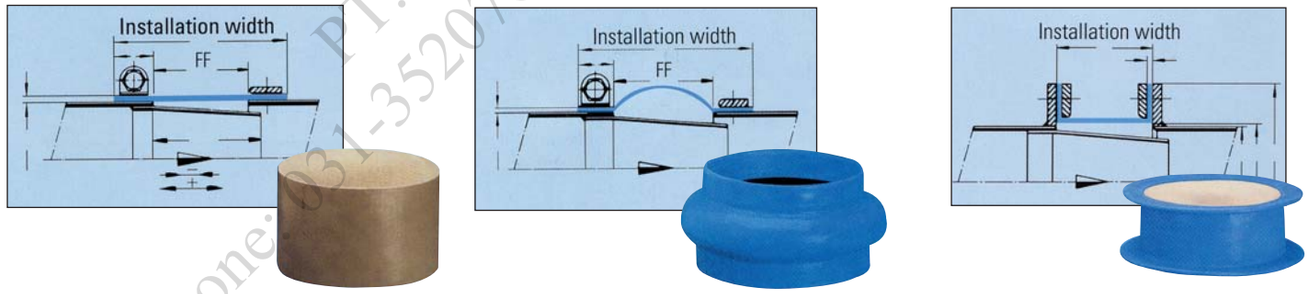
Specific combinations of fluorine based hydrocarbon polymers and reinforcing materials offer an unusually high resistance to corrosive substances at high temperatures, ideal for most operating conditions in flue gas desulphurization systems (FGD);

- Very good rebound characteristics that help resist permanent deformation
- Special resistance to SO_2, H_2SO_4 and other corrosive chemical substances
- Continuous operating temperature in excess of 400ºF

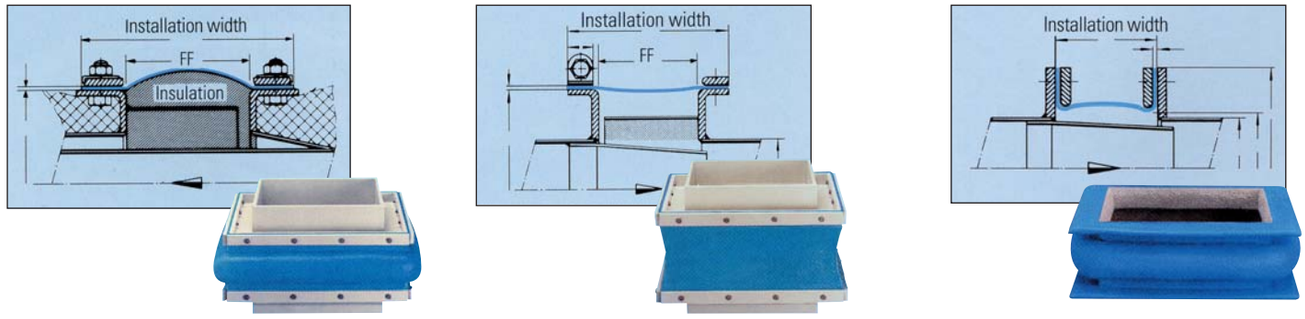
Ideal for

In addition to FGD systems, non metallic, flue duct style expansion joints are commonly used in gaseous medias such as hot air, chemical vapors, engine exhaust, etc. For example:

- Steam boiler systems
- Gas Turbine Exhausts
- Industrial furnace & chimney construction
- Refuse incinerators
- Ventilation and aeration systems
- HPI, CPI emissions control
- Pulp & Paper industry



The illustrated types can be used in different applications with different material make-up, but with the same design and movement absorption.

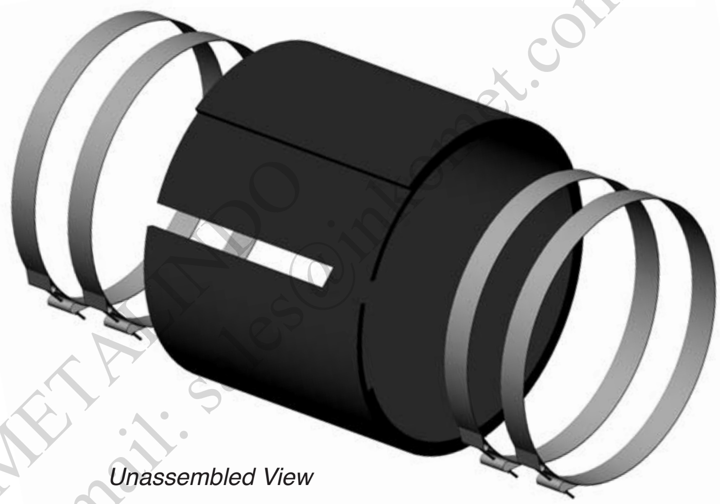


Style 8420 Split

Easy installation and removal

- Split design eliminates equipment disassembly, reducing costly downtime
- Available in EPDM, nitrile* and fluoroelastomer in sizes from 2" to 24" standard. Contact Garlock for larger sizes
- Can be customized for your application; contact Garlock with your specifications
- Adhesive kits with installation instructions are provided with every shipment to facilitate quick assembly, clamps not included

* EPDM and nitrile are standard—
other elastomers available on request.



Unassembled View

Specifications

	2" Max. Pipe Gap Opening	4" Max. Pipe Gap Opening	6" Max. Pipe Gap Opening
Clamps Required:	4	4	4
Thickness: 2"-12" Size (50.8 mm-304.8 mm)	1/4" (6.4 mm)	1/4" (6.4 mm)	1/4" (6.4 mm)
14"-24" Size (355.6 mm-609.6 mm)	3/8" (9.5 mm)	3/8" (9.5 mm)	3/8" (9.5 mm)
Pressure, Max.:	15 psi (1.034 bar)	5 psi (0.345 bar)	5 psi (0.345 bar)
Vacuum:	14" Hg (356 mm Hg)	5" Hg (127 mm Hg)	5" Hg (127 mm Hg)
Temperature, Max. with standard adhesive kit	165°F (74°C)	165°F (74°C)	165°F (74°C)
with Viton* adhesive	400°F (204°C)	400°F (204°C)	400°F (204°C)
Movement:	Vibration Only	Vibration Only	Vibration Only
Lateral Misalignment, Max.:	1/2" (12.7 mm)	1/2" (12.7 mm)	1/2" (12.7 mm)
Width of Joint: (203.2 mm)	8" (203.2 mm)	10" (254 mm)	12" (304.8 mm)

Notes:
1. All applications above 165°F (74°C) require Viton* adhesive kits.
2. T-bolt clamps recommended on all applications; not included with adhesive kits.

* Viton is a registered trademark of DuPont Dow Elastomers.

Industry Specifics

Nuclear

Garlock is the **ONLY** manufacturer of **SAFETY RELATED** elastomeric expansion joints in the United States. Garlock maintains an active nuclear quality program in accordance to **10CFR50 Appendix B and 10CFR21** as detailed in our Quality Manual for select product offerings. We are also a ISO 9001 registered company since 1992 and NUPIC (Nuclear Procurement Issues Committee) audited. Here are a couple of our key products for the Nuclear industry:

- Style 204 / 204HP
- Style 206

Style 204 HP

U.S. Navy

Garlock manufactures numerous expansion joints in accordance with U.S. Navy specifications. U.S. Navy specification **MIL-E-15330D** was superseded by **ASTM F 1123**. Contact the product line for information relating to other military specifications.

- Style 9278 / 206
- Style 9278A / 204
- Style 7706 - S type
- Style 7250

Style 7706

U.S. Coast Guard

Garlock manufactures to applicable Code of Federal Regulations and ASTM standards. **46CFR56 series**

- Style 206
- Style 204 HP
- Style 8100

Style 206

Style 8100

International

Garlock has undergone design review and received provincial **Canadian Registration Number (CRN)**.

- Style 204 HP

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

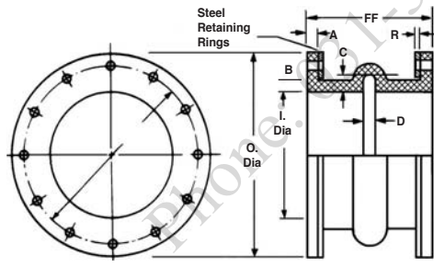
Technical Data

Sizes • Dimensions • Movements • Standard 150# Drilling

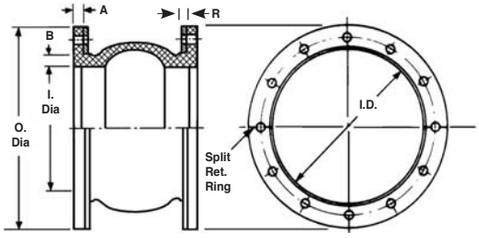
Joint Size (Inside Dia.)[1]	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6	8	10	12	14	16	18	20	22	24	26	28	30	34	36
Flange Outside Dia.	4 1/4	4 5/8	5	6	7	7 1/2	9	10	11	13 1/2	16	19	21	23 1/2	25	27 1/2	29 1/2	32	34 1/4	36 1/2	38 3/4	43 3/4	46
Bolt Circle Dia.	3 1/8	3 1/2	3 7/8	4 3/4	5 1/2	6	7 1/2	8 1/2	9 1/2	11 3/4	14 1/4	17	18 3/4	21 1/4	22 3/4	25	27 1/4	29 1/2	31 3/4	34	36	40 1/2	42 3/4
Number Bolt Holes	4	4	4	4	4	4	8	8	8	8	12	12	12	16	16	20	20	20	24	28	28	32	32
Diameter Bolt Holes	5/8	5/8	5/8	3/4	3/4	3/4	3/4	7/8	7/8	7/8	1	1	1 1/8	1 1/8	1 1/4	1 1/4	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 5/8	1 5/8
Single Arch Std FF	6	6	6	6	6	6	6	6	6	6	8	8	8	8	8	8	10	10	10	10	10	10	10
Dimensions Flg. Thk. A	9/16	9/16	9/16	9/16	19/16	9/16	9/16	9/16	5/8	3/4	3/4	3/4	7/8	7/8	7/8	1	1	1	1	1	1	1	1
200, 200HP, Body Thk. B	1/2	1/2	5/8	3/4	3/4	3/4	7/8	7/8	7/8	7/8	1	1 3/16	1 3/16	1 3/16	1 3/16	1 1/4	1 1/4	1 1/4	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8
204HP Arch Ht. C	1	1	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/2	1 1/2	1 1/2	2	2	2	2	2	2	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4
Arch Width D	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4	3/4	3/4	7/8	7/8	7/8	1	1	1	1	1
Std Double Arch FF	10	10	10	10	10	10	10	10	10	10	12	12	12	12	12	14	14	14	14	14	14	14	14
Std Triple Arch FF	14	14	14	14	14	14	14	14	14	14	16	16	16	16	16	18	18	18	18	18	18	18	18
Retaining Ring Thk. R	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8
204, 204HP, 200, 200HP Max. Axial Compression	1/4	1/4	1/4	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4	3/4	3/4	7/8	7/8	7/8	1	1	1	1	1
Max. Lateral Deflection	1/4	1/4	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Max. Axial Elongation	1/8	1/8	1/8	1/4	1/4	1/4	1/4	1/4	1/4	3/8	3/8	3/8	3/8	3/8	3/8	7/16	7/16	7/16	1/2	1/2	1/2	1/2	1/2
Dimensions Flg. Thk. A	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	5/8	5/8	5/8	5/8	5/8	5/8
206 EZ-FLO®, 204 G306 EZ-FLO® Body Thk. B	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	9/16	9/16	5/8	5/8	5/8	5/8	5/8	5/8	5/8	13/16	13/16	13/16	13/16	13/16	13/16
206 EZ-FLO® Max. Axial Compression	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	1	1	1	1	1	1	1	1 1/8	1 1/8	1 1/8	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4
Max. Lateral Deflection	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Max. Axial Elongation	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2

All specifications in inches unless otherwise noted.

Styles 200, 200HP, 204, 204HP



Styles 206, 306 EZ-FLO®



204 Single Arch Movements

Size (Inches)	Angular Movement (Degrees)	Torsional Movement (Degrees)
2	14.5	3
3	10	3
4	7.5	3
5	6	3
6-8	5	3
10-12	4	3
14-16	2.5	2
18-30	2	1
34-54	1.5	1
56-96	1	1

Note: The degree of angular movement is based on the max. extension shown.

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ID	40	42	48	50	54	60	66	72	78	84	90	96	108	120
OD	50 3/4	53	59 1/2	61 3/4	66 1/4	73	80	86 1/2	93	99 3/4	106 1/2	113 1/4	126 3/4	140 1/4
ØBC	47 1/4	49 1/2	56	58 1/4	62 3/4	69 1/4	76	82 1/2	88 3/4	95 1/2	102	108 1/2	120 3/4	132 3/4
#BH	36	36	44	44	44	52	52	60	60	64	68	68	72	76
ØBH	1 5/8	1 5/8	1 5/8	1 7/8	2	2	2	2	2 1/8	2 1/4	2 3/8	2 1/2	2 1/2	2 1/2
FF	10	12	12	12	12	12	12	12	12	12	12	12	12	12
A	1	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/164	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 3/8
B	1 3/8	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 13/16	1 13/16	1 13/16	1 13/16	1 13/16	2
C	2 1/4	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2
D	1	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8
FF	14	16	16	16	16	16	16	16	18	18	18	18	18	18
FF	18	20	20	20	20	20	20	20	22	22	22	22	22	22
R	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8
204 C	1	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8
L	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
E	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
A	5/8	7/8	7/8	7/8	7/8	7/8	7/8	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 3/8
B	13/16	1	1	1	1	1	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 1/2
206 C	1 1/4	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8
L	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
E	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2

Notes:

1. Pipe sizes through 1½" are supplied with a filled arch (Style 204, 204HP), and movements have been reduced accordingly. Open-arch construction is available on special order.
2. Pressure/vacuum ratings are for standard FF dimensions only. Consult Garlock for non-standards.
3. For shorter "FF" dimensions, consult Garlock.
4. Forces to compress, deflect and elongate elastomeric expansion joints are based on ambient temperature and zero pressure in the pipeline. These forces should be considered only as approximate and may vary with the elastomers and fabric used in construction. To convert force in pounds to kilograms, divide by 2.205.
5. Movement of multiple-arch joints can be determined by multiplying the number of arches by the single-arch values in the table above.
6. For filled-arch joints, reduce the axial compression, elongation and transverse deflection value by 50%.
7. Rated movements are non-concurrent.
8. Control units are recommended for most applications.

Drilling Specifications

ANSI B16.1.....1975 Class 125
ANSI B16.24.....1971 Class 150
ANSI B16.5.....1973 Class 150
MSS SP-51..... 1965 MSS 150 lb.
AWWA C201..... Class B
Note: Special drillings available.

Pressure Ratings

Style 204 / GUARDIAN® 200

Pressure and vacuum service

Pipe Size I.D. Inches	mm	Pressure psi	bar	Vacuum In. Hg	mm Hg
1/2-4	13-100	165	11	29.9	750
5-12	125-300	140	10	29.9	750
14	350	85	6	29.9	750
16-24	400-600	65	4.5	29.9	750
26-66	650-1650	55	3.8	29.9	750
68-96	1700-2400	45	3	29.9	750
98-108	2450-2700	40	2.8	29.9	750
110-120	2750-3000	30	2	29.9	750

Style 204HP / GUARDIAN® 200HP

High pressure and vacuum service

Pipe Size I.D. Inches	mm	Pressure psi	bar	Vacuum In. Hg	mm Hg
1/2-4	13-100	200	14	29.9	750
5-12	200-300	190	13	29.9	750
14	350	130	9	29.9	750
16-20	400-500	110	8	29.9	750
22-24	550-600	100	7	29.9	750
26-40	650-1000	90	6	29.9	750
42-66	1050-1650	80	5.5	29.9	750
68-96	1700 -2400	70	5	29.9	750
98-108	2450-2700	60	4	29.9	750
110-120	2750-3000	50	3.5	29.9	750

Style 206 EZ-FLO®

High pressure service

Pipe Size I.D. Inches	mm	Pressure psi	bar	Vacuum In. Hg	mm Hg
2-10	50-250	250	17	26	650
12	300	250	17	12	300
14	350	130	9	12	300
16-20	400-500	110	8	12	300
22-24	550-600	100	7	12	300
26-40	650-1000	90	6	12	300
42-66	1050-1650	80	5.5	12	300
68-96	1700 -2400	70	5	12	300
98-108	2450-2700	60	4	12	300
110-120	2750-3000	50	3.5	12	300

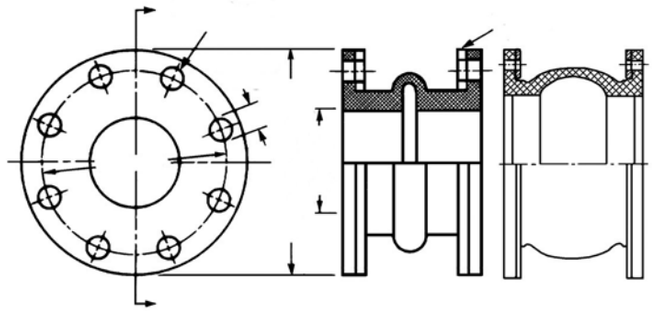
Notes:

1. See page B-6 for temperature and pressure ratings of GUARDIAN® 306 EZ-FLO® expansion joint.
2. Pressure and vacuum ratings at neutral FF dimension. Extended face-to-face dimensions result in reduced pressure and vacuum ratings for Style 206 EZ-FLO® expansion joints.

Types of Expansion Joints

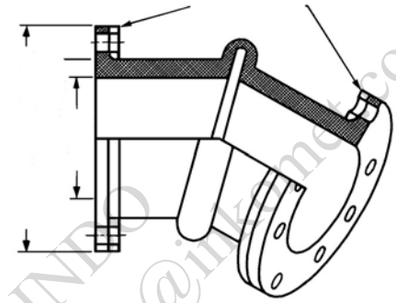
Single Arch

- Fabric and rubber construction
- Reinforced with metal/wire rings
- Full-face flanges integral with joint body
- Flanges drilled to companion bolt pattern
- Gaskets not required



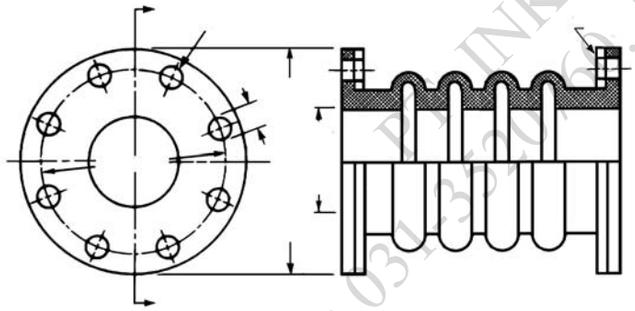
Offset

- Compensates for initial misalignment and non-parallelism of piping axis
- Custom-built to your specifications
- Complete drawings and specifications recommended with inquiries/orders



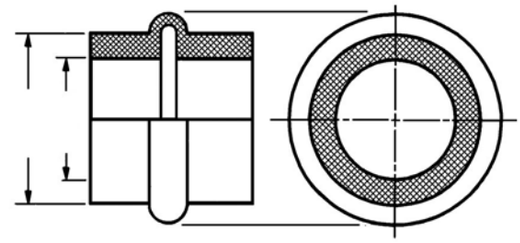
Multiple Arch

- Accommodates greater movement than single arch
- Minimum joint length depends on number of arches
- Maximum of four arches recommended to maintain lateral stability



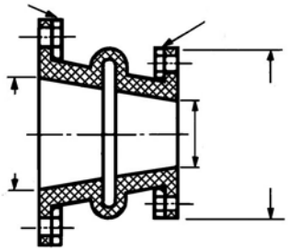
Sleeve

- Same as single arch type, except sleeve end I.D. equals pipe O.D.
- Slips over straight ends of open pipe
- Ends secured by suitable clamps
- Recommended for low pressure service only

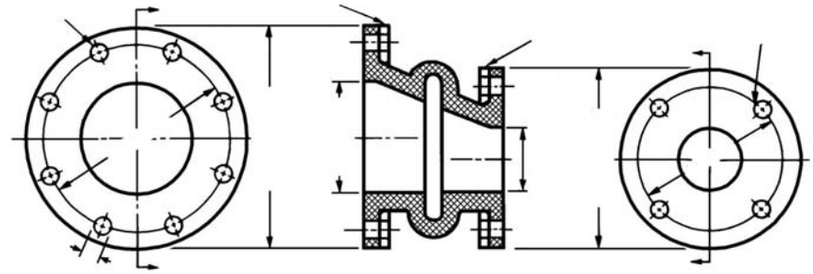


Taper or Reducer

- Connects piping of different diameters
- Concentric tapered joints: same axis for both ends
- Eccentric: axis of one end offset from other end
- Tapers in excess of 15° are not recommended
- Pressure ratings are based on larger I.D.
- Available with or without arches



Concentric Taper



Eccentric Taper

Expansion Joint Components

Tube

- Synthetic or natural rubber forms seamless, leak-proof lining
- Extends fully through bore to outer flange edge
- Common materials include chlorobutyl, neoprene, natural rubber, EPDM, Viton* and Hypalon*

Body or Carcass

- When wrapped or plied, reinforcements provide support and flexibility between tube and cover
- Fabric reinforcement: polyester or other suitable fabrics impregnated with specified elastomers
- Metal reinforcement: bonded rectangular steel rings exclusive to Garlock, or continuous strands of wire and round steel body rings
- Metal reinforcement rings provide longer service life, extra safety protection, and extra rigidity, allowing higher pressure ratings

Cover

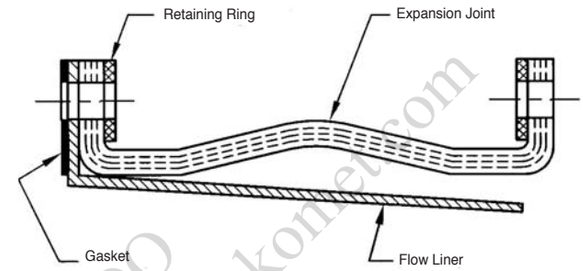
- Homogeneous layer of synthetic or natural rubber
- Chlorobutyl is standard; other elastomers available to meet your specific applications
- Rubber or other weather-resistant coating protects carcass from corrosion or damage

Metal Retaining Rings

- Must be used in all applications; provides metal surface to distribute bolting pressure equally, preventing flange damage during bolt tightening
- Install against external flange surface
- Standard material: mild steel with corrosion-resistant coating; galvanized or stainless steel also available

Metal Flow Liners

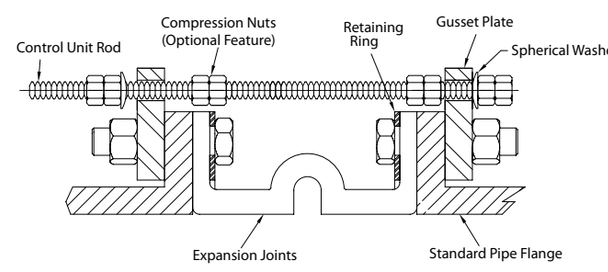
- Extends service life by providing protection from abrasive materials or solids, especially in high velocity applications
- Flanged at one end, installed at the head of the flow, tapered to a 5° angle, allows lateral deflection
- Liner flange thickness: 10 gauge
  Liner body thickness: 12 gauge
- Available in 304/316 stainless steel; also: titanium, Hastelloy C**
- Special metal liner configurations also available for reducing or multiple arch design. Contact Garlock.



Metal Flow Liner Installation

Control Units

- Recommended on most applications to prevent damage due to excessive pipe movements
- Consists of two or more tie rods connected between pipe flanges
- Triangular end plates (gussets) have two holes for bolting securely to flange, and one hole to accommodate the connecting tie rod
- Spherical washers are incorporated to accomodate moderate piping alignments, but also assists with angular, torsional and lateral movements
- Each rod incorporates double nuts on each end to keep the expansion joint from over-elongating
- When excessive axial compression is a concern, compression nuts can be incorporated to restrict movements as needed and to protect the expansion joint from damage
- NOT designed to replace pipeline anchoring

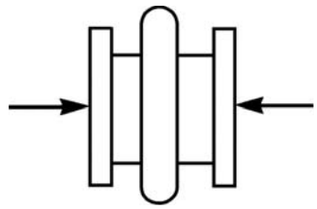


Typical Control Unit for Rubber Expansion Joint

Types of Pipe Movements

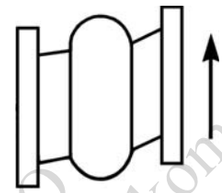
Axial Compression

- Longitudinal movement shortens face-to-face dimension along axis of expansion joint or flexible coupling
- Pipe flanges remain perpendicular to axis



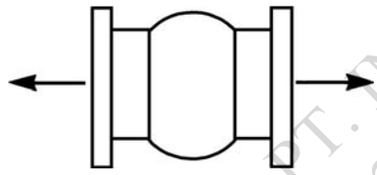
Lateral/Transverse Movement

- Offset movement of one or both pipe flanges
- Both flanges remain parallel to each other while forming angle to axis of joint



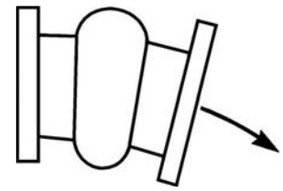
Axial Elongation

- Longitudinal movement lengthens face-to-face dimension along axis of expansion joint or flexible coupling
- Pipe flanges remain perpendicular to axis



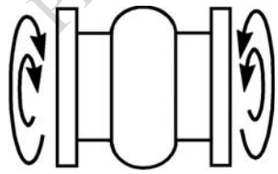
Angular Movement

- Deflection or rotation of one or both flanges
- Forms angle with axis of expansion joint or flexible coupling



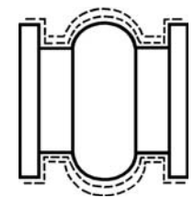
Torsional Movement

- Rotation of one flange with stationary counterpart
- Simultaneous rotation of both flanges in opposing motion



Vibration

- Oscillating movement around axis of expansion joint or flexible coupling
- Pipe flanges remain parallel with each other
- Flanges remain perpendicular to axis
- Mechanical vibration in steel piping system reduced with installation of pipe connectors or expansion joints



Typical Properties of Elastomers

Material Designation		Rating Scale Code	Elastomer Physical and Chemical Properties Comparison							
ANSI / ASTM D1418-77	ASTM D-2000 D1418-77	7 - Outstanding 3 - Fair to Good 6 - Excellent 2 - Fair 5 - Very Good 1 - Poor to Fair 4 - Good 0 - Poor X - Contact Manufacturer **COMMON NAME** **Chemical Group Name**	Water Chemical Animal & Vegetable Oil Alkali, Condensed	Alkali, Dilute Oil & Gasoline Lacquers Oxygenated Hydrocarbons	Aromatic Hydrocarbons Aliphatic Hydrocarbons Acid, Concentrated Acid, Dilute	Swelling in Oil Radiation Water Absorption Electrical Insulation	Dielectric Strength Tensile Strength Compression Set Rebound, Cold	Rebound, Hot Dynamic Impermeability Abrasion	Tear Flame Cold Heat	Oxidation Sunlight Weather Ozone
CR	BC BE	**NEOPRENE** chloroprene	4 3 4 0	4 4 0 1	2 3 4 6	4 5 4 3	5 4 2 4	5 2 4 5	4 4 4 4	5 5 6 5
NR	AA	**GUM RUBBER** polyisoprene, synthetic	5 3 X X	X 0 0 4	0 0 3 3	0 6 5 5	6 6 4 6	6 6 2 7	5 0 5 2	4 0 2 0
IR	AA	**NATURAL RUBBER** polyisoprene, synthetic	5 3 X X	X 0 0 4	0 0 3 3	0 6 5 5	6 6 4 6	6 2 2 6	5 0 5 2	4 0 2 0
IIR	AA	**BUTYL** isobutene-isoprene	5 6 5 4	4 0 3 4	0 0 4 6	0 4 5 5	5 4 3 0	5 2 6 4	4 0 4 5	6 5 5 6
CIIR	AA BA	**CHLOROBUTYL** chloro-isobutene-isoprene	5 6 5 4	4 0 3 4	0 0 4 6	0 4 5 5	5 4 3 0	5 2 6 4	4 0 4 5	6 5 5 6
NBR	BE BK CH	**BUNA-N / NITRILE** nitrile-butadiene	4 3 5 0	4 5 2 0	4 6 4 4	5 5 4 1	0 5 5 4	4 5 4 4	3 0 3 4	4 0 2 2
SBR	AA	**SBR / GRS / BUNA-S** styrene-butadiene	5 3 X 2	4 0 0 4	0 0 3 3	0 6 5 5	4 5 4 4	4 4 2 5	3 0 5 3	2 0 2 0
CSM	CE	**HYPALON*** chloro-sulfonyl-polyethylene	5 6 4 4	4 4 3 1	2 3 4 6	4 5 4 3	5 2 2 2	4 2 4 4	3 4 4 4	6 7 6 7
FKM	HK	**VITON* / FLUOREL**** fluorocarbon elastomer	5 6 6 0	4 6 1 0	6 6 6 5	6 5 5 3	5 5 6 2	4 5 5 5	2 6 2 7	7 7 7 7
EPR	BA CA DA	**EPDM** ethylene-propylene-diene-terpolymer	5 6 5 6	6 0 3 6	0 0 4 6	0 7 6 6	7 5 4 6	6 5 4 5	4 0 5 6	6 7 6 7
AFMU		**TEFLON† / TFE / FEP** fluoro-ethylene-polymers	7 7 7 7	7 7 7 7	7 7 7 7	7 3 7 X	X X X X	X X X 4	X X X 7	7 7 7 7
S	GE	**SILICONE**	5 5 5 0	2 X 0 2	0 0 2 6	2 5 6 6	4 0 3 6	6 0 2 0	2 3 6 7	6 6 6 6

Temperature Ratings

Body Material	Max. Temp.
Chlorobutyl/Polyester	+250°F (+120°C)
Chlorobutyl/Nylon Tire Cord	+250°F (+120°C)
Neoprene/Fiberglass/Kevlar	+250°F (+120°C)
Chlorobutyl/Fiberglass/Kevlar†	+300°F (+150°C)
Fluoroelastomer/fiberglass/Kevlar	+400°F (+205°C)

Liner and/or Cover Material	Max. Temp.
Chlorobutyl	+300°F (+150°C)
EPDM	+300°F (+150°C)
FEP fluorocarbon	+400°F (+205°C)
Fluoroelastomer	+400°F (+205°C)
HNBR (hydrogenated nitrile)	+300°F (+150°C)
Hypalon	+250°F (+120°C)
Natural/gum	+180°F (+80°C)
Neoprene	+250°F (+120°C)
Nitrile	+250°F (+120°C)
PTFE	+450°F (+230°C)

* Hypalon and Viton are registered trademarks of DuPont Dow Elastomers.

** Fluorel is a registered trademark of 3M Companies.

† Teflon and Kevlar are registered trademarks of DuPont.

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Expansion Joint Installation

Preparation

Check service range

- Double check performance limits against anticipated operating conditions
- Check temperature, pressure, vacuum recommendations
- Check total joint deflection—alter as needed to reduce deflection to correct range
- Anchor lines

Check location

- Proper location is usually close to main anchoring point
- Install pipe guide(s) for proper alignment
- Joint should absorb pipeline expansion / contraction between fixed anchor points

Check cover

- Check outside joint cover for damage
- Cover will keep harmful materials from penetrating joint carcass

Check alignment

- Alignment should be 0.125" (3.2 mm) or less
- If 0.125" (3.2mm) must be exceeded, use a special offset joint

Check support

- Weight must not be carried by joint
- Support with hangers or anchors

Check flanges

- Clean all mating flanges
- Do not gouge or mutilate surfaces during cleaning
- Carefully examine used parts for smoothness

Installation

Apply lubricant

- On elastomeric joints only, not required with all PTFE- or FEP-lined joints
- Coat rubber faces with graphite in water, or glycerine, to prevent joint adherence to pipe flanges

Insert bolts from arch side

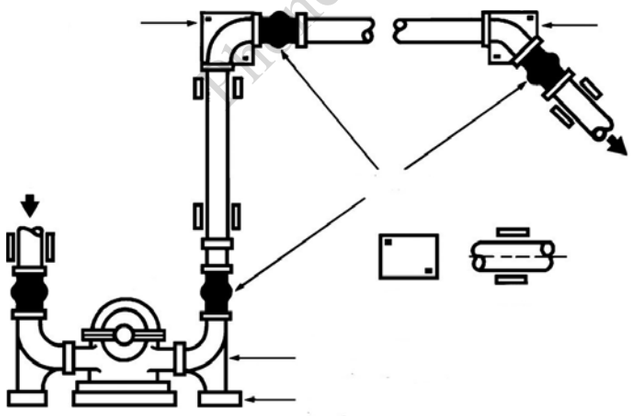
- On elastomeric joints only, not necessary with PTFE joints/couplings with threaded holes
- Set bolt heads adjacent to arch

Tighten bolts

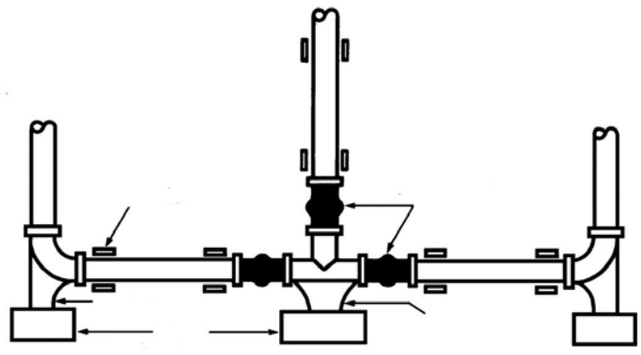
- Elastomeric joints only, tighten gradually and equally, alternating around flange
- Edges of joint must bulge slightly at flange O.D.

Check tightness

- Within one week after application, then periodically
- In hot or cold water systems during cyclical changes



Typical Piping Layout



Proper Use of Anchors in Branch Connections

Troubleshooting

General Precautions

Elastomeric Joints Only

- Use proper care breaking seal
- Drive flanges apart gently with wooden wedges
- Bring insulation only to pipe flange—do not insulate over or around joint
  - Covering joints may make leak detection difficult
  - Insulation could restrict joint movement or cause overheating
- Store in cool, dry, dark area
- Do not rest on flange edges
- Carefully protect joints near welding operations
- Never install spool-type joints next to flangeless check valves or butterfly valves
- Install only against full-face metal flanges or damage/leakage could result; restrictions also apply to raised face or any non-full face flange

Flange leakage

- Check bolt tightness
- Check mating flange surface area for:
  - Grooves
  - Scratches
  - Distorted areas
- Over-extension may indicate need for control units

Liquid weeping from bolt holes

- Check tube portion of joint for leaks; replace if necessary

Cracking at base of arch or flange

- Check installed face-to-face dimensions for over-extension or over-compression
- Check for proper pipe alignment: must not exceed 0.125" (3.2mm)

Excessive ballooning of arch

- Indicates distortion/deterioration of joint strengthening members, or excessive system pressure
- Re-evaluate service conditions
- Install new joint

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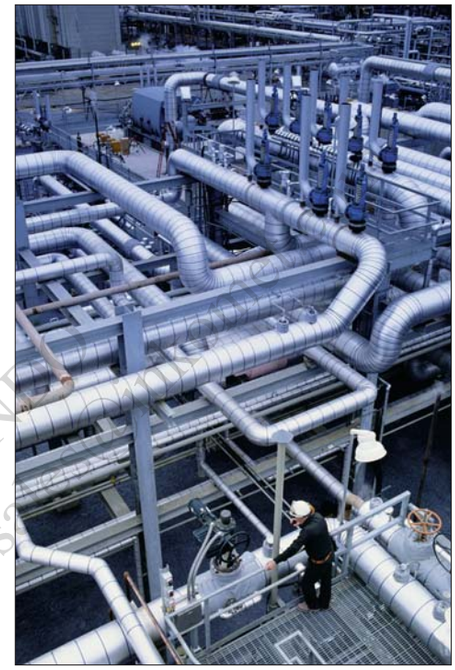
Expansion Joint Weights*

For Rubber Spool-Type Joints, and Styles 200 and 204

Joint Size (Inches)	Approx Lbs per Joint				Approx. Lbs / Set	
	Face to-Face Dimension				Retaining Rings	Control Units
	6 Inches	8 Inches	10 Inches	12 Inches		
2	3.5	4.0	—	—	3.5	5.5
2-1 /2	4.0	5.0	—	—	5.0	6.5
3	4.5	5.5	—	—	5.5	6.5
3-1/2	5.5	6.6	—	—	6.5	6.5
4	6.5	7.8	—	—	6.8	5.5
5	7.5	9.5	—	—	7.5	10.5
6	8.8	11.5	13.8	15.5	8.8	10.5
8	12.5	15.0	20.0	22.0	12.5	10.5
10	16.0	23.5	25.0	28.0	15.8	22
12	—	28.8	35.0	41.5	23.5	22
14	—	38.0	45.0	53.0	25.5	29
16	—	48.0	52.0	60.0	31.0	29
18	—	50.0	55.0	68.0	29.5	29
20	—	55.0	67.0	78.0	36.0	26
24	—	—	77.0	91.0	46.0	33
26	—	—	92.0	110.0	50.0	52
28	—	—	110.0	120.0	60.0	52
30	—	—	118.0	130.0	63.0	58
34	—	—	128.0	140.0	82.0	76
36	—	—	140.0	152.0	85.0	76
42	—	—	—	222.0	113.0	115
48	—	—	—	252.0	138.0	150
54	—	—	—	275.0	157.0	162
60	—	—	—	337.0	180.0	298
72	—	—	—	365.0	260.0	361
78	—	—	—	405.0	280.0	301
84	—	—	—	430.0	320.0	393



* For total approximate weights, add the weight of the expansion joint at the required face-to-face dimension to the weight of retaining rings and/or control units.

Example (Metrics):

A 100 mm joint (200 mm face-to-face) with retaining rings equals 3.5 Kg. + 3.1 Kg., or 6.6 Kg. A 350 joint (250 mm face-to-face) with retaining rings and control units equals 20.4 Kg. + 11.6 Kg. + 12.2 Kg., or 44.2 Kg.

To convert pounds to kilograms, divide by 2.205.

Note: For calculating weight of Style 206 EZ-FLO® expansion joint = Style 204 x 0.66.

For PTFE Couplings, with Flanges and Restricting Bolts

	Pipe Size (Inches)								
	1	1-1/2	2	2-1/2	3	4	5	6	8
Style 214	2 lbs.	4 lbs.	7 lbs.	10 lbs.	12 lbs.	18 lbs.	24 lbs.	29 lbs.	47 lbs.
Style 215	2 lbs.	4 lbs.	8 lbs.	11 lbs.	13 lbs.	19 lbs.	25 lbs.	30 lbs.	47 lbs.

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Application Data Form

For quotation or application recommendations, simply copy this page, fill it out entirely and mail or fax it to Garlock or to your local authorized distributor.

Date: _____

Name: _____ Company: _____

Phone No.:_____ Fax No.: _____

Pipe Size: _____ Control Units?: _____

Temperature: _____ Hydrostatic Testing?: _____

Pressure/Vacuum: _____ Replacement?: For What Style?: _____

Media: _____ Comments: _____

Movements - Compression: _____ _____

Elongation: _____ _____

Lateral: _____ _____

Face-to-Face Dimension: _____ _____

Drilling (if other than 125/150 lb.): _____ _____

Retaining Rings: _____ _____

Advancing the Science of Sealing™

Engineered Gasketing Products

Garlock
SEALING TECHNOLOGIES®

an EnPro Industries company

Garlock Gasketing

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Engineering Data

Garlock Gaskets®

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.

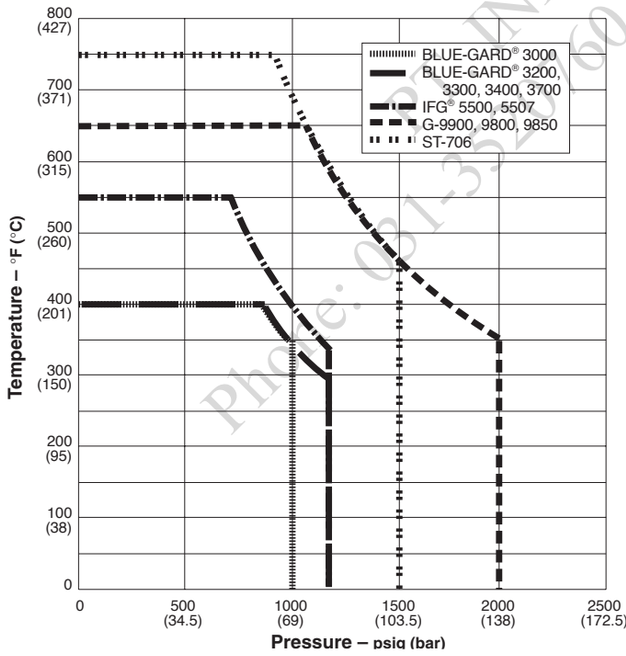
Let us help you choose the right product for your application.

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).

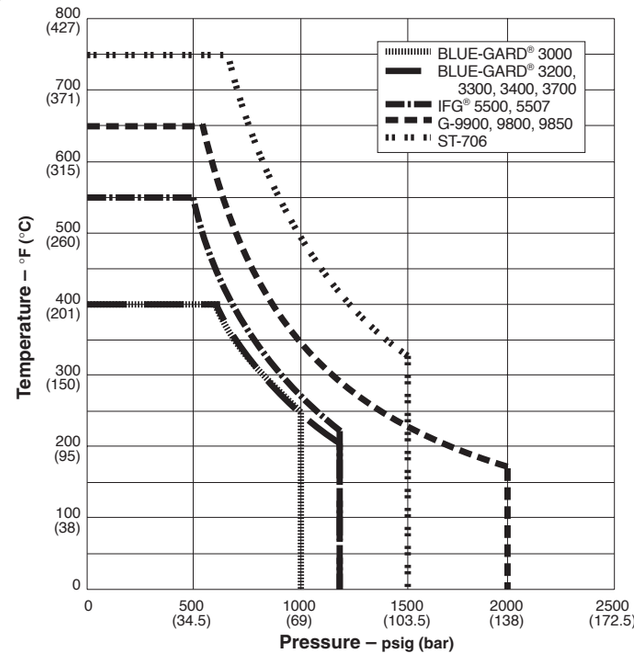
Today's environmental concerns demand positive seals. Garlock gaskets provide that assurance, and perform with proven reliability. Whether your industry is chemical processing, hydrocarbon processing, power generation, pulp and paper, microelectronics or transportation, Garlock gasketing products are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

Compressed Inorganic Fiber Gasketing

Typical Physical Properties*

		706	5500[4,5]	5507[4]
Color		White	Gray	Sand
Binder		Nitrile (NBR)	Nitrile (NBR)	EPDM
Temperature[1]	Maximum Minimum Continuous max.	+1,000°F (+540°C) -100°F (-75°C) +750°F (+400°C)	+800°F (+425°C) -100°F (-75°C) +550°F (+290°C)	+800°F (+425°C) -100°F (-75°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 @ 5 hours)				
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.

Notes:

1 Based on ANSI RF flanges at our preferred torque. When approaching maximum pressure, continuous operating temperature, minimum 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)

*** Values do not constitute specification limits**

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

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.

5 See also "Flanges, Stainless Steel" the Gasketing Terms section.

Style 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

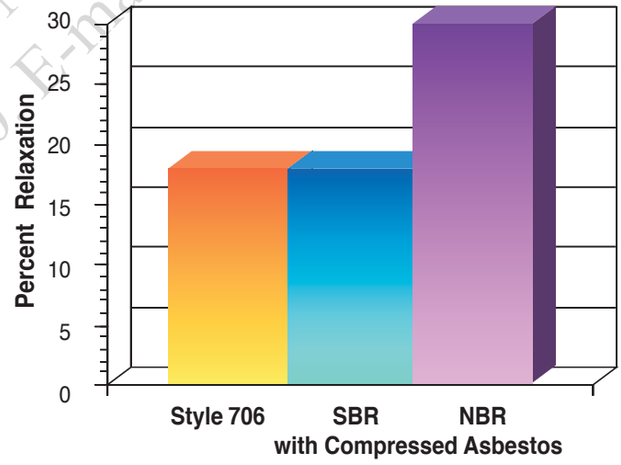
Patent #5,603,513

Flange Free™ ANTI-STICK

Media

Style 706:	Saturated and super heated steam†, oils, grease, water, and heat transfer fluids*
Style 5500:	Water, aliphatic hydrocarbons, oils, gasoline, saturated steam†, inert gases, most refrigerants
Style 5507:	Water, saturated steam†, mild chemicals and mild alkalies

ASTM F38 Typical Creep Relaxation



Styles 5500 and 5507

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)
- Style 5500 has passed the Garlock Fire Test and is ABS Fire Safe Type Approved.

* Contact Garlock Engineering with specific transfer fluid application.

† Above 150 psig, contact Engineering.

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

High Temp Compressed Graphite or Carbon Fiber Gasketing

Typical Physical Properties*

		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) -100°F (-75°C) +650°F (+340°C)	+900°F (+480°C) -100°F (-75°C) +650°F (+340°C)	+900°F (+480°C) -100°F (-75°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	ml/hr	0.1	0.1	0.1
Nitrogen	ml/hr	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 @ 5 hours)				
ASTM #1 Oil at +300°F (+150°C)				
Thickness increase	%	0-5	0-10	0-5
Weight increase	%	< 10	< 20	< 10
ASTM IRM #903 Oil at +300°F (+150°C)				
Thickness increase	%	0-10	15-40	0-10
Tensile loss	%	< 35	< 65	< 35
ASTM Fuel A at +70-85°F (+20-30°C)				
Thickness increase	%	0-5	0-10	0-5
Weight increase	%	< 7	< 20	< 7
ASTM Fuel B +70-85°F (+20-30°C)				
Thickness increase	%	0-10	5-20	0-10
Weight increase	%	< 15	< 20	< 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, continuous operating temperature, minimum 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 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[2]

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

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

Note: 1. For nuclear orders, specify Style G-9920.
2. Refer to Mil Spec section under "Gasketing Terms" for order/inquiry requirements

At the Garlock on-site fire test facility, valves and sealing materials have been tested for functionality in the most extreme applications. 9900, 9800, 9850, 706 and 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

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.

BLUE-GARD® Compressed Gasketing

Typical Physical Properties*

	3000	3200† / 3400[4]	3300[4]	3700[4]	2900 / 2950
Color	Blue	Off-white/ Grey-black	Black	Light grey	Black/ Green
Binder	Nitrile (NBR)	SBR	Neoprene (CR)	EPDM	Nitrile (NBR)
Temperature[1] Maximum	+700°F (+370°C)	+700°F (+370°C)	+700°F (+370°C)	700°F (+370°C)	+700°F (+370°C)
Minimum	-100°F (-75°C)	-100°F (-75°C)	-100°F (-75°C)	-100°F (-75°C)	-40°F (-40°C)
Continuous max.	+400°F (+205°C)	+400°F (+205°C)	+400°F (+205°C)	+400°F (+205°C)	+400°F (+205°C)
Pressure, max.[1] psig (bar)	1,000 (70)	1,200 (83)	1,200 (83)	1,200 (83)	1,000 (70)
P x T, max.[1] (psig x °F) 1/32", 1/16"	350,000	350,000	350,000	350,000	350,000
(bar x °C) (0.8mm, 1.6 mm)	(12,000)	(12,000)	(12,000)	(12,000)	(12,000)
1/8"	250,000	250,000	250,000	250,000	250,000
(3.2 mm)	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)
Sealability (ASTM F37B)[2]					
ASTM Fuel A ml/hr	0.2	0.1	0.2	0.1	0.25
Nitrogen ml/hr	0.6	0.4	1.0	0.7	1.00
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	25
Compressibility Range (ASTM F36) %	7-17	7-17	7-17	7-17	7-17
Recovery (ASTM F36) %	50	50	50	40	50
Tensile Strength across grain (ASTM F152) psi (N/mm²)	2,250 (15)	2,250 (15)	2,250 (15)	2,500 (17)	1,500 (10)
Fluid Resistance (ASTM F146 @ 5 hours)					
ASTM #1 Oil at +300°F (+150°C)					
Thickness increase %	0-5	0-10	0-5	20-35	0-5
Weight increase %	< 8	< 20	< 15	—	0-10
ASTM IRM #903 Oil at +300°F (+150°C)					
Thickness increase %	0-15	15-30	15-30	60-100	0-15
Tensile loss %	< 35	< 70	< 50	—	0-35
ASTM Fuel A at +70-85°F (+20-30°C)					
Thickness increase %	0-5	0-15	0-10	10-40	0-5
Weight increase %	< 8	< 25	< 20	—	0-10
ASTM Fuel B +70-85°F (+20-30°C)					
Thickness increase %	0-10	5-20	5-20	20-50	0-10
Weight increase %	< 15	< 30	< 20	—	0-20
Density 1/16" (1.6 mm) thick lbs/ft³ (g/cm³)	100 (1.60)	100 (1.60)	100 (1.60)	100 (1.60)	105 (1.68)

Notes:

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

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**

† Refer to Mil spec section under "Gasketing Terms" for order/inquiry requirements.

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

BLUE-GARD®
Styles 3000 to 3700

Benefits

Excellent sealability

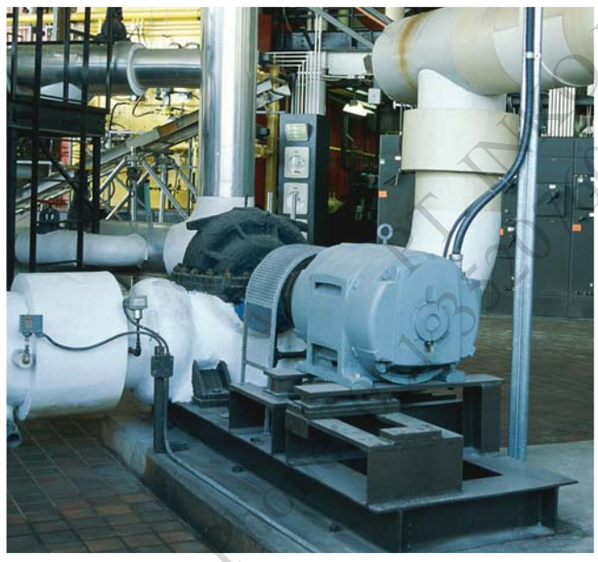
- Unique blend of aramid fibers, fillers and elastomeric binders provides improved torque retention and drastically lowered emissions levels

Versatile

- Variety of elastomers excel in a wide range of services

Cost savings

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



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

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[2], inert gases (Style 3200 meets MIL-G-24696)[1]
3300:	Water, saturated steam[2], refrigerants, oils, and fuels
3700:	Water, saturated steam[2], and mild chemicals
2900, 2950:	Water, aliphatic hydrocarbons, oils, and gasoline

Notes:

[1] Refer to Mil spec section under "Gasketing Terms" for order/inquiry requirements. To ensure receipt of product branded Mil-G-24696, certification will be required - fees associated based on quantity. Refer to Mil spec section under "Gasketing Terms" for order/inquiry requirements.

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

[2] Above 150 psig, contact Engineering.

BLUE-GARD®
Style 3000

MULTI-SWELL™ Style 3760

Benefits

Ultra-tight seal in water and oil applications

- Proprietary formulation creates additional gasket load when the gasket comes in contact with oil or water
- Twice as compressible as standard fiber gaskets - conforms to irregular surfaces

Versatile

- Stops leakage in:
  - Gear boxes
  - Compressors
  - Pumps
  - Lube oil systems
  - Access covers

Typical Physical Properties*

		3760
Color		Blue/off-white
Binder		Proprietary
Temperature[1]	Minimum Continuous max.	-100°F (-75°C) +400°F (+205°C)
Pressure, max.[1]	psig (bar)	500 (35)
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)	150,000 (5,100) 100,000 (3,400)
Sealability (ASTM F37B)[2]		
ASTM Fuel A	ml/hr	0.15
Nitrogen	ml/hr	0.20
Gas Permeability (DIN 3535 Part 4)[3]	cc/min.	–
Creep Relaxation (ASTM F38)	%	30
Compressibility Range (ASTM F36)	%	15-30
Recovery (ASTM F36)	%	40
Tensile Strength across grain (ASTM F152)	psi (N/mm^2)	1,000 (6.9)
Fluid Resistance (ASTM F146 @ 5 hours)		
ASTM #1 Oil at +300°F (+150°C)		
Thickness increase, Typ., %		≥15
Weight Increase, Typ., %		30
ASTM IRM #903 Oil at +300°F (+150°C)		
Thickness increase, Typ., %		75
Weight Increase, Typ., %		85
Dist. H_2O +70-85°F (20-30°C)		
Thickness increase, Typ., %		25
Density 1/32" (0.8 mm) thk	lbs/ft^3 (g/cm^3)	85 (1.36)

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.

LEAK-GARD™ Style 3750 is also available exclusively for oil-swell applications.

Notes:

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

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 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)

*** Values do not constitute specification limits**

Vegetable Fiber Gasketing

Typical Physical Properties*

		660	681
Material		Vegetable fiber with cork granules and glue-glycerin binder	Vegetable fiber with glue-glycerin binder
Temperature, max.		+212°F (+100°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	36
Thicknesses available	inches	0.010, 1/64, 0.021, 1/32, 3/64, 1/16, 3/32, 1/8, 3/16, 1/4	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	5
Weight increase	max. %	30	15
ASTM Fuel B			
Thickness increase	max. %	5	5
Weight increase	max. %	30	15
Distilled Water			
Thickness increase	max. %	30	30
Weight increase	max. %	100	90
Compressibility at 1,000 psi	Range %	40-55	25-40
Recovery	%	>40	>40
Tensile Strength, min.	psi (N/mm²)	1,000 (7)	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).

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Vegetable Fiber Tolerances on Thicknesses

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"		

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.")

Thermally Bonded GYLON®

Benefits

Effective seal
- Patented bonding 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, 3510, HP 3560, HP 3561, 3565, and 3594 can all be welded using this process

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
Temperature	-450ºF (-268ºC) to 500ºF (260ºC)	
Pressure	800 psig max.	

Notes:

[1] ASTM F37B Sealability, milliliters/hour (1/4" thick)
ASTM Fuel A (isooctane):
Gasket load: 3,000 psi (20.7 N/mm^2), 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/mm^2)

GYLON® Gasketing

Typical Physical Properties*

GYLON® Styles	3500	3504	3510	3522	3540	3545	
Color	Fawn GYLON®	Blue GYLON®	Off-white GYLON®	GYLON® Diaphragm	White GYLON®	White GYLON®	
Composition	PTFE with silica	PTFE with glass microspheres	PTFE with barium sulfate	PTFE	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)	
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, psig Cont. max.[1] (bar)	1,200 (83)	800 (55)	1,200 (83)	Consult Engineering	1,200 (83)	1,200 (83)	
P x T, max.[1] 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)	
psig x °F 1/8" (3.2 mm)	250,000	250,000	250,000		250,000	250,000	
(bar x °C)	(8,600)	(8,600)	(8,600)		(8,600)	(8,600)	
Sealability **ASTM Fuel A** ml/hr (ASTM F37B)[3]	0.22	0.12	0.04	—	0.25	0.15	
Gas Permeability cc/min. (DIN 3535 Part 4)[4]	< 0.015	< 0.015	< 0.015	—	< 0.015	< 0.015	
Creep Relaxation % (ASTM F38)	18	40	11	35	10	15	
Compressibility Range (ASTM F36) %	7-12	25-45	4-10	20-25	70-85	60-70	
Recovery % (ASTM F36)	>40	>30	>40	>50	>8	>15	
Tensile Strength psi (ASTM D1708) (N/mm^2)	2,000 (14)	2,000 (14)	2,000 (14)	5,000 (34)	—	—	
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, 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 3565, 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)

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, except Style 3565, based on 1/16" (1.6mm).

*** Values do not constitute specification limits**

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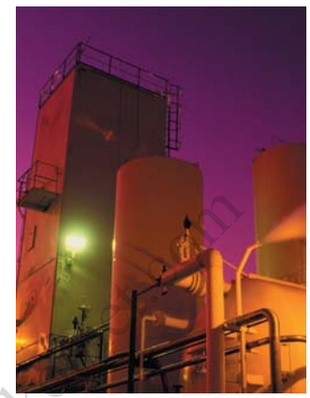
	HP 3560	HP 3561	3565	3594
	Fawn inserted GYLON®	Off-white inserted GYLON®	ENVELON® GYLON®	Green Gen2™ GYLON®
	GYLON® with perforated 316LSS insert	GYLON® with perforated 316LSS insert	PTFE with glass	PTFE with glass filler
	— — +500°F (+260°C)	— — +500°F (+260°C)	-450°F (-268°C) +500°F (+260°C)	-450°F (-268°C) +500°F (+260°C)
	2,500 (172)	2,500 (172)	1,200 (83)	800 (55)
	700,000 (25,000) 450,000 (15,000)	700,000 (25,000) 450,000 (15,000)	350,000 (12,000) 250,000 (8,600)	350,000 (12,000) 250,000 (8,600)
	0.2[2]	0.1[2]	0.33[2]	0.50
	< 0.015[2]	< 0.015[2]	< 0.015[2]	< 0.015
	20[2]	20[2]	35[2]	30
	4-9[2]	3-7[2]	35-50[2]	10-20
	>45[2]	>50[2]	>35[2]	>45
	5,000[2] (34)	5,000[2] (34)	1,800[2] (13)	2,000 (14)
	Will not support flame			
	Will not support			



Garlock Gaskets®

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

Test Data

Before

Compression at 2,000 psi (14 N/mm²) for 1 hour at 500°F (260°C)

After

◀ Note the uneven cold flow shown by conventional PTFE.

GYLON® Style 3545

Benefits

WINNER
Chemical Processing's
VAALER AWARD
1995

Tighter seal

- Highly compressible PTFE outer layers seal under low bolt load—suitable for many flat face and glass-lined 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

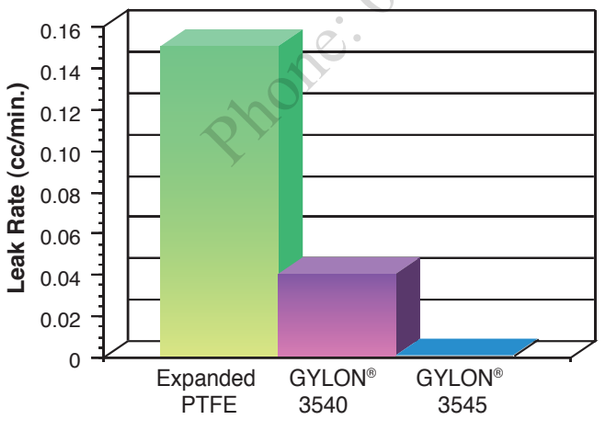
- Soft PTFE can be cut easily from larger sheets, reducing inventory costs and expensive downtime
- Rigid PTFE core facilitates installation, especially on large diameter flanges and hard-to-reach areas

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

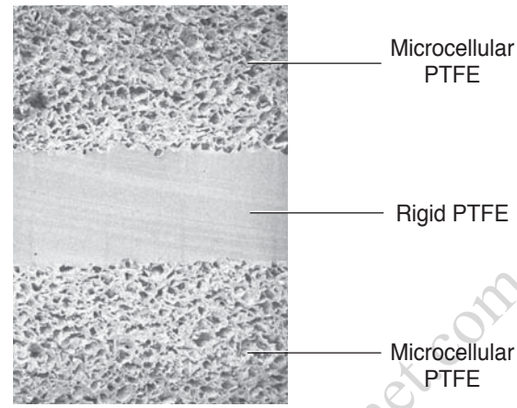
Test Results

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.

Configuration



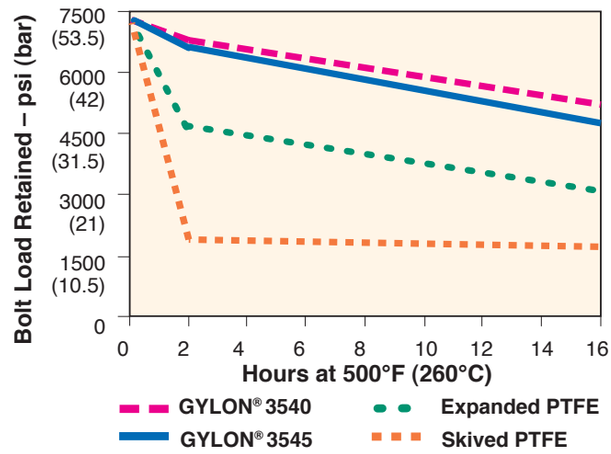
Cross-sectional view under electron microscope
All layers manufactured using proprietary GYLON® process—thermally fused layers, without the use of adhesives

Media

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

GYLON® 3545: Strong caustics, strong acids, hydrocarbons, chlorine and cryogenics and glass-lined equipment. Conforms to FDA regulations.

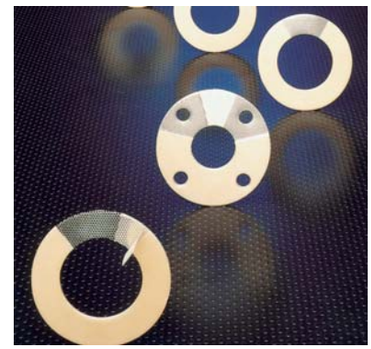
DIN 52913 Gasket Bolt Load vs. Time



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

* For flat face flanges, a minimum compressive stress of 1,500 psi (10.3 N/mm²) is recommended on the contacted gasket area for 150 psig (1.0 N/mm²) liquid service. Consult with the flange manufacturer to confirm that adequate compressive stress is available.

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
(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†

Style 370

STRESS SAVER® Style 370

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

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.	+300°F (+150°C)	+300°F (+150°C)	+400°F (+204°C)
	Min.	-40°F (-40°C)	-40°F (-40°C)	-15°F (-26°C)
Pressure, max	psig	250	250	250
	(bar)	(17)	(17)	(17)
P x T, max.	(psig x °F)	50,000	50,000	50,000
	(bar x °C)	(1717)	(1717)	(1717)

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

STRESS SAVER® Style 6800

Economical

- More economical gasket where a PTFE envelope is not required

STRESS SAVER® XP

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
- Certified to NSF 61 for drinking water

XP

FGG =BM= CZ™

SYSTEM COMPATIBLE

Media

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

Style 6800: Water, very mild acids and caustics

Style XP: Potable 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.

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

HOCHDRUCK® Style 3128 Gasketing

High-Performance Reinforced graphite gasket material with improved sealability characteristics

Benefits

- Easy and safe to handle without breakage
- Anti-scratch and anti-stick properties built in surface of gasket
- Seals much tighter than standard graphite gaskets
- Available with reduced sulfur (3128RS)
- Dove-tails seal tightly

Easy to install

- Can be cut with a utility knife
- Remains flat during installation

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GRAPH-LOCK® Typical Physical Properties*

	3124 / 3126	3123/3125	3125 SS	3125 TC	HOCHDRUCK® 3128
Description	316SS Wire Inserted	Homogeneous/ Laminated	0.002" 316SS Foil Inserted	0.004" 316SS Tang Inserted	Reinforced Graphite
Temperature[1], Minimum Max. in atmosphere Max. in steam **Pressure, max.**[1] psig (bar)	-400°F (-240°C) +850°F (+454°C) +1200°F (+650°C) 2,000 (140)	-400°F (-240°C) +850°F (+454°C) +1200°F (+650°C) 2,000 (140)	-400°F (-240°C) +850°F (+454°C) +1200°F (+650°C) 2,000 (140)	-400°F (-240°C) +850°F (+454°C) +1200°F (+650°C) 2,000 (140)	-400°F (-240°C) +850°F (+454°C) +1200°F (+650°C) 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	 1.5[3] 0.2	 0.2/0.3 0.5	 0.25 0.2	 0.3[3] 0.3	 0.2 0.1
Gas Permeability cc/min. (DIN 3535 Part 4)[4]	0.1	0.4	0.4	0.4	0.4
Creep Relaxation % (ASTM F38)	17	5/10	12	15	10
Compressibility % (ASTM F36)	40	40	35	35	30-40
Recovery (ASTM F36) %	>12	>15	>20	>20	20
Tensile Strength psi (ASTM F152) (N/mm^2)	3,300 (23)	600 (4)	4,500 (31)	3,500 (24)	4,500 (31)

Notes:

1 Based on ANSI RF flanges at our preferred torque. Maximum temperature of +1,000°F (+540°C) for GRAPH-LOCK® HT. 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.

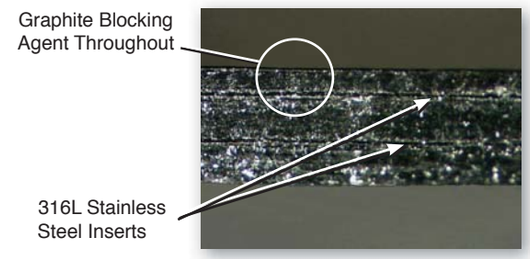
*** Values do not constitute specification limits**

HOCHDRUCK® Installation

Easy to Cut

Easy to Install

Easy to Seal



Dovetail Installation Instructions

After mating the matching dovetail sections together, wrap a length of either Garlock Smooth Finished or Garlock Diamond Textured Graphite tape (0.010" thick) around dovetail area. Width of graphite tape must be at least 1/2" greater than dovetail area. Wrap tape one full revolution around gasket in dovetail area. Be sure to overlap tape by approximately 1/2" and cut tape. DO NOT attempt to open or move tape at this point - it will damage the tape. With a smooth piece of metal that is greater in area than the dovetail area, softly tap with a hammer and blend the tape into the gasket. Place flanges together and follow normal installation procedures.

Premium Grade (ASTM) Rubber Gasketing

Typical Physical Properties

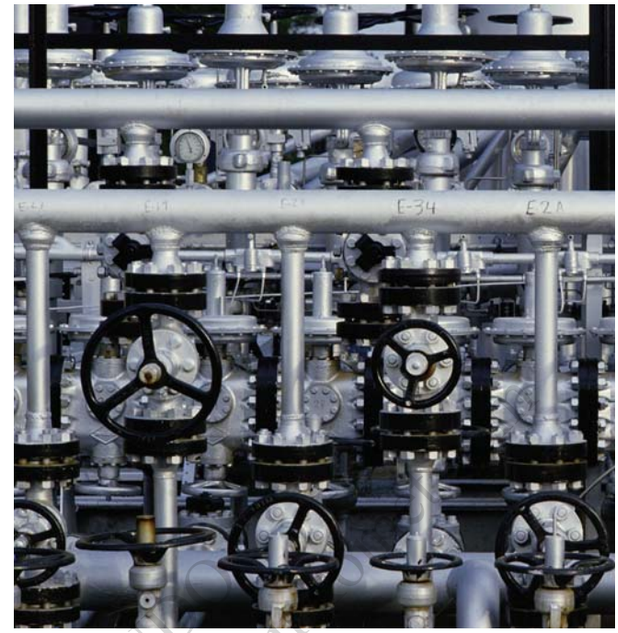
	Premium Grade								
Material	EPDM	Neoprene	Neoprene	Neoprene	Nitrile	SBR	Fluoro-elastomer (Type A)	Fluoro-elastomer (Type A)	Fluoro-elastomer Blend
Style	**8314**	**7986**	**7797**	**9064**	**9122**	**22**	**9518**	**9520**	**9780**
Color	Black	Black	Black	Off-White	Black	Red	Black	Black	Black
Hardness (ASTM D2240) (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., % (ASTM D412)	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 (ASTM D471) 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)
Preferred Oper Press.	150 (10)	150 (10)	150 (10)	150 (10)	150 (10)	150 (10)	150 (10)	150 (10)	150 (10)
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	2AA807A13Z1
7797	4BC815A14E014E034G21
7986	6BC620E014E034G21
8314	4AA610A13B13B33, BA610A14B13
9064	2BE620A14E014E034F17
9122	5BG620A14B14EA14E014E034
9518	2HK710B37Z1
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	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%

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Reinforced Rubber Gasketing & Diaphragms

Style 9200

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

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.	Reinforced Rubber		Diaphragm	
	19	9200	7992	8798
Material	SBR rubber with 5.0 oz. cotton sheeting with 1/32" thickness as fabric insert; 10.8 oz. cotton chafer in all others	Nitrile with proprietary 5oz nylon insert†	Neoprene with 22 oz. hose duck fabric insert	Neoprene with 13 oz. nylon fabric insert
Rubber hardness (Shore A) ±5	80	70	50	70
Burst test across 2" (50 mm) dia. opening, psi (bar)	Not recommended for use as diaphragm material	Not recommended for use as diaphragm material	290 (20) 1/8" – 1 ply	1,000 (70) 1/8" – 1 ply
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", 1/8": 1 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
Thickness available	1/32", 1/16", 3/32", 1/8", 3/16", 1/4"	1/16", 1/8"	1/16", 3/32", 1/8", 3/16", 1/4"	1/16", 3/32", 1/8", 3/16", 1/4"
Width available	48"	48"	48"	48"
Finish available	Thru 1/8": Cloth Over 1/8": Smooth	Thru 1/8": Cloth Over 1/8": Smooth	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)	250 (17)	NA	NA
Preferred Oper. Press.	150 (10)	150 (10)	NA	NA

† 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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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 clean out 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: 700°F (370°C);
   Continuous Operating Temp.: 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.

When approaching maximum pressure, continuous operating temperature, minimum temperature or 50% of maximum PxT, consult Garlock Applications Engineering.

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.

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	3560	3561	3535 3540 3545	3530	5500 9850 9900	9800	706	2900 2950 3000	2920 3200 3400	2930 3300	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[1]	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	B[1]	B[1]	B[1]	B[1]	B[1]	B[1]	B[1]
Acetic Anhydride	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	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	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, 150°F and below	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Air, 150°F - 300ºF	A	A	A	A	A	A	A	B	B	B	B	B	B	B
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
Ammonia Gas, Above 150°F	A	A	A	A	A	A	A	C	C	C	C	C	B	B
Ammonia 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
Ammonium Phosphate, Dibasic	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Ammonium Phosphate, 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
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

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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
Bio-diesel (B100)	A	A	A	A	A	A	A	A	A	A	A	A	–	–
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	B	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 Hyprochlorite)	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	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]
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

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Carbon Dioxide, Dry	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Carbon Dioxide, 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
Chlorinated Solvents, Wet	A	A	A	C	C	A	A	C	C	C	C	C	C	C
Chlorine, Dry	A	A	A	A	A	A	A	–	–	–	–	–	–	–
Chlorine, 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
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	B	C	C	B	C	B	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	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[13]	B[13]	A	A	A	A	A	B[13]	B[13]	B[13]	B[13]	B[13]	B[13]	B[13]
Diazomethane	A	A	A	A	A	A	A	–	–	–	–	–	–	–

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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	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
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
E85 (85% Ethanol, 15% Gas)	A	A	A	A	A	A	A	A	A	A	A	A	–	–
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	B	B	C
Ethanol, Ethyl Alcohol 10	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Ethers	A	A	A	A	A	A	A	B	C	B	B	C	B	B

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	GYLON®													
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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	B1
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	B4
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	–	–	–	–	–	A[14]	C	C	C	C	C	C	C	C
Fluorine, Liquid	–	–	–	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	B	B	C
Fuel Oil, Acid	A	A	A	A	A	A	A	A	B	A	A	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	B	B	C
Gasoline, Sour	A	A	A	A	A	A	A	A	C	A	A	B	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	B	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	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	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	B	B	C
Hydraulic Oil, Synthetic (Phosphate Esters)	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

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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, Anhydrous	C	C	C	C	C	A	A	C	C	C	C	C	C	C
HF Acid, Less than 65%, Above 150°F	C	C	A	C	C	A	A	C	C	C	C	C	C	C
HF Acid, 65% to Anhydrous,Above 150°F	C	C	–	C	C	A	A	C	C	C	C	C	C	C
HF Acid, Up to Anhydrous,150°F & below	C	C	A	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
Hydrogen Peroxide, 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	C	B	C
Isooctane	A	A	A	A	A	A	A	A	C	A	A	C	B	C
Isophorone	A	A	A	A	A	A	A	C	C	C	C	C	C	B
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	C	B	C
Kerosene	A	A	A	A	A	A	A	A	C	A	A	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
Lactic Acid, 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	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, Refined	A	A	A	A	A	A	A	A	B	A	A	B	B	C
Lubricating Oils, Mineral or Petroleum Types	A	A	A	A	A	A	A	A	B	A	A	B	B	C
Lubricating Oils, 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	A
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

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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	B	B	C
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	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	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
Nitric Acid, Above 30%	A	A	A	A	A	A	C	C	C	C	C	C	C	C
Nitric Acid, Crude	A	A	A	–	–	A	C	C	C	C	C	C	C	C
Nitric Acid, 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

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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	C	B	C
Oil, Petroleum	A	A	A	A	A	A	A	A	B	A	A	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
Ozone	See Note 7						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	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	B	B	C
Petroleum Oils, Refined	A	A	A	A	A	A	A	A	B	A	A	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
Phosphoric Acid, Less than 45%	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Phosphoric Acid, Above 45%, to 150°F	B	B	A	B	B	A	A	C	C	C	C	C	C	C
Phosphoric Acid, 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	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Picric Acid, 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

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Producer Gas	A	A	A	A	A	A	A	A	C	B	A	C	B	C
Propane	A	A	A	A	A	A	A	A	C	B	A	C	B	C
1,3-Propane Sultone	A	A	A	–	–	A	A	–	–	–	–	–	–	–
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	A	A	A
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													
R 10	A	A	A	B	B	A	A	C	C	C	C	C	C	C
R 11	A	A	A	A	A	A	A	A	C	B	A	C	C	C
R 12	A	A	A	A	A	A	A	A	A	B	A	A	A	A
R 13	A	A	A	A	A	A	A	A	A	B	A	A	A	A
R 13B1	A	A	A	A	A	A	A	A	A	B	A	A	A	A
R 21	A	A	A	A	A	A	A	C	C	C	C	C	A	C
R 22	A	A	A	A	A	A	A	B	B	B	B	B	A	A
R 23	A	A	A	A	A	A	A	C	A	C	C	A	A	A
R 31	A	A	A	A	A	A	A	C	A	C	C	A	A	A
R 32	A	A	A	A	A	A	A	A	A	B	A	A	A	A
R 112	A	A	A	A	A	A	A	A	C	B	A	C	A	C
R 113	A	A	A	A	A	A	A	A	A	B	A	A	A	C
R 114	A	A	A	A	A	A	A	A	A	B	A	A	A	A
R 114B2	A	A	A	A	A	A	A	A	C	B	A	C	A	C
R 115	A	A	A	A	A	A	A	A	A	B	A	A	A	A
R 123	A	A	A	A	A	A	A	C[3]	C	C[3]	C[3]	C	A[3]	C
R 124	A	A	A	A	A	A	A	C	A	C	C	A	A	A
R 125	A	A	A	A	A	A	A	–	A	–	–	A	A	A
R 134a	A	A	A	A	A	A	A	B	A	B	B	A	A	A
R 141b	A	A	A	A	A	A	A	A	–	B	A	–	A	–
R 142b	A	A	A	A	A	A	A	A	A	B	A	A	A	A
R 143a	A	A	A	A	A	A	A	–	A	–	–	A	A	A
R 152a	A	A	A	A	A	A	A	A	A	B	A	A	A	A
R 218	A	A	A	A	A	A	A	A	A	B	A	A	A	A
R 290 (Propane)	A	A	A	A	A	A	A	A	C	B	A	C	B	C
R 500	A	A	A	A	A	A	A	A	–	B	A	–	A	–
R 502	A	A	A	A	A	A	A	A	A	B	A	A	A	–
R 503	A	A	A	A	A	A	A	C	A	C	C	A	A	A
R 507	A	A	A	A	A	A	A	B	–	C	B	–	A	A
R 717 (Ammonia)	A	A	A	A	A	A	A	B	–	C	B	–	A	A
R 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
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	–

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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	A	B	A	C	B	B	B	B	B	B	B
Sodium Metaphosphate	A	A	A	A	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
Sodium Phosphate, Dibasic	B	B	A	B	A	A	A	B	B	B	B	B	B	B
Sodium Phosphate, Tribasic	C	B	A	C	A	A	A	C	C	C	C	C	C	C
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[12]	A	A	A	A	A	A	A	A[12]	A[12]	A[12]	B[9]	B[9]	B[9]	B[9]
Steam, 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	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
Sulfur Trioxide, Wet	A	A	A	B	B	A	B	C	C	C	C	C	C	C
Sulfuric Acid, 10%, 150°F and below	A	A	A	B	B	A	–	C	C	C	C	C	C	C
Sulfuric Acid, 10%, Above 150°F	A	A	A	C	C	A	–	–	C	–	–	C	C	C
Sulfuric Acid, 10-75%, 500°F and below	A	A	A	C	C	A	–	–	C	–	–	C	C	C
Sulfuric Acid, 75-98%, 150°F and below	A	A	B	C	C	A	C	C	C	C	C	C	C	C
Sulfuric Acid, 75-98%, 150°F to 500°F	A	B[17]	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

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Tannic Acid	A	A	A	–[8]	–[8]	A	A	A	A	A	A	A	A	A
Tar	A	A	A	A	A	A	A	C	A	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
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	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	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, 150ºF and below	A	A	A	A	A	A	A	B	–	–	B	–	A	A
Urea, above 150ºF	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

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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	–
Water, Acid Mine, 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
Water, Return Condensate	A	A	A	A	A	A	A	A	A	A	A	–	–	A
Water, Seawater	A	A	A	B	B	A	A	A	A	A	A	A	A	A
Water, 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:

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

>If fire resistant gaskets are required please consult Fire Tests under Gasket Terms, or contact Applications Engineering.

NOTES:

1. Consult the factory regarding your specific applications. See "Monomers" in Gasketing catalog Terms section.
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 60% 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. For saturated steam above 150psig, consult Garlock Engineering. Minimum recommended assembly stress = 4,800psi.

    Preferred assembly stress = 6,000-10,000psi.

    Gasket thickness of 1/16" strongly preferred.
13. Some detergent solutions are strongly alkaline and/or may contain bleach. Please contact Applications Engineering.
14. Gylon 3545 is suitable for up to 200°F wet or dry fluorine gas. Above this please consult Applications Engineering.
15. If lead chromate is also present please consult Applications Engineering.
16. If NSF 61 Approved gaskets are required, contact Applications Engineering.
17. GYLON® 3504 is acceptable for use in sulfuric acid (up to 99%) up to 250ºF. To optimize the performance of the assembly and minimize media permeation we highly recommend using the recommended installation instructions on page C-40 (with emphasis on the re-torque) and a minimum gasket stress of 4,800 psi.

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

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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"
706	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
5500/5507	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
9900	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
9800 / 9850	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
BLUE-GARD®	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
MULTI-SWELL™	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
LEAK-GARD™	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

GYLON® Gasketing

	30" x 30"	60" x 60"				70" x 70"			60" x 90"		40" x 40"	
	1/32"	1/16"	1/8"	3/16"	1/4"	1/16"	1/8"	1/4"	1/16"	1/8"	1/16"	1/8"
Style 3500	■	■	■	■	■	■	■		■	■		
Style 3504	■	■	■	■	■	■	■	■	■	■		
Style 3510	■	■	■	■	■	■	■		■	■		
Style 3530		■	■								■	■
Style 3540		■	■	■	■	■	■					
Style 3545		■	■	■	■	■	■					
Style 3565		■	■	■	■	■	■	■	■	■		

Flexible Graphite Gasketing

	24" x 24"			40" x 40"			59.4" x 60"		
	1/32"	1/16"	1/8"	1/32"	1/16"	1/8"	1/32"	1/16"	1/8"
Style 3123/3125	■	■	■	■	■	■	■	■	■
Style 3124/3126	■	■	■	■	■	■	■	■	■
Style 3125SS				■	■	■	■	■	■
Style 3125TC				■	■	■		■	■
Style 3128					■	■		■	■

Note: Tolerance is ±10% of thickness. This supercedes the limits in ASTM F104.

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

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

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"

* 1/64" GYLON® tolerance = ±0.005"
Vegetable Fibers only 1/64" and under = ±0.0035"

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"

Close tolerance sheet available upon request. Tolerance supercede the limits in ASTM F104.

"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)
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 (Wire-inserted)	1/16"	2.0	2,500
	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
3128	1/16"	3.0	2,000
	1/8"	3.6	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
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
5500	1/16"	6.6	2,600
	1/8"	6.6	3,300
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
9900	1/16"	4.5	4,100
	1/8"	6.0	4,100
STRESS SAVER® 370	1/8"	2.0	400
STRESS SAVER® XP	1/8"	0.5	100

Gasket Constants

* 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.

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
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
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	M9: Tensile Strength
3000	F712102A9B4E22L101M5	Typical: 0.2 ml/hr Max: 1.0 ml/hr	Typical: 0.6 ml/hr Max: 1.5 ml/hr	—	—
3200/3400[4]	F712902A9B4E45L102M9	Typical: 0.1 ml/hr Max: 1.0 ml/hr	Typical: 0.4 ml/hr Max: 1.0 ml/hr	—	2,250 psi min. (15 N/mm² min.)
3300	F712403A9B4E34L103M9	Typical: 0.2 ml/hr Max: 1.5 ml/hr	Typical: 1.0 ml/hr Max: 2.5 ml/hr	—	1,750 psi min. (12 N/mm² min.)
3700[4]	F712902A9B4E99L104M9	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%	2,250psi min (15 N/mm² min.)
3750	F712803B4E05L100M9	—	—	—	3056 psi min. (21 N/mm² min.)
3760[4,5]	F719996B6L100M3	—	—	—	—
5500	F712103A9B4E23L501M4	Typical: 0.2 ml/hr Max: 1.0 ml/hr	Typical: 0.5 ml/h Max: 1.5 ml/hr	—	—
5507	F71250A9B2E36L504M5	Typical: 0.1 ml/hr Max: 1.0 ml/hr	Typical: 0.5 ml/ Max: 1.5 ml/hr	—	—
9800	F712402A9B3E34L302M9	Typical: 0.1 ml/hr Max: 0.5 ml/hr	Typical: 0.1 ml/hr Max: 0.5 ml/hr	—	1,400 psi min. (9.7 N/mm² min.)
9850	F712202A9B3E22L301M9	Typical: 0.1 ml/hr Max: 0.5 ml/hr	Typical: 0.1 ml/hr Max: 0.5 ml/hr	—	1,600 psi min. (11 N/mm² min.)
9900	F712102A9B3E22L401M5	Typical: 0.1 ml/hr Max: 0.5 ml/hr	Typical: 0.1 ml/hr Max: 0.5 ml/hr	—	—
706	F712102A9B4E34L501M9	Typical: 0.5 ml/hr Max: 1.5 ml/hr	—	—	1,400 psi min. (9.7 N/mm² min.)

GYLON® Style[6]	ASTM Line Callout	A9: Leakage in Fuel A (Isooctane)[7]
3500	F452111A9B4E11M5	Typical: 0.22 ml/hr Max: 1.0 ml/hr
3504	F456111A9B7E11M6	Typical: 0.12 ml/hr Max: 1.0 ml/hr
3510	F451111A9B4E11M6	Typical: 0.04 ml/hr Max: 1.0 ml/hr
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]	F451111A9B2E11M6	Typical: 0.22 ml/hr Max: 1.0 ml/hr
HP 3561[8]	F451111A9B2E11M6	Typical: 0.04 ml/hr Max: 1.0 ml/hr
3565	F457111A9B6E11M6	Typical: 0.33 ml/hr Max: 1.0 ml/hr
3594	F453111A9B6E11M6	Typical: 0.50 ml/hr Max: 1.0 ml/hr

Style[1]	ASTM Line Callout
660	F328148M4
681	F326128M6

[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] % Increase in ASTM #903 Oil (fourth numeral 9 is thickness, fifth numeral 9 is weight): 3200/3400- Thickness: 25-50%; 3700- Thickness: 60-100%; and 3760- Thickness: 75%, Weight: 85%.

[5] Third numeral 9: F36 Compressibility: 3760: 15-30%, 3540: 70-85%, and 3545: 60-70%.

[6] For Styles 3500 thru 3545, thickness is 1/32"; for Styles 3560 and 3561, thickness is 1/16".

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

[8] F868 Line callout = OFMF9: 9 = Perforated stainless steel.

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 over torquing. 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

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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.

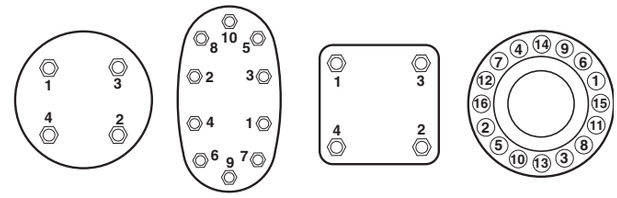
Operating Pressure in psig (bar)	Minimum Assembly Stress Recommended psi (N/mm^2)		
	1/32" (0.8 mm) Thick	1/16" (1.6 mm) Thick	1/8" (3.2 mm) Thick
Up to 300 (21)	2,500 (17)	3,600 (25)	4,800 (33)
Up to 800 (55)	4,800 (33)	5,400 (37)	6,400 (44)
Up to 2,000 (140)	7,400 (51)	8,400 (58)	9,400 (65)

Maximum recommended compressive stress for:
- Compressed fiber and GYLON® gaskets = 15,000 psi
- Multi-Swell™ Style 3760 = 10,000 psi
- GRAPH-LOCK® gaskets = 10,000 psi

Recommended compressive stress for:
- STRESS SAVER® gaskets = 600 - 1,200 psi
- Rubber gaskets to 60 duro = 600 - 900 psi
- Rubber gaskets to 70 duro and higher = 600 - 1,200 psi

* Maximum stresses assume standard ASME serrated flanges at 125-250 micro-inch flange finish.

Correct Bolting Patterns



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

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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.

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

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		15,000 psi		30,000 psi	
				Torque (ft. lbs.)	Clamping Force (lbs./bolt)	Torque (ft. lbs.)	Clamping Force (lbs./bolt)	Torque (ft. lbs.)	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		45,000 psi		60,000 psi	
				Torque (ft. lbs.)	Clamping Force (lbs./bolt)	Torque (ft. lbs.)	Clamping Force (lbs./bolt)	Torque (ft. lbs.)	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 30,000 psi Bolt Torque (ft. lbs.)	Bolt Stress 30,000 psi Gasket Stress (psi)	Bolt Stress 60,000 psi Bolt Torque (ft. lbs.)	Bolt Stress 60,000 psi Gasket Stress (psi)	Bolt Stress 75,000 psi Bolt Torque (ft. lbs.)	Bolt Stress 75,000 psi Gasket Stress (psi)	Minimum Recommended Assembly Stress 1/32" Thick (psi)	Minimum Recommended Assembly Stress 1/16" Thick (psi)	Minimum Recommended Assembly Stress 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:

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WARNING:

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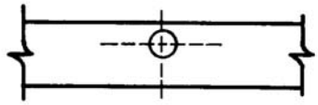
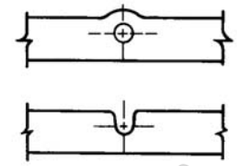
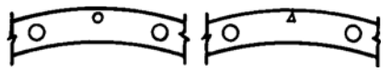
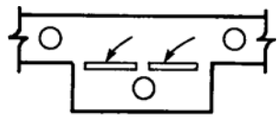
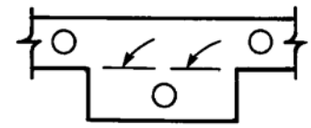
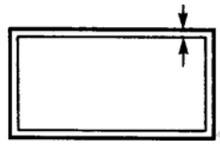
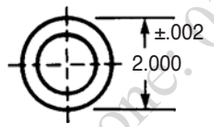
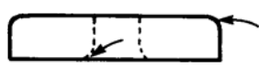
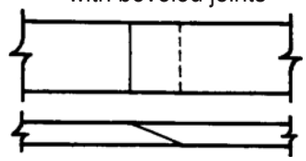
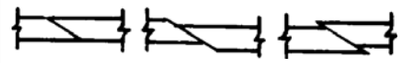
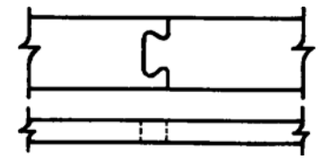
Gasket Design Tips

Problem	Result	Suggested Solutions
Bolt holes close to edge 	Causes breakage in stripping and assembling	Projection or "ear" 
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

3A
GYLON® Style 3522 is 3A compliant. For documentation, please contact Garlock Applications Engineering.

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

- 706
- BLUE-GARD® 3000, 3200
- GRAPH-LOCK® 3125SS, 3125TC
- GYLON® 3500, 3504, 3510
- 5500*
- 8459**
- 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.

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 -100°F (-75°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.

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

** Non-stocked item.

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.

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®), 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 9900, 9800, 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. Styles 3000, 98206 and Stress Saver XP are the preferred choices in water service in stainless steel flanges, due to their very low leachable chlorides. Consult Garlock Engineering when considering other styles. See Stress Saver XP, catalog page 16.

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.

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Full Face Gaskets
See Flanges.

Gasket Constants
The ASME and ASTM committees are 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 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.

Military Specifications
Garlock has two gasketing products that meet Navy specifications. Garlock Style 3200 is specified for Mil G-24696 and Style 9900 is specified for STR-508. Ordinarily the products are certified prior to sale to the Navy.

Due to the variation of the certification and specification requirements, a manual review must be performed on each inquiry or order to verify certification and specification demands and to insure the order is processed to meet the needs of the requestor. Certification and specification charges will vary with the number of sheets due to the number of batches required to complete the order.

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 Appli-cations Engineering does have compression vs. load curves which can be inverted to calculate a rough esti-mate 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.

NSP 61 for Drinking Water

See Stress Saver XP, catalog page 16.

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. GRAPH-LOCK® Styles 3123 (1/16" thick max) and 3128 HOCH-DRUCK® are also acceptable.

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 con-centration 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.

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

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 x 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
Values available from Applications Engineering.

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.

USP (United States Pharmacopeia)
GYLON® Style 3500, 3504 and 3522 are USP Class VI approved. For documentation, please contact Garlock Applications Engineering.

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.

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
F607	Test Method for Adhesion of Gasket Materials to Metal Surfaces

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

* DIN: Deutsches Institut für Normung e.V.

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.

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 System

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.

Test Equipment

Quick Reference Selection Guide

Fourier Transform Infrared Spectrometer (FTIR)

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.

Imaging System

System consists of a Polarized Light Microscope (PLM), Stereo Microscope, Marcro Stand, Digital Camera and Image Analysis Software. The System is useful in many areas including investigating new materials, analysis of competitive products and in failure analysis.

The state of polarization of a light beam is generally modified when it is reflected or transmitted through a material. That phenomenon allows PLM to be useful in material identification and characterization, especially fibers and fillers. Magnification in excess of 400X is possible.

The Stereo Microscope provides 3D images with a maximum magnification of approximately 100X.

The Digital Camera / Image Analysis Software permits for achieving, manipulation and measurement of the images of interest.

Stereo microscope or Dissecting microscope: Stereoscopic (3D) vision is possible by the combined action of two eyes. This requires an independent optical system for each eye (similar to how binoculars work). A stereo microscope features two tubes with independent optical systems with two eyepieces and two objectives. Which means that a stereo microscope is in fact, a combination of two compound monocular microscopes whose optical axes are at a right angle to each other and directed to the same specimen area.

Stereo microscopes are used for viewing natural specimens such as minerals, insects, plant parts; they are also used for technical applications such as illuminating coins, textiles, and electronic components. Because of its long working distance, dissection and precision assembly are possible under the stereo microscope.

A stereo microscope uses two different paths of light. This allows you to see a specimen in 3-D. Stereo microscopes have high depth perception but low resolution and magnification. These microscopes are great for dissecting as well as for viewing fossils and insect specimens. The best models have a built-in light source and zoom capabilities.

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 x 10^{-11} standard cc/ second

Garlock Gaskets®

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

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

Bolts

Grade _____
Diameter _____
Length _____
Number _____

Chemical Compatibility

Media _____
pH _____
Concentration _____
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

Advancing the Science of Sealing™

Garlock Metallic Gasket Catalog

Garlock
SEALING TECHNOLOGIES®

an EnPro Industries company

Garlock Metallic Gaskets

Garlock Metallic Gaskets, a division of Garlock Sealing Technologies, manufactures spiral wound, metal clad, solid metal and metal core gaskets at its facility in Houston, Texas. This facility is registered to ISO-9001.

In recent years, Garlock Metallic Gaskets has introduced some of the industry's most innovative production methods and products. For example, the CONTROLLED DENSITY™ process for spiral wound gaskets ensures a high tightness level at a lower bolt stress. The TANDEM SEAL™ combines chemical resistance and fire safety in a single gasket. The Garlock EDGE® gasket seals at lower bolt stress while virtually eliminating the problem of inward buckling. Garlock Metallic Gaskets is also known for excellence in material and product quality as well as its outstanding customer service.

This catalog is provided for customer information and convenience. However, Garlock Metallic Gaskets applications engineers and customer service personnel are also on hand to assist you with your application requirements and technical questions. Please give us a call at 1-888-GARLOCK. We are here to serve you.

Contents

Gasket Selection

Sprial Wound Gaskets

One of the best all-around seals, the spiral wound gasket offers a low-cost solution that has the ability to handle temperature and pressure fluctuations. Multiple plies of metal and filler in the spiral create a barrier that reduces the possibility of leaks.

Other Metal Gaskets

Garlock manufactures a wide variety of double-jacketed, spiral-wound, metal-clad and solid metal gaskets for heat exchanger and coker applications. GRAPHONIC® and Kammprofile gaskets are also available in heat exchanger configurations.

Temperature and Chemical Considerations

Be certain that the gasket you order is as resistant as possible to the media and temperature involved. Check the chemical compatibility of the metal as well as the filler material for the media to be sealed. As a general rule, the metal used in either the spiral winding or double-jacketed gasket should be similar to the flange material.

The compressibility of flexible graphite makes it an excellent filler material for metallic gaskets. Flexible graphite may be used in services with temperatures up to 850°F (450°C), though it should not be used with strong oxidizers such as nitric or sulfuric acid.

PTFE filler material provides excellent chemical resistance at temperatures below 500°F (260°C). In accordance with ASME B16.20, an inner ring is required when using conventional PTFE filler materials, in order to protect the winding from radial buckling.

See page D-19 for the temperature limits of common metals and filler materials.

Operating Pressure

Operating pressures have a direct effect on the construction and selection of metallic gaskets. Higher pressures raise the potential for gasket blowout, while lower pressure applications require a gasket design that seals under lower bolt loads.

Garlock gaskets suitable for high pressure include:

- Kammprofile gaskets
- Spiral wound gaskets with inner ring
- Solid metal gaskets

Low pressure gaskets include:

- GRAPHONIC® gaskets
- Garlock Kammprofile gaskets
- The Garlock EDGE® gasket

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Spiral Wound Gaskets

Manufactured in Accordance with ASME B16.20

Spiral wound gaskets—made with an alternating combination of formed metal wire and soft filler materials—form a very effective seal when compressed between two flanges. A v-shaped crown centered in the metal strip acts as a spring, giving gaskets greater resiliency under varying conditions. Filler and wire material can be changed to accommodate different chemical compatibility requirements. Fire safety can be assured by choosing flexible graphite as the filler material. If the load available to compress a gasket is limited, gasket construction and dimensions can be altered to provide an effective seal.

A spiral wound gasket may include a centering ring, an inner ring or both. The outer centering ring centers the gasket within the flange and acts as a compression limiter, while the inner ring provides additional radial strength. The inner ring also reduces flange erosion and protects the sealing element.

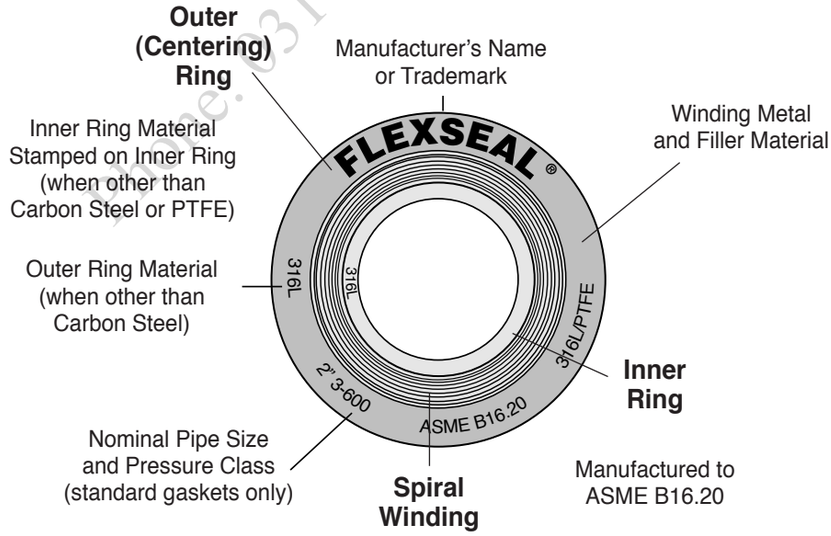
Resiliency and strength make spiral wound gaskets an ideal choice under a variety of conditions and applications. Widely used throughout refineries and chemical processing plants, spiral wound gaskets are also effective for power generation, pulp and paper, aerospace, and a variety of valve and specialty applications.

As set forth in ASME B16.20, all PTFE filled spiral wound gaskets will be supplied with inner rings. In addition, the following higher pressure class spirals will be supplied with inner rings for all filler material:

- NPS 24 and larger 900#
- NPS 12 and larger 1500#
- NPS 4 and larger 2500#

Starting in May 2008, the metricated edition of this standard recommends the use of inner rings for all graphite filled spiral wound gaskets. However, these gaskets may be specified without inner rings by the purchaser. Both styles will still be stamped ASME B16.20 compliant on the outer guide ring.

Gasket Identification Markings Required by ASME B16.20



Performance Metrics

Controlled Density™ Process

- Garlock manufacturing process ensures optimum filler density across the gasket winding to achieve consistent compression and superior sealability
- High tightness level achieved with minimal compressive load, for longer-lasting seal
- All SW gaskets manufactured in accordance with the guidelines set forth in the ASME B16.20 specifications

ROTT Test and Results

ROTT Test

- **Purpose:** Determine room temperature sealing capabilities, by measuring the sealability of a gasket at incremental gasket stress values
- **Sample used:** Two 304 SS and flexible graphite-filled 4" Class 150 ASME B16.20 spiral wound gaskets
- **Procedure:** The leak rate is measured during the loading and unloading cycles, and a tightness curve is generated.*

Test Results

- When compared with other spiral wound gaskets, the Garlock metallic gasket was able to achieve equivalent tightness at a lower load in all tightness parameter values.
- During stress cycling, the performance of the Garlock metallic gasket gaskets was excellent, compared with other spiral wound gaskets.

Gasket Style and Material	Gasket Factor "M"	Gasket Factor "Y" (psi)
Traditional spiral wound gasket—304 SS and flexible graphite	3.00	10,000
Garlock spiral wound gasket	3.00	7,500

Gasket Material	Gasket Constant Gb (psi)	Gasket Constant 'a'	Gasket Constant Gs (psi)	Stress Req'd for Tightness of 100 (psi)	Stress Req'd for Tightness of 1000 (psi)	Stress Req'd for Tightness of 10,000 (psi)
Garlock flexible graphite-filled spiral wound gasket (ASME B16.20)	627	0.35	6.22	3,140	7,040	11,430
Flexible graphite spiral wound gasket	2,300	0.237	13	6,851	11,823	20,405
PTFE-filled spiral wound gasket	4,500	0.14	70	8,575	11,836	16,339
Foil-reinforced flexible graphite sheet	816	0.377	0.066	4,631	11,033	26,284
Garlock GRAPHONIC® gasket	315	0.36	1.857	1,653	3,787	8,676
"Low stress" spiral wound type gasket, flexible graphite filled	598	0.385	0.03	3,520	8,540	14,570
Garlock Kammprofile gasket	368	0.4	0.28	2,324	5,838	14,664

Comparison of Seating Requirements

* 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.

The Garlock EDGE®

Benefits

Requires lower seating stress

- Seals at lower stress than conventional gaskets without an inner ring
- Eliminates flange damage caused by overtightening
- Relief ports allow tighter seal at lower loads

Eliminates radial buckling

- STABL-LOCK™ inner wrap construction prevents sealing element from flowing into and contaminating process stream

Tightest seal

- Modified guide ring ensures contact centered on raised face flange surfaces*

Multiple applications

- Available in a dual flange (DF) design to accommodate both 150 and 300 lb flanges—reduces inventory costs
- Select from a wide variety of metallic and filler materials with a full range of temperature capabilities**
- Also available in HEAT SHIELD™ configuration for high temp services above 850°F.

Seals with lower bolt loads

- Relief tab design provides solid seating of centering ring face
- Withstands bolt load loss caused by thermal cycling
- Inner wrap construction eliminates radial buckling
- Prevents catastrophic failure and potential damage to downstream equipment due to wire unraveling

* Contact Garlock Engineering when using the EDGE® gasket on lap joint flanges with substandard backing rings.

** See chart on page D-19.

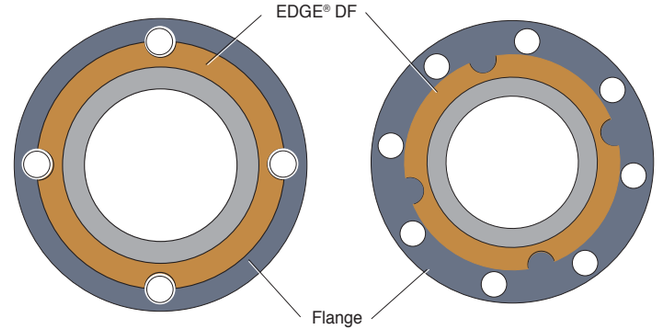
Compare

Standard spiral wound gasket shows excessive inward buckling

The patented Garlock EDGE® spiral wound gasket is designed to reduce inward buckling

Gasket Style and Material	"M"	"Y" (psi)	Gb (psi)	"a"	Gs (psi)
Garlock EDGE® with 304 stainless and flexible graphite filler	2.00	5,000	793	0.4	0.31

Dual Flange (DF) Design



150 lb. **300 lb.**

HEAT SHIELD™ Gasket

Benefits

Outstanding fire resistance

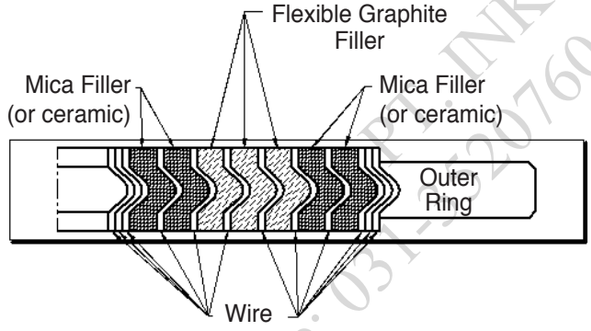
- Combination of graphite filler and mica layers give superior fire safety

Ideal for oxidizing environments

- Layers of pure mica protect graphite filler and resist oxidation
- Good choice for plant steam drums, hydrocarbon catcrackers, hydrogen units, and exhaust manifolds

Construction

- Heat-resistant graphite filler
- Heat- and oxidation-resistant pure mica filler
- Spiral-wound wires, available in most commercially available metals
- Rings of any standard metal, including INCONEL* X750



Also available in Kammprofile and EDGE® design

* INCONEL is a registered trademark of Inco Alloys International, Inc.

Specifications

Temperature, max.:	1250°F (677°C)
Flange class:	150 to 600 lb.
Pipe diameters:	2" to 24"; specials available

Gasket Style and Material	Gasket Factor "M"	Gasket Factor "Y" (psi)
Traditional spiral wound gasket—304 SS and flexible graphite	3.00	10,000
Garlock spiral wound gasket	3.00	7,500

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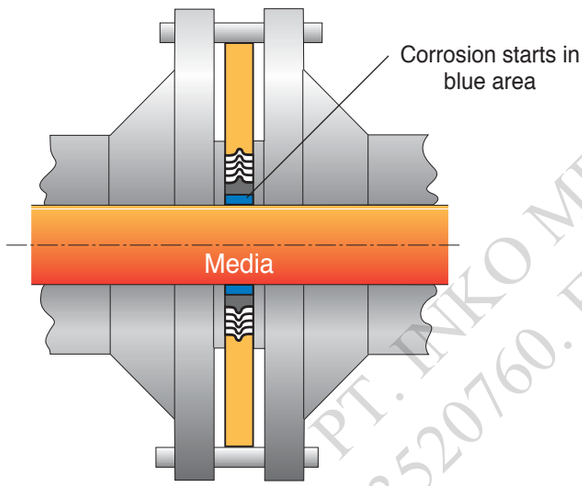
TANDEM SEAL™*

Benefits

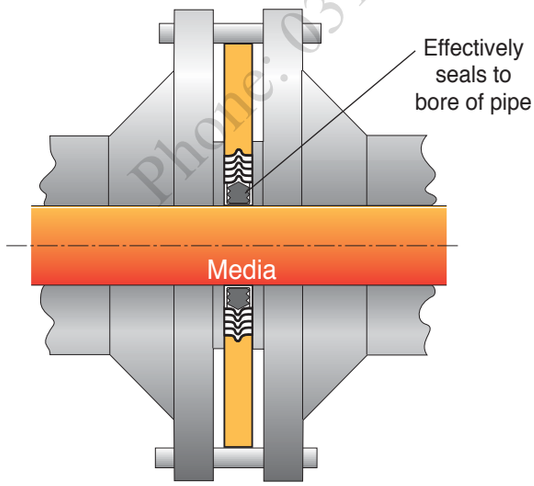
Chemical-resistant and fire-safe

- PTFE envelope withstands aggressive chemicals and corrosive media
- Fire-safe—passed independent fire tests
- Two sealing elements significantly reduce corrosion and bacterial contamination of flanges
- Seals to the ID of the pipe bore
- Specify pipe schedule when ordering

Seal Comparison

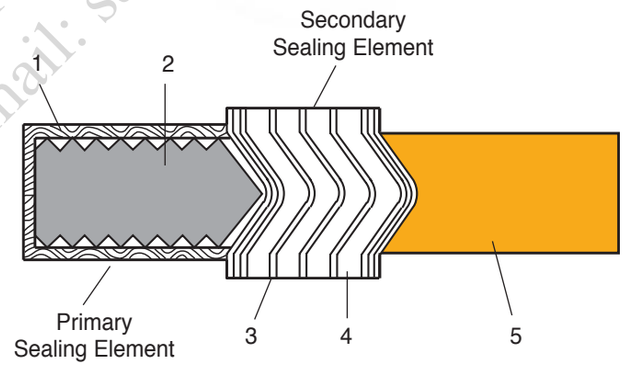


Traditional Design



TANDEM SEAL™ Design

Standard Construction



1. PTFE envelope
2. Profiled inner ring
3. Metal windings
4. Filler material
5. Outer guide ring

* Patent No. 5511797

FLEXSEAL® RW, RWI and SW Gaskets

Advantages

- Durable; easy installation and removal
- Seals pressures to flange ratings, in accordance with ASME B16.5
- Suitable for temperatures from cryogenic to 2,000°F (1,093°C)*
- Guide ring simplifies centering of sealing element on the flange face
- Designed solutions accommodate a variety of conditions by combining various metals and filler materials

Style RW

- General purpose gasket suitable for flat face and raised face flanges up to Class 2500**
- Centering ring accurately locates the gasket on the flange face, provides additional radial strength, and acts as a compression limiter
- Spiral winding (sealing element) consists of preformed metal and soft filler material

Style RWI

- Suitable for flat face and raised face flanges up to Class 2500**
- Recommended for higher pressure applications, for use with PTFE fillers, and when mandated by ASME B16.20 as follows: NPS 24 and larger in Class 900, NPS 12 and larger in Class 1500, and NPS 4 and larger in Class 2500.
- Inner ring acts as compression limiter and protects sealing elements from process media attack

Style SW

- Suitable for tongue and groove, male-female, or groove-to-flat face flanges†
- Spiral winding only, containing preformed metal and soft filler material
- Also available with inner rings—Style SWI

* Consult Garlock Engineering for material recommendations above 850°F (450°C)

** Depending on gasket size, an inner ring is recommended for applications above Class 600, due to the high available bolt load. See also Note 1, page D-22.

† This design does not have a compression limiter.

Ordering Information

RW / RWI

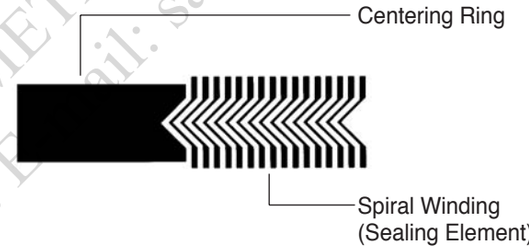
When ordering specify:

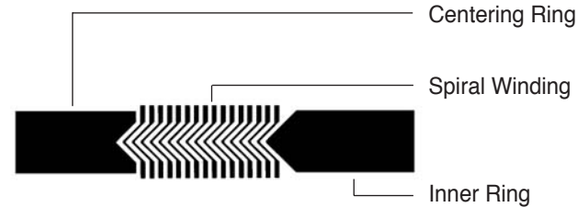
- Nominal pipe size or specific gasket dimensions
- Winding and filler materials
- Centering and/or inner compression ring material
- Pressure rating

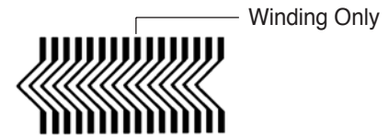
SW

When ordering, specify:

- O.D. and I.D. dimensions (and tolerance, if other than standard—see page D-19)
- Thickness of gasket
- Winding and filler material
- Inner ring material, if required (Style SWI)
- Pressure rating







Note: For M & Y factors, see page D-33.
For ROTT Test results, see page D-4.

FLEXSEAL®
MC and MCR Gaskets

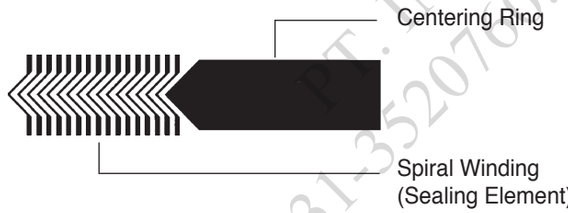
For Manhole Cover Assemblies

MC Gasket (manhole cover)

- Spiral winding only, containing preformed metal and soft filler material

MCR Gasket (manhole cover with centering ring)

- Centering ring accurately locates the gasket on the flange face, provides additional radial strength, and acts as a compression limiter
- Spiral winding (sealing element) consists of pre-formed metal and soft filler material

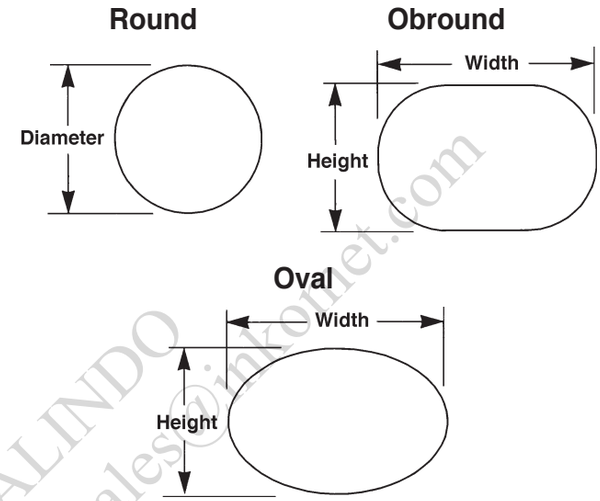


Ordering Information

When ordering, specify:

- Make and model of boiler and/or equipment if available (See chart page D-10)
- Gasket style and configuration
- Dimensions of gasket (thickness, flange seating width, and shape)
- Maximum operating pressure and temperature
- Type of metal and filler materials

MC and MCR Configurations



Style	Nominal I.D. Dimensions (Inches)	Thickness (Inches)	Flange Width (Inches)
MC Oval	11 x 15	0.175	3/4
MC Oval	11 x 15	0.175	15/16
MC Oval	11 x 15	0.175	1-1/4
MC Oval	12 x 16	0.250	15/16
MCR Oval	12 x 16	0.250	13/16
MC Oval	12 x 16	0.175	3/4
MC Oval	12 x 16	0.175	15/16
MC Oval	12 x 16	0.175	1-1/4
MC Oval	12 x 16	0.250	1-1/4
MC Round	16-1/16	0.175	3/4

Dimensions of MC and MCR Gaskets

Notes:

1. For pitted and rough flange surfaces, specify a gasket thickness of 0.250".
2. Orders for special cover assemblies should be accompanied by a dimensional drawing showing the minimum width of seating surfaces and other essential dimensions.
3. Style MC oval and obround gaskets are available in 0.175" and 0.250" thickness and in varying widths as shown above.
4. Orders for non-standard gaskets should also include a sketch or drawing of the cover assembly with all dimensions shown.

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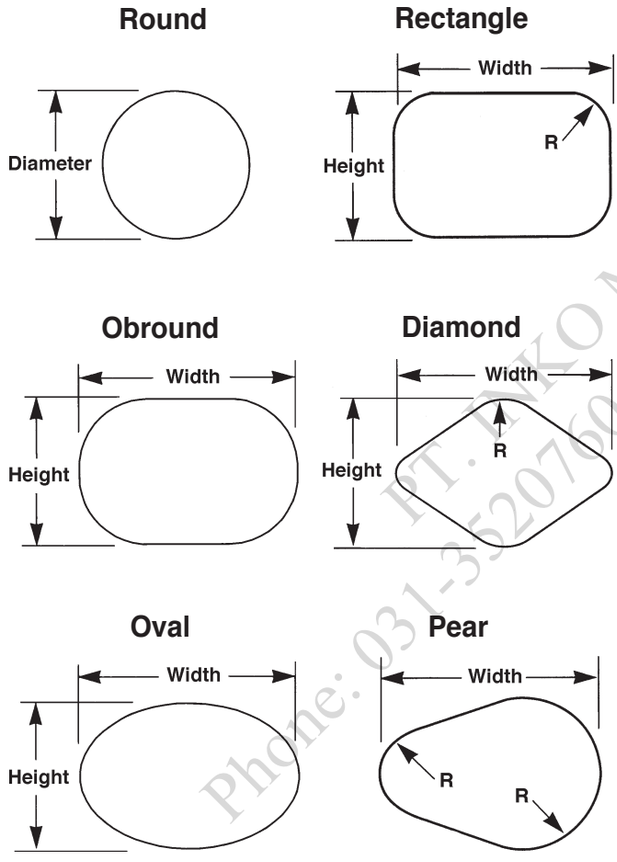
FLEXSEAL® HH Gaskets

For Boiler Handhole and Tubecap Assemblies

- Fits most standard boilers (specify maximum operating pressure when ordering)
- Available in thicknesses of 0.125" (special), 0.175" (standard) and 0.250" (special—for pitted surfaces)

Style HH Configurations



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Boiler Gasket Dimensions

Manufacturer and Model No.	Shape	Nominal I.D. Dimensions (Inches)	Flange Width (Inches)
Babcock and Wilcox			
#40 (207)	Diamond	3-3/8 x 3-3/4	3/16
#48 (208)	Oval	3-13/16 x 4-3/4	7/32
#24 (211)	Oval	4-1/2 x 5-1/2	7/32
#47	Round	2-1/32	3/16
#70	Round	3-9/32	3/16
#28 (212)	Rectangle	4-13/16 x 5	7/32
Badenhausen (See Riley Stoker)			
Cleaver-Brooks	Obround	3-9/32 x 4-17/32	3/8
Combustion Engr.			
29N-L839	Diamond	3-3/8 x 4-1/4	1/4
4N-L740	Round	3-1/8	1/4
5N-L902	Round	3-5/8	1/4
Foster Wheeler			
2 3/4 (1003)	Obround	2-25/32 x 3-13/32	7/32
3 15/16 (1005)	Oval	4-3/16 x 5-3/16	5/16
Heine	Round	3-5/8	3/8
Keeler	Obround	3 x 4	3/8
Oilfield	Oval	3 x 4	3/8
	Oval	3-1/2 x 4-1/2	3/8
Riley Stoker W-C2	Obround	3-23/32 x 5-23/32	11/32
Springfield	Oval	3-17/32 x 4-17/32	5/16
Union	Oval	3 x 4	3/8
	Pear	4-1/4 x 5-1/4	3/8
Vogt	Oval	4-1/4 x 5-1/8	7/32 (new)
Wickes			
	Pear	4-1/8 x 5-1/8	9/32
D2300	Oval	3 x 4	5/16
D2301	Oval	3-1/2 x 4-1/2	5/16

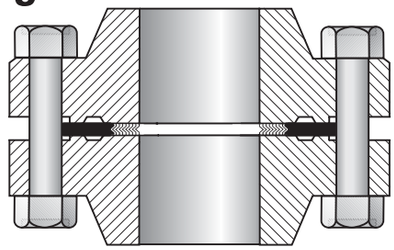
Ordering Information

When ordering, specify:

- Make and model of boiler and/or equipment, if available
- Gasket style and configuration
- Dimensions of gasket (thickness, flange seating width, and shape)
- Maximum operating pressure and temperature
- Type of metal and filler materials

FLEXSEAL® RW-RJ, RWI-RJ Gaskets

For Replacement of Ring Joint Gaskets



- Ideal replacement for solid metal oval or octagonal API ring joint gaskets (RTJ)
- Saves cost of flange replacement when gasket groove is badly worn
- Fast and easy installation—requires only a 3/16" flange separation (ring joint gasket may require as much as 3/4")
- Wide variety of metal and filler materials have a full range of temperature and pressure capabilities
- RW-RJ gaskets not stocked, but can be special-ordered; RWI-RJ gaskets available on request.

Nominal Pipe Size (Inches)	150 psi Gasket I.D.	150 psi Gasket O.D.	150 psi Ring O.D.	300 psi Gasket I.D.	300 psi Gasket O.D.	300 psi Ring O.D.	400 psi Gasket I.D.	400 psi Gasket O.D.	400 psi Ring O.D.
1/2	—	—	—	9/16	1-1/16	2-1/8	9/16	1-1/16	2-1/8
3/4	—	—	—	13/16	1-5/16	2-5/8	13/16	1-5/16	2-5/8
1	1-1/8*	1-5/8*	2-5/8*	1-1/16	1-5/8	2-7/8	1-1/16	1-5/8	2-7/8
1-1/4	1-3/8*	1-7/8*	3*	1-5/16	2	3-1/4	1-5/16	2	3-1/4
1-1/2	1-5/8*	2-1/4*	3-3/8*	1-9/16	2-3/8	3-3/4	1-9/16	2-3/8	3-3/4
2	2-1/8*	2-7/8*	4-1/8*	2-1/8	2-3/4	4-3/8	2-1/8	2-3/4	4-3/8
2-1/2	2-3/4*	3-5/16*	4-7/8*	2-3/4	3-5/16	5-1/8	2-3/4	3-5/16	5-1/8
3	3-5/16*	3-15/16*	5-3/8*	3-5/16	3-15/16	5-7/8	3-5/16	3-15/16	5-7/8
4	4-5/16*	5-3/16*	6-7/8*	4-5/16	5-3/16	7-1/8	4-5/16	5-3/16	7
5	5-5/16*	6-3/16*	7-3/4*	5-5/16	6-7/16	8-1/2	5-5/16	6-7/16	8-3/8
6	6-5/16*	7-3/16*	8-3/4*	6-7/16	7-5/8	9-7/8	6-7/16	7-5/8	9-3/4
8	8-1/4*	9-3/16*	11*	8-1/4	9-15/16	12-1/8	8-1/4	9-15/16	12
10	10-5/16*	11-7/16*	13-3/8*	10-5/16	12	14-1/4	10-5/16	12	14-1/8
12	12-3/16*	13-9/16*	16-1/8*	12-7/8†	14-1/4†	16-5/8†	12-7/8†	14-1/4†	16-1/2†
14	13-7/16*	14-15/16*	17-3/4*	14-1/4†	15-3/4†	19-1/8†	14-1/4†	15-3/4†	19†
16	15-5/16*	16-15/16*	20-1/4*	16-1/4†	17-3/4†	21-1/4†	16-1/4†	17-3/4†	21-1/8†
18	17-1/4*	19*	21-5/8*	18-1/4†	20-1/4†	23-1/2†	18-1/4†	20-1/4†	23-3/8†
20	19-1/8*	21-1/8*	23-7/8*	20-1/4†	22-3/16†	25-3/4†	20-1/4†	22-3/16†	25-1/2†
24	23*	25-1/4*	28-1/4*	24-1/4†	26-5/16†	30-1/2†	24-1/4†	26-5/16†	30-1/4†

Nominal Pipe Size (Inches)	600 psi Gasket I.D.	600 psi Gasket O.D.	600 psi Ring O.D.	900 psi Gasket I.D.	900 psi Gasket O.D.	900 psi Ring O.D.	1500 psi Gasket I.D.	1500 psi Gasket O.D.	1500 psi Ring O.D.
1/2	9/16	1-1/16	2-1/8	9/16*	1-1/16*	2-1/2*	9/16*	1-1/16*	2-1/2*
3/4	13/16	1-5/16	2-5/8	13/16*	1-3/8*	2-3/4*	13/16*	1-3/8*	2-3/4*
1	1-1/16	1-5/8	2-7/8	1-1/16*	1-5/8*	3-1/8*	1-1/16*	1-5/8*	3-1/8*
1-1/4	1-5/16	2	3-1/4	1-5/16*	2*	3-1/2*	1-5/16*	2*	3-1/2*
1-1/2	1-9/16	2-3/8	3-3/4	1-9/16*	2-3/8*	3-7/8*	1-9/16*	2-3/8*	3-7/8*
2	2-1/8	2-3/4	4-3/8	2-1/4*	3-1/4*	5-5/8*	2-1/4*	3-1/4*	5-5/8*
2-1/2	2-3/4	3-5/16	5-1/8	2-9/16*	3-5/8*	6-1/2*	2-9/16*	3-5/8*	6-1/2*
3	3-5/16	3-15/16	5-7/8	3-3/16*	4-3/16*	6-5/8*	3-3/16*	4-11/16*	6-7/8*
4	4-5/16	5-3/16	7-5/8	4-1/16*	5-3/16*	8-1/8*	4-1/16*	5-11/16*	8-1/4*
5	5-5/16	6-7/16	9-1/2	5-5/16	6-7/16	9-3/4	5-1/16*	6-15/16*	10*
6	6-7/16	7-5/8	10-1/2	6-5/16	7-5/8	11-3/8	6*	7-9/16*	11-1/8*
8	8-1/4	9-15/16	12-5/8	8-1/4	9-15/16	14-1/8	7-7/8*	9-3/4*	13-7/8*
10	10-5/16	12	15-3/4	10-5/16	12	17-1/8	9-13/16*	11-7/8*	17-1/8*
12	12-7/8†	14-1/4†	18†	12-7/8	14-1/4	19-5/8	11-15/16*	13-13/16*	20-1/2*
14	14-1/4†	15-3/4†	19-3/8†	13-13/16	15-9/16	20-1/2	13-7/16	15-3/16	22-3/4
16	16-1/4†	17-3/4†	22-1/4†	15-9/16	17-9/16	22-5/8	15	17	25-1/4
18	18-1/4†	20-1/4†	23-3/8†	17-11/16	19-15/16	25-1/8	17-1/4	19-1/2	27-3/4
20	20-1/4†	22-3/16†	26-7/8†	19-11/16	21-15/16	27-1/2	19-3/16	21-7/16	29-3/4
24	24-1/4†	26-5/16†	31-1/8†	23-3/16	25-15/16	33	23	25-1/2	35-1/2

Dimensions for weld neck type flanges having a pipe bore equal to that of schedule 40 pipe and heavier, but not for slip-on flanges; except:

† Both charts: suitable for slip-on and weld neck type flanges

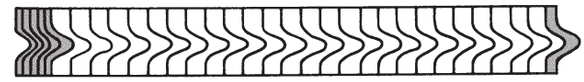
* Top chart: for weld neck type flanges having a pipe bore equal to that of schedule 40 pipe. Not for slip-on flanges.

* Bottom chart: for schedule 80 pipe and heavier.

FLEXSEAL® LMF, LTG and STG Gaskets

For Male-Female, Tongue and Groove Flanges

- Spiral winding of preformed metal and soft filler material—for use where no space is provided for a compression guide ring
- Inner diameter of windings is reinforced with several plies of metal without filler to give greater stability
- Style LMF — large male-female flanges
  Style LTG — large tongue and groove flanges
  Style STG — small tongue and groove flanges



Cross Sectional View of Winding

Ordering Information

When ordering, specify:

- Nominal pipe size
- Pressure rating
- Winding materials (304 SS is standard, filler material must be specified)
- Thickness of winding (0.125" is standard)

Applications

- Valves
- Pumps
- Flanges
- Heat exchangers
- Vessels

Style LMF Gasket Dimensions

Nominal Pipe Size (Inches)	150 - 1500 psi I.D. (Inches)	150 - 1500 psi O.D. (Inches)
1/4	1/2	1
1/2	1	1-3/8
3/4	1-5/16	1-11/16
1	1-1/2	2
1-1/4	1-7/8	2-1/2
1-1/2	2-1/8	2-7/8
2	2-7/8	3-5/8
2-1/2	3-3/8	4-1/8
3	4-1/4	5
3-1/2	4-3/4	5-1/2
4	5-3/16	6-3/16
4-1/2	5-11/16	6-3/4
5	6-5/16	7-5/16
6	7-1/2	8-1/2
8	9-3/8	10-5/8
10	11-1/4	12-3/4
12	13-1/2	15
14	14-3/4	16-1/4
16	17	18-1/2
18	19-1/4	21
20	21	23
24	25-1/4	27-1/4

Nominal Pipe Size (Inches)	2500 psi I.D. (Inches)	2500 psi O.D. (Inches)
1/2	13/16	1-3/8
3/4	1-1/16	1-11/16
1	1-1/4	2
1-1/4	1-5/8	2-1/2
1-1/2	1-7/8	2-7/8
2	2-3/8	3-5/8
2-1/2	3	4-1/8
3	3-3/4	5
3-1/2	—	—
4	4-3/4	6-3/16
5	5-3/4	7-5/16
6	6-3/4	8-1/2
8	8-3/4	10-5/8
10	10-3/4	12-3/4
12	13	15

Style LTG Dimensions

Nominal Pipe Size (Inches)	150 - 2500 psi I.D. (Inches)	150 - 2500 psi O.D. (Inches)
1/2	1	1-3/8
3/4	1-5/16	1-11/16
1	1-1/2	2
1-1/4	1-7/8	2-1/2
1-1/2	2-1/8	2-7/8
2	2-7/8	3-5/8
2-1/2	3-3/8	4-1/8
3	4-1/4	5
3-1/2	4-3/4	5-1/2
4	5-3/16	6-3/16
5	6-5/16	7-5/16
6	7-1/2	8-1/2
8	9-3/8	10-5/8
10	11-1/4	12-3/4
12	13-1/2	15
14	14-3/4	16-1/4
16	17	18-1/2
18	19-1/4	21
20	21	23
24	25-1/4	27-1/4

Style STG Dimensions

Nominal Pipe Size (Inches)	150 - 2500 psi I.D. (Inches)	150 - 2500 psi O.D. (Inches)
1/2	1	1-3/8
3/4	1-5/16	1-11/16
1	1-1/2	1-7/8
1-1/4	1-7/8	2-1/4
1-1/2	2-1/8	2-1/2
2	2-7/8	3-1/4
2-1/2	3-3/8	3-3/4
3	4-1/4	4-5/8
3-1/2	4-3/4	5-1/8
4	5-3/16	5-11/16
5	6-5/16	6-13/16
6	7-1/2	8
8	9-3/8	10
10	11-1/4	12
12	13-1/2	14-1/4
14	14-3/4	15-1/2
16	16-3/4	17-5/8
18	19-1/4	20-1/8
20	21	22
24	25-1/4	26-1/4

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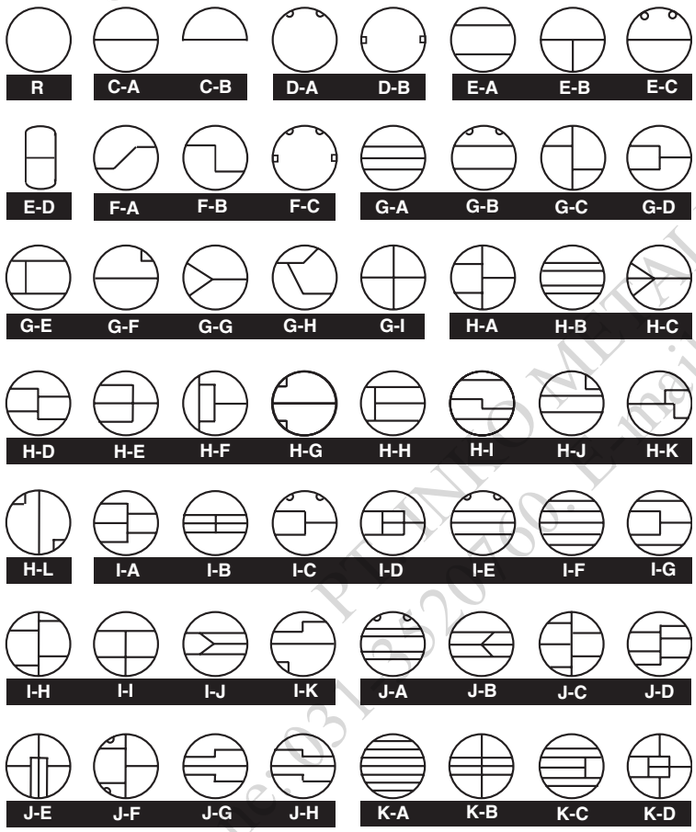
Exchanger and Vessel Gaskets

Garlock manufactures a wide variety of solid metal, metal clad, and metal core gaskets. Among the most requested styles are double-jacketed gaskets, Kamm-profile, corrugated gaskets, and solid metal gaskets, all available in a choice of metals and filler materials.

Custom configurations of heat exchanger gaskets are also available. Spiral windings can be designed with or without partitions welded to the winding, or inner and outer rings with welded partitions. Contact Garlock for all of your heat exchanger and vessel gasket needs.

Garlock Heat Exchanger Gasket Configurations



Tolerances

Gasket Outside Diameter	Inside Diameter Tolerance	Outside Diameter Tolerance
Up to 36"	+1/16" / -0	+0 / -1/16"
36" and above	+1/8" / -0	+0 / -1/8"

Thickness: ±1/32"
Rib Width: ±1/64"
Radii: ±1/16"
Rib Location: ±1/16"

Gasket Widths

Gasket Diameter	Minimum Width (Gasket and Ribs)	Maximum Width
Up to 12"	3/16"	*
Over 12"	1/4"	*

* **Note:** There is no maximum width for heat exchanger gaskets.

Series 600 Metal-Clad Gaskets

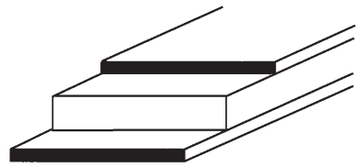
Gasket Styles

Style 600—Corrugated Solid Metal

A plain, all-metal corrugated gasket for use in low pressure applications that require a thin line contact because of space or weight limitations. Corrugated gaskets are a versatile sealing element where the available bolt loads are low.

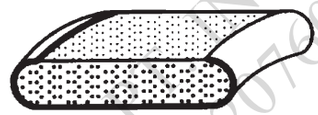
Style 606—Solid Metal with Flexible Graphite Covering

A solid metal gasket covered with a layer of flexible graphite. This covering layer seals at a low load and fills voids and imperfections in the flange.



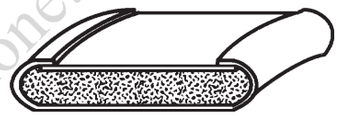
Style 620—Single-Jacketed

Generally used where the radial dimensions of the equipment sealing surfaces only allow space for a narrow width seal. Single-jacketed gaskets are constructed as shown. The metal jacket reinforces the soft sealing material.



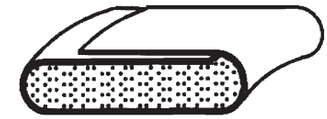
Style 623—Double-Jacketed

The double-jacketed gasket has good compressibility and resilience and is the most popular metal-clad gasket manufactured.



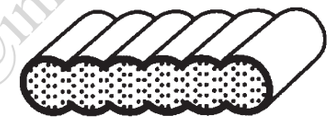
Style 624—Single-Jacketed Overlap

Construction of this gasket offers more filler protection than the standard single-jacketed design. Although constructed like a single-jacketed gasket, it has the added benefit of totally encasing the filler material.



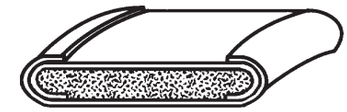
Style 626—Double-Jacketed Corrugated

Concentric corrugated sealing element totally encapsulates the soft filler material. The corrugations give improved resilience in applications where thermocycling is a problem.



Style 627—Double Shell

The double shell on this gasket allows greater hoop strength and rigidity with the addition of a completely overlapping inner seal. This gasket will withstand higher compressive loads common in high pressure applications.



Style 629—Double-Jacketed Corrugated with Corrugated Metal Filler

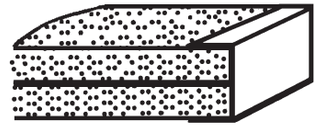
The metal filler in Style 629 has greater resilience to problems resulting from thermocycling. The temperature limits of this gasket are governed only by the metal selected.

Series 600 Gasket Styles

Style 631—Two-Piece French-Type

Garlock Style 631 is ideal for narrow circular applications that require a positive unbroken metal gasket line across the full width of the flange. The filler is exposed on the OD. This gasket is also available in one, two, and three-piece constructions.

Style 635—Selected Metal and CERAFELT®*

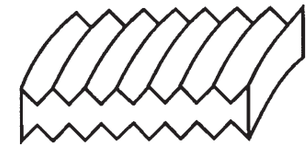


This gasket is designed to be used in lightweight flanges. The thick compressible layer of CERAFELT® is shielded on the ID with a metallic barrier. Style 635 is commonly used in applications with very hot gases and low pressures.

Style 640—Solid Metal

This gasket offers extremely tight sealing, high mechanical strength, and good resistance to temperature, corrosion and pressure. Bolting stress and flange surface finish are key to the performance of this design.

Style 641—Solid Metal Profile



Profile gaskets combine the desirable qualities of a solid metal gasket with the advantages of a reduced area of contact, thereby reducing the bolt stress required to effect a seal. This gasket has the same advantages of strength, heat conductivity, and resistance to temperature, pressure and corrosion as Garlock Style 640.

Style 642—Grooved Metal

See Kammprofile, page D-17.

Styles 644 and 645—Single- and Double-Jacketed Profile

Metal-jacketed profile gaskets employ the same principle of reduced contact area while protecting the flange faces from damage due to scoring. This gasket can be manufactured in one of two designs—either single-jacketed (Style 644) or double- jacketed (Style 645).

CERAFELT® is a registered trademark of Thermal Ceramics.

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GRAPHONIC®
Metallic Gasket

The superior technology of the GRAPHONIC® family of gaskets ensures excellent sealing performance and reliability, even in the most difficult applications. Each of the three styles combines a corrugated metal core with a compressible sealing element of various materials, for resistance to a wide range of harsh conditions, including extreme temperature, corrosive chemicals, and thermal cycling.

Applications

- Valves
- Pumps
- Flanges
- Heat exchangers
- Vessels

GRAPHONIC® Gasket (Style 603)

With flexible graphite sealing element

- Accommodates a wide range of temperatures
- Seals effectively during thermal cycling
- Fire safe—passed API 6FB fire tests
- Chemically resistant
- Long service life

TEPHONIC® Gasket (Style 604)

With ePTFE sealing element

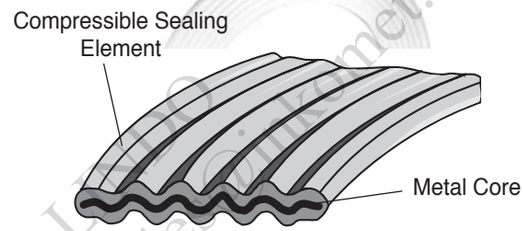
- Chemically inert
- Forms a tight seal under low bolt load
- Conforms to minor sealing surface imperfections
- Withstands temperatures to 500°F (260°C)

G.E.T.™ Gasket (Style 607)

With graphite and ePTFE sealing element

- Combines fire safety with chemical resistance
- Conforms to minor sealing surface imperfections
- Rigid yet compressible

Construction



Standard Metals

- 316L Stainless

Also Available

- 304 Stainless
- Carbon steel
- INCONEL® 600
- INCONEL® 625
- INCOLOY® 800
- INCOLOY® 825
- HASTELLOY® C276
- MONEL® 400

Sealing Elements

- Flexible graphite
- ePTFE
- Combination graphite and ePTFE

Engineering Data

	GRAPHONIC®	TEPHONIC® and G.E.T.™
Temperature,		
Minimum:	-400°F (-240°C)	-400°F (-240°C)
Max. in atmosphere:	850°F (454°C)	500°F (260°C)
Max. in steam:	1,200°F (650°C)	500°F (260°C)
Max. continuous:	850°F (454°C)	500°F (260°C)
Pressure, max.:	1,000 psig (70 bar)	
P x T, max.		
1/16" thickness:	700,000 (25,000)†	–
1/8" thickness:	400,000 (13,500)	250,000 (8,500)

† P x T max. = psig x °F (bar x °C)

Note: When approaching maximum temperatures, consult the Garlock Metallic Gasket Engineering Dept. at **1-800-972-7638** or **1-281-459-7200**.

Garlock Kammprofile™ Gasket

Benefits

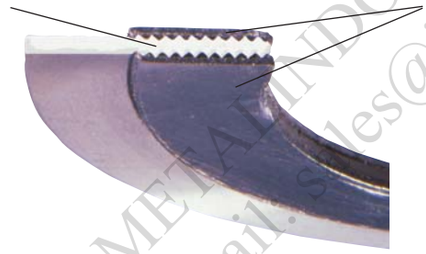
- Accommodates standard ASME flanges as well as weaker and non-circular flanges
- Seals less-than-perfect flanges
- Handles pressures from vacuum to Class 2500
- Performance replacement for jacketed heat exchanger gaskets
- Fire safe—passed API 6FB fire tests
- Available in heat shield configuration for high temp applications above 850ºF (454ºC) (see page D-6)

Applications

- Valves
- Pumps
- Flanges
- Heat exchangers
- Vessels

Serrated solid metal core

- Solid metal core resists cold flow, overcompression and blowout
- Rigid core provides exceptional stability, even in large sizes, and facititates handling and installation
- Available in wide variety of metals



Soft, deformable sealing material

- Under compression, fills seating surface imperfections to form a tight connection
- Seals under low stress—ideal for weaker flanges
- Withstands extreme fluctuations in temperatures and pressures

Style Selection Guide

Garlock Kammprofile Styles	Construction		Centering Ring		Flange			
	Parallel Root	Convex Root	Integral	Floating	Male/Female	Tongue/Groove	Flat Face	Raised Face
642 A	●				●	●		●
642 AR	●		●				●	●
642 AR2	●			●			●	●
642 AC		●			●	●		●
642 ARC		●	●				●	●
642 ARC2		●		●			●	●

- **Parallel root core** is standard design
- **Convex root core** compensates for weaker flanges and resulting flange rotation
- **Integral centering ring** ensures optimum gasket positioning
- **Floating centering ring** allows for expansion and contraction during thermal cycling

Gasket Style	Gasket Factor "M"	Gasket Factor "Y" (psi)
Kammprofile gasket	4.00	1,000*

Note: When designing a flange, a "Y" value of 4,000 psi is suggested.

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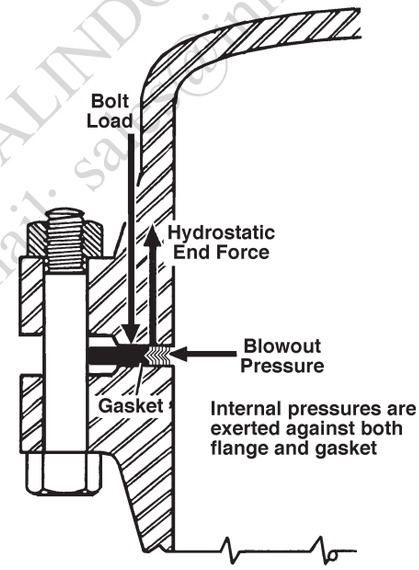
Factors Affecting Gasket Performance

A gasket is any deformable material which, when clamped between essentially stationary faces, prevents the passage of media across the gasketed connection.

Compressing the gasket material causes the material to flow into the imperfections of the sealing areas and effect a seal. This seal prevents the escape of the contained media. In order to maintain this condition, sufficient load must be applied to the connection to oppose the hydrostatic end force created by the internal pressure of the system.

Gasket performance depends on a number of factors, including:

1. **Gasket Metal and Filler Material:** The materials must withstand the effects of:
   a. **Temperature:** Temperature can adversely affect mechanical and chemical properties of the gasket, as well as physical characteristics such as oxidation and resilience.
   b. **Pressure**: The media or internal piping pressure can blow out the gasket across the flange face.
   c. **Media:** The gasket materials must be resistant to corrosive attack from the media.
2. **Joint Design:** The force holding the two flanges together must be sufficient to prevent flange separation caused by hydrostatic end force, resulting from the pressure acting on the internal area.
3. **Proper Bolt Load:** If the bolt load is insufficient to deform the gasket, or is so excessive that it crushes the gasket, a leak will occur.
4. **Surface Finish:** If the surface finish is not suitable for the gasket, a seal will not be effected.



Forces Acting on a Gasket

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Spiral Wound Specifications

Temperature Limits for Common Metals

Material	Minimum °F	Minimum °C	Maximum °F	Maximum °C	Abbreviation
304 Stainless Steel	-320	-195	1,400	760	304
316L Stainless Steel	-150	-100	1,400	760	316L
317L Stainless Steel	-150	-100	1,400	760	317L
321 Stainless Steel	-320	-195	1,400	760	321
347 Stainless Steel	-320	-195	1,700	925	347
Carbon Steel	-40	-40	1,000	540	CRS
20Cb-3 (Alloy 20)	-300	-185	1,400	760	A-20
HASTELLOY® B 2	-300	-185	2,000	1,090	HAST B
HASTELLOY® C 276	-300	-185	2,000	1,090	HAST C
INCOLOY® 800	-150	-100	1,600	870	IN 800
INCOLOY® 825	-150	-100	1,600	870	IN 825
INCONEL® 600	-150	-100	2,000	1,090	INC 600
INCONEL® 625	-150	-100	2,000	1,090	INC 625
INCONEL® X750	-150	-100	2,000	1,090	INX
MONEL® 400	-200	-130	1,500	820	MON
Nickel 200	-320	-195	1,400	760	NI
Titanium	-320	-195	2,000	1,090	TI

Guide Ring Color Code*
Yellow
Green
Maroon
Turquoise
Blue
Silver
Black
Brown
Beige
White
White
Gold
Gold
No Color
Orange
Red
Purple

Temperature Limits for Filler Material

Material	Minimum °F	Minimum °C	Maximum COT °F	Maximum COT °C	Abbreviation
Ceramic †	-350	-212	2,000	1,090	CER
Flexible Graphite	-350	-212	850	454	F.G.
PTFE	-400	-240	500	260	PTFE

Stripe Color Code*
Light Green
Gray
White

Standard Tolerances

For windings

Gasket Diameter	ID	OD
Up to 1"	" +1/64" -0	" +0 -1/32"
1" to 24"	" +1/32" -0	" +0 -1/32"
24" to 36"	" +3/64" -0	" +0 -1/16"
36" to 60"	" +1/16" -0	" +0 -1/16"
60" and above	" +3/32" -0	" +0 -3/32"

For spiral wound gaskets not otherwise specified.

Gasket Thickness	Gasket Tolerance	Width Limits Minimum	Width Limits Maximum	Compressed Thickness
0.125"**	±0.005"	3/16"	1"††	0.090 - 0.100"
0.175"**	±0.005"	1/4"	1-1/2"††	0.125 - 0.135"
0.250"**	±0.005"	5/16"	1-1/2"††	0.180 - 0.200"
0.285"**	±0.005"	5/16"	1-1/2"††	0.200 - 0.220"

Available Thicknesses

Winding	Ring(s) Inner & Outer
0.125"	3/32"
0.175"	1/8"
0.250"	3/16"
0.285"	3/16"

Note:
Thickness tolerance is ±0.005" on all gaskets, except +0.010" -0.005" on gaskets with:

- Less than 1" ID and greater than 26" ID
- PTFE filler
- Flange widths of 1" or greater

* ASME B 16.20 standard

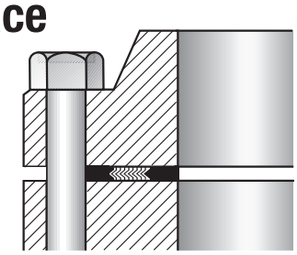
† Contact Garlock Engineering when selecting this material.

** Measured across the metallic portion of the gasket not including the filler, which may protrude slightly.

†† Spiral wound gaskets can be made to large maximum widths if required. Call Garlock for details.

Flange Types

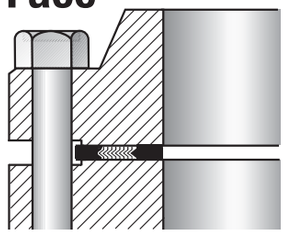
Flat Face



Unconfined Gasket

- Mating faces of both flanges are flat
- Gasket may be ring type, or full face, which covers the entire face both inside and outside the bolts

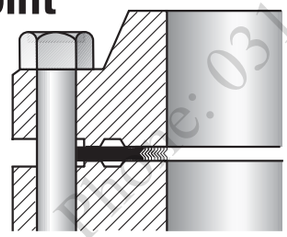
Raised Face



Unconfined Gasket

- Flange sealing surface is reduced to achieve higher seating stress
- Gasket is usually ring type, contained entirely within bolts

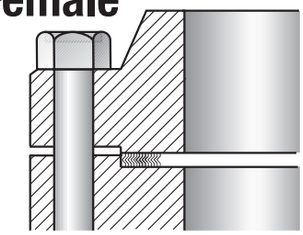
Ring Joint



Also Called "API Joint" or "RTJ"

- Both flange faces have matching flat-bottomed grooves with sides tapered from the vertical at 23°
- Gasket seats on flat section of flange between bore and ring joint groove
- Garlock spiral wound gaskets can replace solid metal ring gaskets

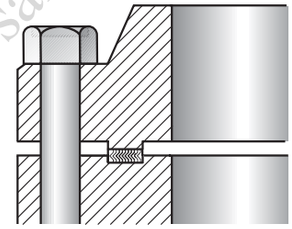
Male-Female



Semi-Confined Gasket

- Depth of female (recessed) face normally equal to or less than height of male (raised) face, to prevent metal-to-metal contact during gasket compression
- Recessed O.D. normally is not more than 1/16" larger than the O.D. of the male face
- Joint must be pried apart for disassembly

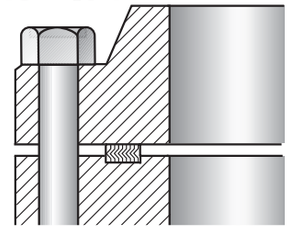
Tongue and Groove



Fully Confined Gasket

- Groove depth is equal to or less than tongue height
- Groove usually not over 1/16" wider than tongue
- Gasket dimensions will match tongue dimensions
- Joint must be pried apart for disassembly

Groove to Flat



Fully Confined Gasket

- One flange face is flat, the other is recessed
- For applications requiring accurate control of gasket compression
- Only resilient gaskets are recommended—spiral wound, hollow metal O-ring, pressure-actuated, and metal-jacketed gaskets

Gasket Selection By Flange Type

	RW	RWI	EDGE®	TANDEM	SW	MC	MCR	HH	RW-RJ	RWI-RJ	LMF	LTG	STG	HEAT SHIELD™
Flat Face	■	■	■	■		■	■	■						■
Raised Face	■	■	■	■			■							■
Ring Joint									■	■				
Male-Female					■	■					■	■	■	
Tongue-&-Groove					■	■						■	■	
Groove-to-Flat					■	■								

Flange Surface Finish

The surface finish of a flange is described as follows:

Roughness

- Average of peaks and valleys measured from mid-line of flange surface (in millionths of an inch)
- Expressed as rms (root mean square) or AA (arithmetic average) or AARH (arithmetic average roughness height)

Lay

- The direction of the predominant surface-roughness pattern
- Example: multidirectional, phonographic spiral serrations, etc.

Waviness

- The departure from overall flatness
- Measured in thousandths or fractions of an inch

Recommended Values

Spiral Wound Gaskets ..... 125-250 rms
GRAPHONIC® Gaskets ..... 125-250 rms
Kammprofile Gaskets ..... 125-250 rms
Jacketed or Metal Clad Gaskets ..... 63-80 rms
Solid Metal Gaskets ..... 63-80 rms

Note:
These values are suggested only and not mandatory; however they are based upon the best cross-section of successful design experience currently available.

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Maximum Flange Bore for FLEXSEAL® RW Gaskets

<table>
<tr><th rowspan="2">Flange Size (NPS)</th><th colspan="8">Pressure Class</th></tr>
<tr><th>75</th><th>150</th><th>300</th><th>400</th><th>600</th><th>900 [1]</th><th>1500 [1]</th><th>2500 [1]</th></tr>
<tr><td>1/2"</td><td rowspan="13">No recommen-dation in 75 lb. flanges</td><td colspan="2" rowspan="3">Weld-neck only [2]</td><td rowspan="5">No flanges. Use Class 600</td><td rowspan="3">Weld-neck only [2]</td><td rowspan="5">No flanges. Use Class 1500</td><td colspan="2" rowspan="5">Weld-neck only [2]</td></tr>
<tr><td>3/4"</td></tr>
<tr><td>1"</td></tr>
<tr><td>1 1/4"</td><td colspan="2" rowspan="2">Slip-on [3] Weld-neck [2]</td><td rowspan="2">Slip-on [3] Weld-neck [2]</td></tr>
<tr><td>1 1/2"</td></tr>
<tr><td>2"</td><td colspan="2" rowspan="2">Slip-on [3] Weld-neck, any bore</td><td rowspan="2">Slip-on [3] Weld-neck, any bore</td></tr>
<tr><td>2 1/2"</td></tr>
<tr><td>3"</td><td colspan="2" rowspan="5">Slip-on, Weld-neck, any bore</td><td>Slip-on, Weld-neck, any bore</td><td colspan="3" rowspan="3">Weld-neck with Standard wall bore (includes nozzle [4] but excludes Slip-on)</td></tr>
<tr><td>4"</td><td colspan="2" rowspan="4">Weld-neck with Schedule 10S bore described in ASME B36.19M (includes nozzle [4] but excludes Slip-on)</td></tr>
<tr><td>6"</td><td rowspan="2">Weld-neck w/ Schedule 60 bore</td></tr>
<tr><td>8"</td></tr>
<tr><td>10"</td><td colspan="2" rowspan="2">Slip-on, Weld-neck, any bore</td><td rowspan="2">Weld-neck w/ Schedule 80 bore</td></tr>
<tr><td>12"</td></tr>
<tr><td>14"</td><td colspan="3" rowspan="5">Weld-neck with Schedule 10 bore described in ASME B36.10M (excludes nozzle [4] and Slip-on [5])</td><td rowspan="3">Weld-neck w/ Standard wall bore (excludes nozzle and Slip-on)</td><td rowspan="5">No flanges</td></tr>
<tr><td>16"</td></tr>
<tr><td>18"</td></tr>
<tr><td>20"</td><td rowspan="2">Weld-neck w/ Sched. 40 bore</td></tr>
<tr><td>24"</td></tr>
</table>

Notes:

1. Inner rings are recommended for all graphite filled gaskets, required for all PTFE filled gaskets, and for NPS 24 and larger in Class 900, NPS 12 and larger in Class 1500, and NPS 4 and larger in Class 2500. (See page D-3 for full description) These inner rings may extend into the pipe bore a maximum of 0.06" (1.5 mm) under the worst combination or maximum bore, eccentric installation, and additive tolerances. Purchaser should specify inner ring material.
2. In these sizes the gasket is suitable for a weld-neck flange with a standard wall bore, if the gasket and the flange are assembled concentrically. This also applies to a nozzle. It is the user's responsibility to determine if the gasket is satisfactory for the flange of any larger bore.
3. Gaskets in these sizes are suitable for slip-on flanges only if the gaskets and flanges are assembled concentrically.
4. A nozzle is a long welded neck; the bore equals the flange NPS.
5. An NPS 24 gasket is suitable for nozzles.

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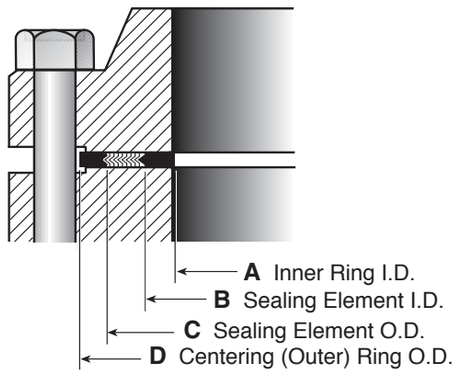
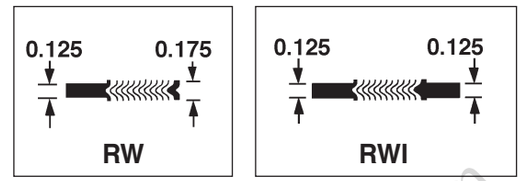
Styles RW, RWI Dimensions 1/4" to 24" Flanges

ASME B16.20 Gaskets for ASME B16.5 Flanges





Class 150

Size NPS	Inner Ring	Sealing Element		Outer Ring
	Inside (A) Diameter	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
1/4*	—	0.50	0.88	1.75
1/2	0.56	0.75	1.25	1.88
3/4	0.81	1.00	1.56	2.25
1	1.06	1.25	1.88	2.63
1-1/4	1.50	1.88	2.38	3.00
1-1/2	1.75	2.13	2.75	3.38
2	2.19	2.75	3.38	4.13
2-1/2	2.62	3.25	3.88	4.88
3	3.19	4.00	4.75	5.38
3-1/2*	—	4.50	5.25	6.38
4	4.19	5.00	5.88	6.88
4-1/2*	—	5.50	6.50	7.00
5	5.19	6.13	7.00	7.75
6	6.19	7.19	8.25	8.75
8	8.50	9.19	10.38	11.00
10	10.56	11.31	12.50	13.38
12	12.50	13.38	14.75	16.13
14	13.75	14.63	16.00	17.75
16	15.75	16.63	18.25	20.25
18	17.69	18.69	20.75	21.63
20	19.69	20.69	22.75	23.88
24	23.75	24.75	27.00	28.25

* ASME B16.20 does not include dimensions for NPS 1/4, 3-1/2 or 4-1/2, or Class 400 flanges up to NPS 3 and Class 900 flanges up to NPS 2-1/2. Dimensions in inches.

Class 300

Size NPS	Inner Ring	Sealing Element		Outer Ring
	Inside (A) Diameter	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
1/4*	—	0.50	0.88	1.75
1/2	0.56	0.75	1.25	2.13
3/4	0.81	1.00	1.56	2.63
1	1.06	1.25	1.88	2.88
1-1/4	1.50	1.88	2.38	3.25
1-1/2	1.75	2.13	2.75	3.75
2	2.19	2.75	3.38	4.38
2-1/2	2.62	3.25	3.88	5.13
3	3.19	4.00	4.75	5.88
3-1/2*	—	4.50	5.25	6.50
4	4.19	5.00	5.88	7.13
4-1/2*	—	5.50	6.50	7.75
5	5.19	6.13	7.00	8.50
6	6.19	7.19	8.25	9.88
8	8.50	9.19	10.38	12.13
10	10.56	11.31	12.50	14.25
12	12.50	13.38	14.75	16.63
14	13.75	14.63	16.00	19.13
16	15.75	16.63	18.25	21.25
18	17.69	18.69	20.75	23.50
20	19.69	20.69	22.75	25.75
24	23.75	24.75	27.00	30.50

Notes:

1. Inner rings are recommended for all graphite filled gaskets, required for all PTFE filled gaskets, and for NPS 24 and larger in Class 900, NPS 12 and larger in Class 1500, and NPS 4 and larger in Class 2500.
2. The gasket outside diameter tolerance for NPS 1/2 through NPS 8 is ±0.03"; for NPS 10 through NPS 24, +0.06", –0.03".
3. The gasket inside diameter tolerance for NPS 1/2 through NPS 8 is ±0.016"; for NPS 10 through NPS 24, ±0.03".
4. The centering ring outside diameter tolerance is ±0.03".
5. There are no Class 400 flanges in NPS 1/2 through NPS 3 (use Class 600), Class 900 flanges in NPS 1/2 through NPS 2-1/2 (use Class 1500), or Class 2500 flanges NPS 14 and larger.

Styles RW, RWI Dimensions 1/4" to 24" Flanges

Class 400

Size NPS	Inner Ring	Sealing Element		Outer Ring
	Inside (A) Diameter	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
1/4*	—	0.50	0.88	1.75
1/2*	—	0.75	1.25	2.13
3/4*	—	1.00	1.56	2.63
1*	—	1.25	1.88	2.88
1-1/4*	—	1.88	2.38	3.25
1-1/2*	—	2.13	2.75	3.75
2*	—	2.75	3.38	4.38
2-1/2*	—	3.25	3.88	5.13
3*	—	4.00	4.75	5.88
3-1/2*	—	4.13	5.25	6.38
4	4.04	4.75	5.88	7.00
4-1/2*	—	5.31	6.50	7.63
5	5.05	5.81	7.00	8.38
6	6.10	6.88	8.25	9.75
8	8.10	8.88	10.38	12.00
10	10.05	10.81	12.50	14.13
12	12.10	12.88	14.75	16.50
14	13.50	14.25	16.00	19.00
16	15.35	16.25	18.25	21.13
18	17.25	18.50	20.75	23.38
20	19.25	20.50	22.75	25.50
24	23.25	24.75	27.00	30.25

Class 600

Size NPS	Inner Ring	Sealing Element		Outer Ring
	Inside (A) Diameter	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
1/4*	—	0.50	0.88	1.75
1/2	0.56	0.75	1.25	2.13
3/4	0.81	1.00	1.56	2.63
1	1.06	1.25	1.88	2.88
1-1/4	1.50	1.88	2.38	3.25
1-1/2	1.75	2.13	2.75	3.75
2	2.19	2.75	3.38	4.38
2-1/2	2.62	3.25	3.88	5.13
3	3.19	4.00	4.75	5.88
3-1/2*	—	4.13	5.25	6.38
4	4.04	4.75	5.88	7.63
4-1/2*	—	5.31	6.50	8.25
5	5.05	5.81	7.00	9.50
6	6.10	6.88	8.25	10.50
8	8.10	8.88	10.38	12.63
10	10.05	10.81	12.50	15.75
12	12.10	12.88	14.75	18.00
14	13.50	14.25	16.00	19.38
16	15.35	16.25	18.25	22.25
18	17.25	18.50	20.75	24.13
20	19.25	20.50	22.75	26.88
24	23.25	24.75	27.00	31.13

Class 900

Size NPS	Inner Ring	Sealing Element		Outer Ring
	Inside (A) Diameter	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
1/2*	—	0.75	1.25	2.50
3/4*	—	1.00	1.56	2.75
1*	—	1.25	1.88	3.13
1-1/4*	—	1.56	2.38	3.50
1-1/2*	—	1.88	2.75	3.88
2*	—	2.31	3.38	5.63
2-1/2*	—	2.75	3.88	6.50
3	3.10	3.75	4.75	6.63
3-1/2*	—	4.13	5.25	7.50
4	4.04	4.75	5.88	8.13
4-1/2*	—	5.31	6.50	9.38
5	5.05	5.81	7.00	9.75
6	6.10	6.88	8.25	11.38
8	7.75	8.75	10.13	14.13
10	9.69	10.88	12.25	17.13
12	11.50	12.75	14.50	19.63
14	12.63	14.00	15.75	20.50
16	14.75	16.25	18.00	22.63
18	16.75	18.25	20.50	25.13
20	19.00	20.50	22.50	27.50
24	23.25 (5)	24.75	26.75	33.00

* ASME B16.20 does not include dimensions for NPS 1/4, 3-1/2 or 4-1/2,
or Class 400 flanges up to NPS 3 and Class 900 flanges up to NPS 2-1/2. Dimensions in inches.

Notes:

1. Inner rings are recommended for all graphite filled gaskets, required for all PTFE filled gaskets, and for NPS 24 and larger in Class 900, NPS 12 and larger in Class 1500, and NPS 4 and larger in Class 2500.
2. The gasket outside diameter tolerance for NPS 1/2 through NPS 8 is ±0.03"; for NPS 10 through NPS 24, +0.06", –0.03".
3. The gasket inside diameter tolerance for NPS 1/2 through NPS 8 is ±0.016"; for NPS 10 through NPS 24, ±0.03".
4. The centering ring outside diameter tolerance is ±0.03".
5. There are no Class 400 flanges in NPS 1/2 through NPS 3 (use Class 600), Class 900 flanges in NPS 1/2 through NPS 2-1/2 (use Class 1500), or Class 2500 flanges NPS 14 and larger.

Styles RW, RWI Dimensions 1/4" to 24" Flanges

ASME B16.20 Gaskets for ASME B16.5 Flanges

Class 1500

Size NPS	Inner Ring	Sealing Element		Outer Ring
	Inside (A) Diameter	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
1/2	0.56	0.75	1.25	2.50
3/4	0.81	1.00	1.56	2.75
1	1.06	1.25	1.88	3.13
1-1/4	1.31 (4)	1.56	2.38	3.50
1-1/2	1.63 (4)	1.88	2.75	3.88
2	2.06 (4)	2.31	3.38	5.63
2-1/2	2.50 (4)	2.75	3.88	6.50
3	3.10	3.63	4.75	6.88
3-1/2*	—	4.13	5.25	7.38
4	3.85	4.63	5.88	8.25
4-1/2*	—	5.31	6.50	9.13
5	4.90	5.63	7.00	10.00
6	5.80	6.75	8.25	11.13
8	7.75	8.50	10.13	13.88
10	9.69	10.50	12.25	17.13
12	11.50 (5)	12.75	14.50	20.50
14	12.63 (5)	14.25	15.75	22.75
16	14.50 (5)	16.00	18.00	25.25
18	16.75 (5)	18.25	20.50	27.75
20	18.75 (5)	20.25	22.50	29.75
24	22.75 (5)	24.25	26.75	35.50

Class 2500

Size NPS	Inner Ring	Sealing Element		Outer Ring
	Inside (A) Diameter	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
1/2	0.56	0.75	1.25	2.75
3/4	0.81	1.00	1.56	3.00
1	1.06	1.25	1.88	3.38
1-1/4	1.31 (4)	1.56	2.38	4.13
1-1/2	1.63 (4)	1.88	2.75	4.63
2	2.06 (4)	2.31	3.38	5.75
2-1/2	2.50 (4)	2.75	3.88	6.63
3	3.10	3.63	4.75	7.75
4	3.85 (5)	4.63	5.88	9.25
5	4.90 (5)	5.63	7.00	11.00
6	5.80 (5)	6.75	8.25	12.50
8	7.75 (5)	8.50	10.13	15.25
10	9.69 (5)	10.63	12.25	18.75
12	11.50 (5)	12.50	14.50	21.63

* ASME B16.20 does not include dimensions for NPS 1/4, 3-1/2 or 4-1/2, or Class 400 flanges up to NPS 3 and Class 900 flanges up to NPS 2-1/2.

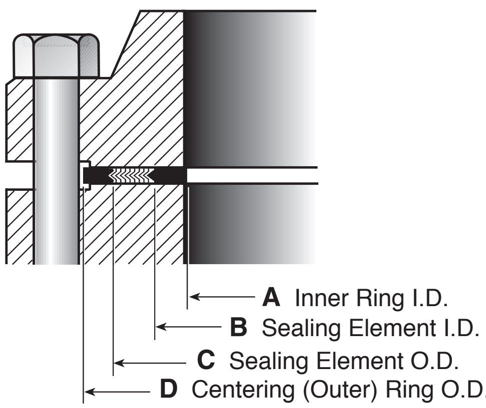
Dimensions in inches.

Notes:

1. Inner rings are recommended for all graphite filled gaskets, required for all PTFE filled gaskets, and for NPS 24 and larger in Class 900, NPS 12 and larger in Class 1500, and NPS 4 and larger in Class 2500.
2. The gasket outside diameter tolerance for NPS 1/2 through NPS 8 is ±0.03"; for NPS 10 through NPS 24, +0.06", –0.03".
3. The gasket inside diameter tolerance for NPS 1/2 through NPS 8 is ±0.016"; for NPS 10 through NPS 24, ±0.03".
4. The centering ring outside diameter tolerance is ±0.03".
5. There are no Class 400 flanges in NPS 1/2 through NPS 3 (use Class 600), Class 900 flanges in NPS 1/2 through NPS 2-1/2 (use Class 1500), or Class 2500 flanges NPS 14 and larger.

Styles RW, RWI Dimensions 22-60" Series A Flanges

ASME B16.20 Gaskets for ASME B16.47 Series A Flanges (MSS SP-44)



Class 150

Size	Inner Ring	Sealing Element		Outer Ring
NPS	Inside (A) Diameter	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
22*	—	22.75	24.00	26.00
26	25.75	26.50	27.75	30.50
28	27.75	28.50	29.75	32.75
30	29.75	30.50	31.75	34.75
32	31.75	32.50	33.88	37.00
34	33.75	34.50	35.88	39.00
36	35.75	36.50	38.13	41.25
38	37.75	38.50	40.13	43.75
40	39.75	40.50	42.13	45.75
42	41.75	42.50	44.25	48.00
44	43.75	44.50	46.38	50.25
46	45.75	46.50	48.38	52.25
48	47.75	48.50	50.38	54.50
50	49.75	50.50	52.50	56.50
52	51.75	52.50	54.50	58.75
54	53.50	54.50	56.50	61.00
56	55.50	56.50	58.50	63.25
58	57.50	58.50	60.50	65.50
60	59.50	60.50	62.50	67.50

Class 300

Size	Inner Ring	Sealing Element		Outer Ring
NPS	Inside (A) Diameter	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
22*	—	22.75	24.75	27.75
26	25.75	27.00	29.00	32.88
28	27.75	29.00	31.00	35.38
30	29.75	31.25	33.25	37.50
32	31.75	33.50	35.50	39.63
34	33.75	35.50	37.50	41.63
36	35.75	37.63	39.63	44.00
38	37.50	38.50	40.00	41.50
40	39.50	40.25	42.13	43.88
42	41.50	42.25	44.13	45.88
44	43.50	44.50	46.50	48.00
46	45.38	46.38	48.38	50.13
48	47.63	48.63	50.63	52.13
50	49.00	51.00	53.00	54.25
52	52.00	53.00	55.00	56.25
54	53.25	55.25	57.25	58.75
56	55.25	57.25	59.25	60.75
58	57.00	59.50	61.50	62.75
60	60.00	61.50	63.50	64.75

Class 400

Size	Inner Ring	Sealing Element		Outer Ring
NPS	Inside (A) Diameter	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
22*	—	22.75	24.75	27.63
26	26.00	27.00	29.00	32.75
28	28.00	29.00	31.00	35.13
30	29.75	31.25	33.25	37.25
32	32.00	33.50	35.50	39.50
34	34.00	35.50	37.50	41.50
36	36.13	37.63	39.63	44.00
38	37.50	38.25	40.25	42.25
40	39.38	40.38	42.38	44.38
42	41.38	42.38	44.38	46.38
44	43.50	44.50	46.50	48.50
46	46.00	47.00	49.00	50.75
48	47.50	49.00	51.00	53.00
50	49.50	51.00	53.00	55.25
52	51.50	53.00	55.00	57.25
54	53.25	55.25	57.25	59.75
56	55.25	57.25	59.25	61.75
58	57.25	59.25	61.25	63.75
60	59.75	61.75	63.75	66.25

Notes:

1. Inner rings are recommended for all graphite filled gaskets, required for all PTFE filled gaskets, and for NPS 24 and larger in Class 900, NPS 12 and larger in Class 1500, and NPS 4 and larger in Class 2500.
2. The gasket inside diameter tolerance for NPS 26 through NPS 34 is ±0.03"; for NPS 36 through NPS 60 is ±0.05".
3. The gasket outside diameter tolerance for NPS 26 through NPS 60 is ±0.06".
4. The centering ring outside diameter tolerance is ±0.03".
5. There are no Class 900 flanges in NPS 50 and larger.

Styles RW, RWI Dimensions 22-60" Series A Flanges

ASME B16.20 Gaskets for ASME B16.47 Series A Flanges (MSS SP-44)

Class 600

Size NPS	Inner Ring	Sealing Element		Outer Ring
	Inside (A) Diameter	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
22*	—	22.75	24.75	28.88
26	25.50	27.00	29.00	34.13
28	27.50	29.00	31.00	36.00
30	29.75	31.25	33.25	38.25
32	32.00	33.50	35.50	40.25
34	34.00	35.50	37.50	42.25
36	36.13	37.63	39.63	44.50
38	37.50	39.00	41.00	43.50
40	39.75	41.25	43.25	45.50
42	42.00	43.50	45.50	48.00
44	43.75	45.75	47.75	50.00
46	45.75	47.75	49.75	52.25
48	48.00	50.00	52.00	54.75
50	50.00	52.00	54.00	57.00
52	52.00	54.00	56.00	59.00
54	54.25	56.25	58.25	61.25
56	56.25	58.25	60.25	63.50
58	58.00	60.50	62.50	65.50
60	60.25	62.75	64.75	68.25

Class 900

Size NPS	Inner Ring	Sealing Element		Outer Ring
	Inside (A) Diameter	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
22*	—	24.25	27.00	33.00
26	26.00	27.00	29.00	34.75 (1)
28	28.00	29.00	31.00	37.25 (1)
30	30.25	31.25	33.25	39.75 (1)
32	32.00	33.50	35.50	42.25 (1)
34	34.00	35.50	37.50	44.75 (1)
36	36.25	37.75	39.75	47.25 (1)
38	39.75	40.75	42.75	47.25 (1)
40	41.75	43.25	45.25	49.25 (1)
42	43.75	45.25	47.25	51.25 (1)
44	45.50	47.50	49.50	53.88 (1)
46	48.00	50.00	52.00	56.50 (1)
48	50.00	52.00	54.00	58.50 (1)

Notes:

1. Inner rings are recommended for all graphite filled gaskets, required for all PTFE filled gaskets, and for NPS 24 and larger in Class 900, NPS 12 and larger in Class 1500, and NPS 4 and larger in Class 2500.
2. The gasket inside diameter tolerance for NPS 26 through NPS 34 is ±0.03"; for NPS 36 through NPS 60 is ±0.05".
3. The gasket outside diameter tolerance for NPS 26 through NPS 60 is ±0.06".
4. The centering ring outside diameter tolerance is ±0.03".
5. There are no Class 900 flanges in NPS 50 and larger.

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.

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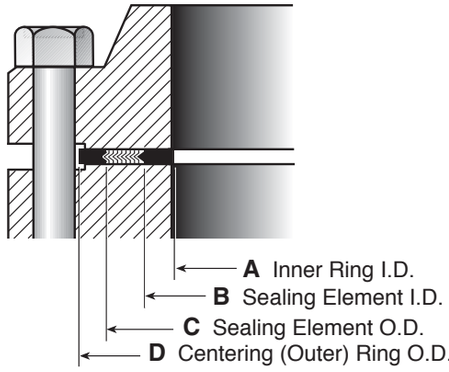
Styles RW, RWI Dimensions 26-60" Series B Flanges

ASME B16.20 Gaskets for ASME B16.47 Series B Flanges (API-605)



Notes:

1. Inner rings are recommended for all graphite filled gaskets, required for all PTFE filled gaskets and for NPS 24 and larger in Class 900, NPS 12 and larger in Class 1500, and NPS 4 and larger in Class 2500.
2. The gasket inside diameter tolerance for NPS 26 through NPS 34 is ±0.03"; for NPS 36 through NPS 60 is ±0.05".
3. The gasket outside diameter tolerance for NPS 26 through NPS 60 is ±0.06".
4. The centering ring outside diameter tolerance is ±0.03".
5. There are no Class 900 flanges in NPS 50 and larger.

Class 75
Large Diameter Weld Neck Flanges

Size NPS	Sealing Element		Outer Ring
	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
26	26.25	27.00	27.88
28	28.25	29.13	29.88
30	30.25	31.13	31.88
32	32.25	33.13	33.88
34	34.25	35.13	35.88
36	36.25	37.25	38.31
38	38.25	39.31	40.31
40	40.25	41.31	42.31
42	42.25	43.25	44.31
44	44.25	45.50	46.50
46	46.25	47.50	48.50
48	48.38	49.50	50.50
50	50.25	51.50	52.50
52	52.38	53.63	54.63
54	54.38	55.63	56.63
56	56.50	57.88	58.88
58	58.50	59.88	60.88
60	60.50	61.75	62.88

Class 150

Size NPS	Inner Ring	Sealing Element		Outer Ring
	Inside (A) Diameter	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
26	25.75	26.50	27.50	28.56
28	27.75	28.50	29.50	30.56
30	29.75	30.50	31.50	32.56
32	31.75	32.50	33.50	34.69
34	33.75	34.50	35.75	36.81
36	35.75	36.50	37.75	38.88
38	37.75	38.37	39.75	41.13
40	39.75	40.25	41.88	43.13
42	41.75	42.50	43.88	45.13
44	43.75	44.25	45.88	47.13
46	45.75	46.50	48.19	49.44
48	47.75	48.50	50.00	51.44
50	49.75	50.50	52.19	53.44
52	51.75	52.50	54.19	55.44
54	53.75	54.50	56.00	57.63
56	56.00	56.88	58.18	59.63
58	58.19	59.07	60.19	62.19
60	60.44	61.31	62.44	64.19

Class 300

Size NPS	Inner Ring	Sealing Element		Outer Ring
	Inside (A) Diameter	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
26	25.75	26.50	28.00	30.38
28	27.75	28.50	30.00	32.50
30	29.75	30.50	32.00	34.88
32	31.75	32.50	34.00	37.00
34	33.75	34.50	36.00	39.13
36	35.75	36.50	38.00	41.25
38	38.25	39.75	41.25	43.25
40	40.25	41.75	43.25	45.25
42	42.75	43.75	45.25	47.25
44	44.25	45.75	47.25	49.25
46	46.38	47.88	49.38	51.88
48	48.50	49.75	51.63	53.88
50	49.88	51.88	53.38	55.88
52	51.88	53.88	55.38	57.88
54	53.75	55.25	57.25	60.25
56	56.25	58.25	60.00	62.75
58	58.44	60.44	61.94	65.19
60	61.31	62.56	64.19	67.19

Styles RW, RWI Dimensions 26-60" Series B Flanges

ASME B16.20 Gaskets for ASME B16.47 Series B Flanges (API-605)

Class 400

Size NPS	Inner Ring	Sealing Element		Outer Ring
	Inside (A) Diameter	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
26	25.75	26.25	27.50	29.38
28	27.63	28.13	29.50	31.50
30	29.63	30.13	31.75	33.75
32	31.50	32.00	33.88	35.88
34	33.50	34.13	35.88	37.88
36	35.38	36.13	38.00	40.25
38	37.50	38.25	40.25	42.25
40	39.38	40.38	42.38	44.38
42	41.38	42.38	44.38	46.38
44	43.50	44.50	46.50	48.50
46	46.00	47.00	49.00	50.75
48	47.50	49.00	51.00	53.00
50	49.50	51.00	53.00	55.25
52	51.50	53.00	55.00	57.25
54	53.25	55.25	57.25	59.75
56	55.25	57.25	59.25	61.75
58	57.25	59.25	61.25	63.75
60	59.75	61.75	63.75	66.25

Class 600

Size NPS	Inner Ring	Sealing Element		Outer Ring
	Inside (A) Diameter	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
26	25.38	26.13	28.13	30.13
28	27.25	27.75	29.75	32.25
30	29.63	30.63	32.63	34.63
32	31.25	32.75	34.75	36.75
34	33.50	35.00	37.00	39.25
36	35.50	37.00	39.00	41.25
38	37.50	39.00	41.00	43.50
40	39.75	41.25	43.25	45.50
42	42.00	43.50	45.50	48.00
44	43.75	45.75	47.75	50.00
46	45.75	47.75	49.75	52.25
48	48.00	50.00	52.00	54.75
50	50.00	52.00	54.00	57.00
52	52.00	54.00	56.00	59.00
54	54.25	56.25	58.25	61.25
56	56.25	58.25	60.25	63.50
58	58.00	60.50	62.50	65.50
60	60.25	62.75	64.75	68.25

Class 900

Size NPS	Inner Ring	Sealing Element		Outer Ring
	Inside (A) Diameter	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
26	26.25 (1)	27.25	29.50	33.00
28	28.25 (1)	29.25	31.50	35.50
30	30.75 (1)	31.75	33.75	37.75
32	33.00 (1)	34.00	36.00	40.00
34	35.25 (1)	36.25	38.25	42.25
36	36.25 (1)	37.25	39.25	44.25
38	39.75 (1)	40.75	42.75	47.25
40	41.75 (1)	43.25	45.25	49.25
42	43.75 (1)	45.25	47.25	51.25
44	45.50 (1)	47.50	49.50	53.88
46	48.00 (1)	50.00	52.00	56.50
48	50.00 (1)	52.00	54.00	58.50

Notes:

1. Inner rings are recommended for all graphite filled gaskets, required for all PTFE filled gaskets, and for NPS 24 and larger in Class 900, NPS 12 and larger in Class 1500, and NPS 4 and larger in Class 2500.
2. The gasket inside diameter tolerance for NPS 26 through NPS 34 is ±0.03"; for NPS 36 through NPS 60 is ±0.05".
3. The gasket outside diameter tolerance for NPS 26 through NPS 60 is ±0.06".
4. The centering ring outside diameter tolerance is ±0.03".
5. There are no Class 900 flanges in NPS 50 and larger.

WARNING:

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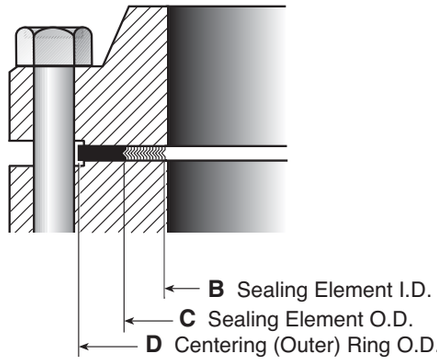
Style RW Dimensions Other Large Diameter Flanges, 26-96"



Class 75
Slip-On and Blind

Size NPS	Sealing Element		Outer Ring
	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
26	27.00	28.25	30.13
28	29.00	30.25	32.13
30	31.00	32.25	34.13
32	33.13	34.38	36.38
34	35.13	36.50	38.38
36	37.13	38.50	40.38
42	43.25	44.75	46.63
48	49.25	50.88	52.63
54	55.38	57.75	59.13
60	61.38	63.38	65.13
66	67.50	69.50	71.75
72	73.50	75.50	77.75

Class 75
Weld Neck and Blind

Size NPS	Sealing Element		Outer Ring
	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
26	26.50	27.75	28.75
28	28.50	29.75	30.75
30	30.50	31.75	32.75
32	32.50	33.75	35.13
34	34.50	35.88	37.13
36	36.50	37.88	39.13
42	42.50	44.00	45.63
48	48.50	50.13	51.63
54	54.50	56.38	57.88
60	60.50	62.50	63.88
66	66.50	68.50	70.25
72	72.50	74.50	76.25

Class 125

Size NPS	Sealing Element		Outer Ring
	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
22	22.75	24.00	26.00
26	26.50	27.75	30.50
28	28.50	29.75	32.75
30	30.50	31.75	34.75
32	32.50	33.88	37.00
34	34.50	35.88	39.00
36	36.50	38.13	41.25
38	38.50	40.13	43.75
40	40.50	42.13	45.75
42	42.50	44.25	48.00
44	44.50	46.38	50.25
46	46.50	48.38	52.25
48	48.50	50.38	54.50
50	50.50	52.50	56.50
52	52.50	54.50	58.75
54	54.50	56.50	61.00
60	60.50	62.50	67.50
66	71.00	72.75	74.25
72	77.50	79.25	80.75
84	90.25	92.00	93.50
96	103.00	104.75	106.25

Style RW Dimensions Other Large Diameter Flanges, 26-96"

Class 175

Size NPS	Sealing Element		Outer Ring
	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
26	26.50	27.75	29.13
28	28.50	29.75	31.13
30	30.50	31.75	33.38
32	32.50	33.75	35.38
34	34.50	35.88	37.50
36	36.50	37.88	39.50
38	38.50	39.88	41.50
40	40.50	42.00	43.50
42	42.50	44.00	45.88
44	44.50	46.00	47.88
46	46.50	48.00	49.88
48	48.50	50.13	51.88
50	50.50	52.25	53.88
52	52.50	54.38	56.13
54	54.50	56.75	58.13
60	60.50	62.50	64.13
66	67.88	68.88	70.13
72	73.38	75.13	76.63
84	87.00	88.75	90.25
96	99.00	100.75	102.25

Class 250

Size NPS	Sealing Element		Outer Ring
	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
26	26.50	27.75	32.75
28	28.50	29.75	35.25
30	30.50	31.75	37.50
32	32.50	33.88	39.75
34	34.50	35.88	41.75
36	36.50	38.13	44.00
38	38.50	40.13	46.00
40	40.50	42.13	48.25
42	42.50	44.25	50.75
44	44.50	46.38	53.00
46	46.50	48.38	55.25
48	48.50	50.38	58.75

Class 350

Size NPS	Sealing Element		Outer Ring
	Inside (B) Diameter	Outside (C) Diameter	Outside (D) Diameter
26	26.50	27.75	29.63
28	28.50	29.75	31.63
30	30.50	31.75	33.88
32	32.50	33.88	35.88
34	34.50	35.88	37.88
36	36.50	38.13	40.38
38	38.50	40.13	42.38
40	40.50	42.13	44.38
42	42.50	44.25	46.63
44	44.50	46.38	49.00
46	46.50	48.38	51.00
48	48.50	50.38	53.00
52	52.50	54.50	57.38
54	54.50	56.50	59.38
60	60.50	62.50	65.38
66	66.50	68.50	72.50
72	72.25	77.00	78.50
84	88.38	90.13	91.63
96	100.75	102.50	104.00

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.

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Gasket Factors "M" and "Y"

"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.

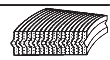
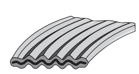
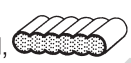
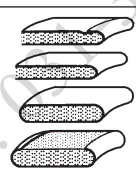
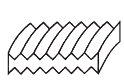
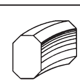
$$M = (W - A_2P) / A_1P$$

Where: W = Total Fastener force (lb. or N)
A_2 = Inside area of gasket (in.^{2} or mm^2)
P = Test pressure (psig or N/mm^2)
A_1 = Gasket area (in.^{2} or mm^2)

"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).

$$Y = W / A_1$$

Gasket Design	Gasket Material	Gasket Factor "M"	Min. Design Seating Stress "Y" psi
Spiral wound metal, non-asbestos filled 	Stainless steel or MONEL®	3.00	10,000
Garlock CONTROLLED DENSITY® flexible graphite-filled spiral wound 	Stainless steel or MONEL®	3.00	7,500
Garlock EDGE® 	Stainless steel or MONEL®	2.00	5,000
Garlock GRAPHONIC® 	Stainless steel and flexible graphite Liquid service:	2.00 (1/16") 9.00 (1/8") 2.00	2,000 (1/16") 3,000 (1/8") 900
Corrugated metal, non-asbestos or Corrugated metal-jacketed, non-asbestos filled 	Soft aluminum Soft copper or brass Iron or soft steel MONEL® or 4%-6% chrome Stainless steel	2.50 2.75 3.00 3.25 3.50	2,900 3,700 4,500 5,500 6,500
Corrugated metal 	Soft aluminum Soft copper or brass Iron or soft steel MONEL® or 4%-6% chrome Stainless steel	2.75 3.00 3.25 3.50 3.75	3,700 4,500 5,500 6,500 7,600
Flat metal-jacketed, non-asbestos filled 	Soft aluminum Soft copper or brass Iron or soft steel MONEL® 4%-6% chrome Stainless steel	3.25 3.50 3.75 3.50 3.75 3.75	5,500 6,500 7,600 8,000 9,000 9,000
Grooved metal 	Soft aluminum Soft copper or brass Iron or soft steel MONEL® or 4%-6% chrome Stainless steel	3.25 3.50 3.75 3.75 4.25	5,500 6,500 7,600 9,000 10,100
Solid flat metal 	Soft aluminum Soft copper or brass Iron or soft steel MONEL® or 4%-6% chrome Stainless steel	4.00 4.75 5.50 6.00 6.50	8,800 13,000 18,000 21,800 26,000
Ring joint 	Iron or soft steel MONEL® or 4%-6% chrome Stainless steel	5.50 6.00 6.50	18,000 21,800 26,000

This table lists many commonly used gasket materials and contact facings with suggested design values of "M" and "Y" that generally have proven satisfactory in actual service when using effective gasket seating width B_1 described in the formula on page D-32. The design values and other details given in this table are suggested only and are not mandatory.

MONEL® is a registered trademark of International Nickel.

Torque Tables

These tables were developed to be used with Garlock spiral wound gaskets. They are to be used only as a general guide. They should not be considered to contain absolute values due to the large number of uncontrollable variables involved with bolted joints.

All bolt torque values are based upon the use of new nuts (ASTM A194, GR 2H) and new bolts (ASTM A193, GR B7) of proper design, acceptable quality and approved materials of construction as well as metallurgy. It is also required that two hardened steel washers be used under the head of each nut and that a thread lubricant (i.e. oil and graphite) be used on the nuts, bolts and washers.

The flanges are assumed to be in good condition and in compliance with ASME B16.5 specifications. Special attention should be given to seating surface finish and flatness.

Only torque wrenches that have been calibrated should be used. The proper bolt tightening pattern must be followed (see installation section on page D-42 for proper bolting pattern) with the desired ultimate torque value arrived at in a minimum of three equal increments. All bolts in the flange should then be checked in consecutive bolt-to-bolt order.

The contact dimensions listed are taken from the ID and OD of the windings, which are different from the ASME ring gasket dimensions.

No provisions have been made in these tables to account for vibration effects on the bolts. These tables are based on ambient conditions, without compensation for elevated temperatures.

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.

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Torque Tables

150# Raised Face Flanges

			FLEXSEAL®		EDGE®		Kammprofile		GRAPHONIC®		Jacketed Gasket	
Nom. Pipe Size (inches)	No of Bolts	Size of Bolts	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)
0.50	4	0.50	16	47	9	52	8	42	11	37	18	53
0.75	4	0.50	22	60	12	60	11	54	16	60	25	60
1	4	0.50	30	60	15	60	13	60	21	60	27	60
1.25	4	0.50	33	60	16	60	24	60	33	60	42	60
1.5	4	0.50	47	60	23	60	31	60	43	60	59	60
2	4	0.63	74	120	36	120	55	120	87	120	94	120
2.5	4	0.63	87	120	43	120	63	120	101	120	108	120
3	4	0.63	120	120	63	120	102	120	120	120	120	120
4	8	0.63	92	120	47	120	76	120	105	120	111	120
5	8	0.75	124	200	63	200	106	200	146	200	189	200
6	8	0.75	178	200	89	200	137	200	185	200	173	200
8	8	0.75	200	200	128	200	190	200	250	200	200	200
10	12	0.88	236	320	120	320	178	320	235	320	300	320
12	12	0.88	320	320	163	320	178	320	312	320	320	320
14	12	1.00	408	490	209	490	268	490	396	490	451	490
16	16	1.00	421	490	210	490	267	490	377	490	449	490
18	16	1.13	649	710	328	710	381	710	560	710	562	710
20	20	1.13	572	710	289	710	335	710	494	710	562	710
24	20	1.25	820	1000	415	1000	438	1000	704	1000	740	1000

Based on ASTM A193 B7 bolts - 60,000 psi maximum bolt stress

300# Raised Face Flanges

			FLEXSEAL®		EDGE®		Kammprofile		GRAPHONIC®		Jacketed Gasket	
Nom. Pipe Size (inches)	No of Bolts	Size of Bolts	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)
0.50	4	0.50	16	47	9	52	8	42	11	37	18	53
0.75	4	0.63	28	84	15	88	14	68	20	67	31	92
1	4	0.63	38	114	19	115	17	84	27	89	34	102
1.25	4	0.63	41	120	20	120	30	120	41	120	53	120
1.5	4	0.75	66	198	32	191	43	200	60	200	81	200
2	8	0.63	37	112	18	109	27	120	43	120	47	120
2.5	8	0.75	48	145	24	144	35	177	56	188	60	180
3	8	0.75	71	200	35	200	57	200	83	200	75	200
4	8	0.75	103	200	52	200	84	200	117	200	123	200
5	8	0.75	124	200	63	200	106	200	146	200	189	200
6	12	0.75	118	200	60	200	92	200	123	200	116	200
8	12	0.88	194	320	98	320	146	320	192	320	207	320
10	16	1.00	206	490	105	490	155	490	205	490	262	490
12	16	1.13	309	710	156	710	171	710	299	710	341	710
14	20	1.13	269	710	138	710	177	710	261	710	297	710
16	20	1.25	399	1000	203	1000	259	1000	365	1000	435	1000
18	24	1.25	478	1000	241	1000	280	1000	412	1000	414	1000
20	24	1.25	526	1000	266	1000	308	1000	454	1000	517	1000
24	24	1.50	723	1600	366	1600	386	1600	621	1600	652	1600

Based on ASTM A193 B7 bolts - 60,000 psi maximum bolt stress

Torque Tables

400# Raised Face Flanges

			FLEXSEAL®		EDGE®		Kammprofile		GRAPHONIC®		Jacketed Gasket	
Nom. Pipe Size (inches)	No of Bolts	Size of Bolts	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)
0.50	4	0.50	16	47	17	52	8	42			18	53
0.75	4	0.63	28	84	29	88	14	68			31	92
1	4	0.63	38	114	38	115	17	84			34	102
1.25	4	0.63	41	120	40	120	30	120			53	120
1.5	4	0.75	66	198	64	191	43	200			81	200
2	8	0.63	37	112	36	109	27	120			47	120
2.5	8	0.75	48	145	48	144	35	177			60	180
3	8	0.75	71	200	71	200	57	200			75	200
4	8	0.88	149	320	120	320	97	320			142	320
5	8	0.88	190	320	146	320	123	320	Contact Engineering		218	320
6	12	0.88	173	320	138	320	106	320			133	320
8	12	1.00	280	490	22-	490	170	490			241	490
10	16	1.13	314	710	230	691	170	710			287	710
12	16	1.25	456	1000	345	1000	188	941			376	1000
14	20	1.25	373	1000	304	911	195	975			328	983
16	20	1.38	532	1630	445	1335	283	1360			475	1360
18	24	1.38	567	1360	527	1360	306	1360			452	1357
20	24	1.50	604	1600	563	1600	326	1600			547	1600
24	24	1.75	962	2887	975	2924	513	2566			868	2603

Based on ASTM A193 B7 bolts - 60,000 psi maximum bolt stress

600# Raised Face Flanges

			FLEXSEAL®		EDGE®		Kammprofile		GRAPHONIC®		Jacketed Gasket	
Nom. Pipe Size (inches)	No of Bolts	Size of Bolts	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)
0.50	4	0.50	16	47	17	52	8	42			18	53
0.75	4	0.63	28	84	29	88	14	68			31	92
1	4	0.63	38	114	38	115	17	84			34	102
1.25	4	0.63	41	120	40	120	30	120			53	120
1.5	4	0.75	66	198	64	191	43	200			81	200
2	8	0.63	37	112	36	109	27	120			47	120
2.5	8	0.75	48	145	48	144	35	177			60	180
3	8	0.75	71	200	71	200	57	200			75	200
4	8	0.88	149	320	120	320	97	320			142	320
5	8	1.00	221	490	170	490	143	490	Contact Engineering		254	490
6	12	1.00	202	490	160	480	123	490			155	466
8	12	1.13	307	710	241	710	187	710			264	710
10	16	1.25	346	1000	254	763	188	938			317	951
12	20	1.25	365	1000	276	829	151	753			301	904
14	20	1.38	408	1224	332	996	213	1066			358	1075
16	20	1.50	514	1543	430	1291	274	1370			460	1379
18	20	1.63	757	2200	704	2112	409	2044			604	1811
20	24	1.63	695	2085	647	1941	375	1875			629	1886
24	24	1.88	1103	3308	1117	3350	588	2940			994	2983

Based on ASTM A193 B7 bolts - 60,000 psi maximum bolt stress

Torque Tables

900# Raised Face Flanges

			FLEXSEAL®		EDGE®		Kammprofile		GRAPHONIC®		Jacketed Gasket	
Nom. Pipe Size (inches)	No of Bolts	Size of Bolts	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)
0.50	4	0.75	22	100	24	100	12	100	Contact Engineering		24	73
0.75	4	0.75	31	100	33	100	15	100			34	103
1	4	0.88	49	160	49	160	22	160			44	131
1.25	4	0.88	53	160	52	160	39	193			68	204
1.5	4	1.00	89	266	85	256	58	289			109	328
2	8	0.88	48	160	47	160	35	176			60	180
2.5	8	1.00	65	245	65	245	47	245			81	242
3	8	0.88	106	319	81	244	66	328			87	260
4	8	1.13	191	572	153	458	124	622			182	545
5	8	1.25	268	804	206	617	173	865			307	921
6	12	1.13	221	664	176	527	135	675			170	511
8	12	1.38	333	1000	303	909	225	1127			319	956
10	16	1.38	306	919	278	835	205	1026			347	1040
12	20	1.38	368	1103	302	907	165	824			329	988
14	20	1.50	388	1164	321	963	206	1031			347	1040
16	20	1.63	514	1541	495	1485	315	1575			529	1586
18	20	1.88	991	2972	933	2800	542	2710			800	2401
20	20	2.00	934	2802	984	2952	540	2850			956	2867
24	20	2.50	1382	4400	1582	4747	833	4400			1409	4227

Based on ASTM A193 B7 bolts - 60,000 psi maximum bolt stress

1500# Raised Face Flanges

			FLEXSEAL®		EDGE®		Kammprofile		GRAPHONIC®		Jacketed Gasket	
Nom. Pipe Size (inches)	No of Bolts	Size of Bolts	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)
0.50	4	0.75	22	100	24	100	20	100	Contact Engineering		24	73
0.75	4	0.75	31	100	33	100	25	100			34	103
1	4	0.88	49	160	49	160	36	160			44	131
1.25	4	0.88	80	240	52	160	64	193			68	204
1.5	4	1.00	118	353	85	256	96	289			109	328
2	8	0.88	76	227	47	160	59	176			60	180
2.5	8	1.00	108	325	65	245	79	245			81	242
3	8	1.13	150	451	104	355	140	419			111	332
4	8	1.25	231	694	169	506	229	686			200	601
5	8	1.50	323	970	218	800	305	915			325	975
6	12	1.38	289	867	212	680	272	815			206	617
8	12	1.63	432	1297	337	1100	418	1253			354	1063
10	12	1.88	754	2262	547	2000	673	2018			682	2045
12	16	2.00	647	2200	532	2200	484	2200			580	1741
14	16	2.25	684	3180	655	3180	701	3180			707	2121
16	16	2.50	1141	4400	969	4400	1027	4400			1035	3104
18	16	2.75	1606	5920	1513	5920	1464	5920			1297	3892
20	16	3.00	1921	7720	1810	7720	1748	7720			1758	5273
24	16	3.50	3100	13000	2867	13000	2516	13000			2553	7658

Based on ASTM A193 B7 bolts - 60,000 psi maximum bolt stress

Torque Tables

2500# Raised Face Flanges

			FLEXSEAL®		EDGE®		Kammprofile		GRAPHONIC®		Jacketed Gasket	
Nom. Pipe Size (inches)	No of Bolts	Size of Bolts	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)	Minimum Torque (ft.lbs)	Preferred Torque (ft.lbs)
0.50	4	0.75	22	100	24	100	20	100	Contact Engineering		24	73
0.75	4	0.75	31	100	33	100	25	100			34	103
1	4	0.88	49	160	49	160	36	160			44	131
1.25	4	1.00	93	279	60	245	75	245			79	237
1.5	4	1.13	129	387	94	355	106	355			120	360
2	8	1.00	88	264	55	245	68	245			70	210
2.5	8	1.13	119	357	71	355	87	355			89	266
3	8	1.25	166	500	115	500	154	500			122	367
4	8	1.50	245	800	178	800	242	800			212	636
5	8	1.75	430	1500	289	1500	406	1500			432	1297
6	8	2.00	611	2200	448	2200	574	2200			434	1303
8	12	2.00	548	2200	427	2200	529	2200			449	1347
10	12	2.50	831	4400	646	4400	794	4400			805	2415
12	12	2.75	1326	5920	963	5920	875	5920			1050	3150

Based on ASTM A193 B7 bolts - 60,000 psi maximum bolt stress

WARNING:
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Torque to Stress Bolts

The torque required to produce a certain stress in bolting is dependent on several conditions, including:

- Diameter and number of threads on bolt
- Condition of nut bearing surfaces
- Lubrication of bolt threads and nut bearing sur faces.

The tables below reflect the results of many tests to determine the relation between torque and bolt stress. Values are based on steel bolts that have been well-lubricated with a heavy graphite and oil mixture.

A non-lubricated bolt has an efficiency of about 50% of a well-lubricated bolt. Also, different lubricants produce results that vary from 50% to 100% of the tabulated stress figures.

For Alloy Steel Stud Bolts (Load in pounds on stud bolts when torque load is applied)

Nominal Diameter of Bolt (inches)	Number of Threads (per inch)	Diameter at Root of Thread (inches)	Area at Root of Thread (sq. inch)	Stress					
				30,000 psi		45,000 psi		60,000 psi	
				Torque (ft lbs)	Compres-sion (lbs)	Torque (ft lbs)	Compres-sion (lbs)	Torque (ft lbs)	Compres-sion (lbs)
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	8,880	236,655	11,840	315,540
3	8	2.838	6.324	7,720	189,720	11,580	264,580	15,440	379,440

For Machine Bolts and Cold Rolled Steel Stud Bolts (Load in pounds on stud bolts when torque load is applied)

Nominal Diameter of Bolt (inches)	Number of Threads (per inch)	Diameter at Root of Thread (inches)	Area at Root of Thread (sq. inch)	Stress					
				7,500 psi		15,000 psi		30,000 psi	
				Torque (ft lbs)	Compres-sion (lbs)	Torque (ft lbs)	Compres-sion (lbs)	Torque (ft lbs)	Compres-sion (lbs)
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	2,340	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

Flange and Bolt Dimensions

For Standard Flanges

NPS (inches)	150 psi				300 psi				400 psi				600 psi			
	Dia. of Flange (inches)	No. of Bolts	Dia. of Bolts (Inches)	Bolt Circle (Inches)	Dia. of Flange (Inches)	No. of Bolts	Dia. of Bolts (Inches)	Bolt Circle (Inches)	Dia. of Flange (Inches)	No. of Bolts	Dia. of Bolts (Inches)	Bolt Circle (Inches)	Dia. of Flange (Inches)	No. of Bolts	Dia. of Bolts (Inches)	Bolt Circle (Inches)
1/4	3-3/8	4	1/2	2-1/4	3-3/8	4	1/2	2-1/4	3-3/8	4	1/2	2-1/4	3-3/8	4	1/2	2-1/4
1/2	3-1/2	4	1/2	2-3/8	3-3/4	4	1/2	2-5/8	3-3/4	4	1/2	2-5/8	3-3/4	4	1/2	2-5/8
3/4	3-7/8	4	1/2	2-3/4	4-5/8	4	5/8	3-1/4	4-5/8	4	5/8	3-1/4	4-5/8	4	5/8	3-1/4
1	4-1/4	4	1/2	3-1/8	4-7/8	4	5/8	3-1/2	4-7/8	4	5/8	3-1/2	4-7/8	4	5/8	3-1/2
1-1/4	4-5/8	4	1/2	3-1/2	5-1/4	4	5/8	3-7/8	5-1/4	4	5/8	3-7/8	5-1/4	4	5/8	3-7/8
1-1/2	5	4	1/2	3-7/8	6-1/8	4	3/4	4-1/2	6-1/8	4	3/4	4-1/2	6-1/8	4	3/4	4-1/2
2	6	4	5/8	4-3/4	6-1/2	8	5/8	5	6-1/2	8	5/8	5	6-1/2	8	5/8	5
2-1/2	7	4	5/8	5-1/2	7-1/2	8	3/4	5-7/8	7-1/2	8	3/4	5-7/8	7-1/2	8	3/4	5-7/8
3	7-1/2	4	5/8	6	8-1/4	8	3/4	6-5/8	8-1/4	8	3/4	6-5/8	8-1/4	8	3/4	6-5/8
3-1/2	8-1/2	8	5/8	7	9	8	3/4	7-1/4	9	8	7/8	7-1/4	9	8	7/8	7-1/4
4	9	8	5/8	7-1/2	10	8	3/4	7-7/8	10	8	7/8	7-7/8	10-3/4	8	7/8	8-1/2
5	10	8	3/4	8-1/2	11	8	3/4	9-1/4	11	8	7/8	9-1/4	13	8	1	10-1/2
6	11	8	3/4	9-1/2	12-1/2	12	3/4	10-5/8	12-1/2	12	7/8	10-5/8	14	12	1	11-1/2
8	13-1/2	8	3/4	11-3/4	15	12	7/8	13	15	12	1	13	16-1/2	12	1-1/8	13-3/4
10	16	12	7/8	14-1/4	17-1/2	16	1	15-1/4	17-1/2	16	1-1/8	15-1/4	20	16	1-1/4	17
12	19	12	7/8	17	20-1/2	16	1-1/8	17-3/4	20-1/2	16	1-1/4	17-3/4	22	20	1-1/4	19-1/4
14	21	12	1	18-3/4	23	20	1-1/8	20-1/4	23	20	1-1/4	20-1/4	23-3/4	20	1-3/8	20-3/4
16	23-1/2	16	1	21-1/4	25-1/2	20	1-1/4	22-1/2	25-1/2	20	1-3/8	22-1/2	27	20	1-1/2	23-3/4
18	25	16	1-1/8	22-3/4	28	24	1-1/4	24-3/4	28	24	1-3/8	24-3/4	29-1/4	20	1-5/8	25-3/4
20	27-1/2	20	1-1/8	25	30-1/2	24	1-1/4	27	30-1/2	24	1-1/2	27	32	24	1-5/8	28-1/2
24	32	20	1-1/4	29-1/2	36	24	1-1/2	32	36	24	1-3/4	32	37	24	1-7/8	33

NPS (inches)	900 psi				1500 psi				2500 psi			
	Dia. of Flange (inches)	No. of Bolts	Dia. of Bolts (Inches)	Bolt Circle (Inches)	Dia. of Flange (Inches)	No. of Bolts	Dia. of Bolts (Inches)	Bolt Circle (Inches)	Dia. of Flange (Inches)	No. of Bolts	Dia. of Bolts (Inches)	Bolt Circle (Inches)
1/2	4-3/4	4	3/4	3-1/4	4-3/4	4	3/4	3-1/4	5-1/4	4	3/4	3-1/2
3/4	5-1/8	4	3/4	3-1/2	5-1/8	4	3/4	3-1/2	5-1/2	4	3/4	3-3/4
1	5-7/8	4	7/8	4	5-7/8	4	7/8	4	6-1/4	4	7/8	4-1/4
1-1/4	6-1/4	4	7/8	4-3/8	6-1/4	4	7/8	4-3/8	7-1/4	4	1	5-1/8
1-1/2	7	4	1	4-7/8	7	4	1	4-7/8	8	4	1-1/8	5-3/4
2	8-1/2	8	7/8	6-1/2	8-1/2	8	7/8	6-1/2	9-1/4	8	1	6-3/4
2-1/2	9-5/8	8	1	7-1/2	9-5/8	8	1	7-1/2	10-1/2	8	1-1/8	7-3/4
3	9-1/2	8	7/8	7-1/2	10-1/2	8	1-1/8	8	12	8	1-1/4	9
4	11-1/2	8	1-1/8	9-1/4	12-1/4	8	1-1/4	9-1/2	14	8	1-1/2	10-3/4
5	13-3/4	8	1-1/4	11	14-3/4	8	1-1/2	11-1/2	16-1/2	8	1-3/4	12-3/4
6	15	12	1-1/8	12-1/2	15-1/2	12	1-3/8	12-1/2	19	8	2	14-1/2
8	18-1/2	12	1-3/8	15-1/2	19	12	1-5/8	15-1/2	21-3/4	12	2	17-1/4
10	21-1/2	16	1-3/8	18-1/2	23	12	1-7/8	19	26-1/2	12	2-1/2	21-1/4
12	24	20	1-3/8	21	26-1/2	16	2	22-1/2	30	12	2-3/4	24-3/8
14	25-1/4	20	1-1/2	22	29-1/2	16	2-1/4	25				
16	27-3/4	20	1-5/8	24-1/2	32-1/2	16	2-1/2	27-3/4				
18	31	20	1-7/8	27	36	16	2-3/4	30-1/2				
20	33-3/4	20	2	29-1/2	38-3/4	16	3	32-3/4				
24	41	20	2-1/2	35-1/2	46	16	3-1/2	39				

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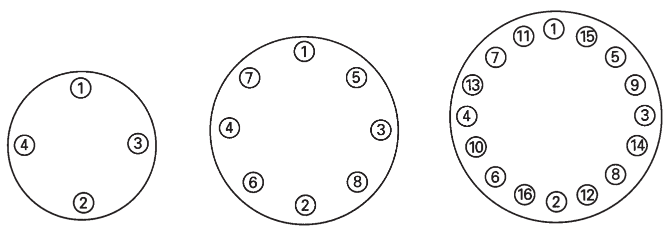
Gasket Installation

In a flanged connection, all components must be correct to achieve a seal. The most common cause of leaky gasketed joints is improper installation procedures.

Bolting Procedures



4-Bolt Flange 8-Bolt Flange 16-Bolt Flange

- Place the gasket on the flange surface to be sealed.
- Bring the opposing flange into contact with the gasket.
- Bolts must be new or in as-new condition. Clean the threads and lubricate them with a quality lubricant, such as an oil and graphite mixture.
- Place the bolts into the bolt holes.
- Finger-tighten the nuts.
- Follow the bolting sequence in the diagrams above.
- During the initial tightening sequence, do not tighten any bolts more than 30% of the recommended bolt stress. Doing so will cause cocking of the flange and the gasket will be crushed.
- Upon reaching the recommended torque requirements, do a circular bolt-to-bolt torque check to make certain that the bolts have been stressed evenly.
- Due to creep and stress relaxation, it is essential to prestress the bolts to ensure adequate stress load during operation.

Prestressing Bolts for Thermal Expansion

Bolts should be prestressed to compensate for thermal expansion as well as for relaxation, creep, hydrostatic end pressure and residual gasket loads.

A difference in the coefficient of thermal expansion between the materials of the flange and the bolts may change loads. In cases of serious thermal expansion, it may be necessary to apply a minimum of stress to the bolts and allow the pipe expansion to complete the compression of the gasket.

A gasket with a centering guide ring should be compressed to the guide ring. A gasket without a centering guide ring must be installed with precautions taken to prevent thermal expansion from crushing the gasket beyond its elastic limit.

Troubleshooting Leaking Joints

One of the best methods for determining the cause of joint leakage is the careful examination of the gasket where the leakage occurred.

Observation	Possible Remedies
Gasket badly corroded	• Select replacement material with improved corrosion resistance.
Gasket extruded excessively	• Select replacement material with better cold flow properties. • Select replacement material with better load capacity—i.e., more dense.
Gasket grossly crushed	• Select replacement material with better load carrying capacity. • Provide means to prevent crushing the gasket by use of a stop ring or redesign of flanges.
Gasket mechanically damaged due to overhang of raised face or flange bore.	• Review gasket dimensions to insure gaskets are proper size. • Make certain gaskets are properly centered in joint.
No apparent gasket compression achieved	• Select softer gasket material. • Select thicker gasket material. • Reduce gasket area to allow higher unit seating load.
Gasket substantially thinner on OD than ID due to excessive flange rotation or bending	• Alter gasket dimensions to move gasket reaction closer to bolts to minimize bending movement. • Provide stiffness to flange by means of back-up rings. • Select softer gasket material to lower required seating stresses. • Reduce gasket area to lower seating stresses.
Gasket unevenly compressed around circumference	• Make certain proper sequential bolt-up procedures are followed. • Ensure flanges are properly aligned
Gasket thickness varies periodically around circumference	• Provide reinforcing rings for flanges to better distribute bolt load. • Select gasket material with lower seating stress. • Provide additional bolts if possible to obtain better load distribution. • If flanges are warped, remachine or use softer gasket material.

Ordering Guide

RW, RWI Spiral Wound

When ordering, specify:

- Nominal pipe size or gasket dimensions, and pressure class
- Winding and filler materials
- Centering and/or inner compression ring material

SW Spiral Wound

When ordering, specify:

- OD and ID dimensions (and tolerance, if other than standard—see page D-19)
- Thickness of gasket
- Winding and filler material
- Inner ring material, if required (Style SWI)
- Pressure rating

HH, MC and MCR Manhole

When ordering, specify:

- Make and model of boiler and/or equipment if available (See chart page D-10)
- Gasket style and configuration
- Dimensions of gasket (thickness, flange seating width, and shape)
- Maximum operating pressure and temperature
- Type of metal and filler materials

Custom Gaskets

A spiral wound gasket can be made to almost any dimension required. Possible designs include multiple windings and rings, with combinations of different fillers or special winding materials and ring shapes. Describe your application or send us a drawing and we'll help you design the appropriate winding.

Heat Exchanger

The size restrictions for heat exchanger gaskets depend only on the available sizes of the materials. Heat exchanger gaskets are commonly made in diameters up to 120", with rib widths up to 1-1/4" and thicknesses up to 1/4".

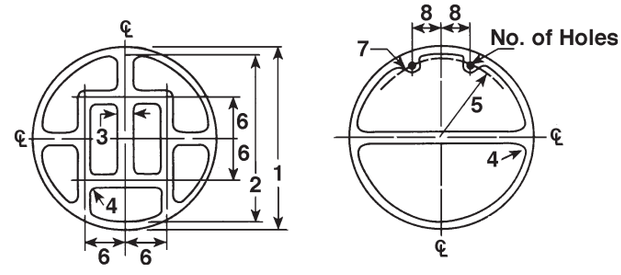
When ordering, specify:

- Style number
- Shape (Give configuration code, page D-13)
- Thickness
- Material (metal or metal and filler)

Plus specify (according to diagram below):

1. Outside diameter
2. Inside diameter
3. Rib width
4. Radii on ribs, at rib intersect points and around bolt holes
5. Bolt circle diameter
6. Distance from center line of gasket to center line of ribs
7. Size and number of bolt holes

Note: In addition to the above information, drawings of your application are always helpful in proper dimensioning of gaskets.



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Application Data Form

Date_____

For: Garlock Metallic Gasketing Engineering
Fax 1-281-458-0502
Page: 1 of _____
Drawing attached ❑ Yes ❑ No

From _____

Title _____
Company _____
Address _____
Fax No. _____
Phone No. _____
E-mail Address _____

Application

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

Service Conditions

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

Bolts

Grade _____
Diameter _____
Length _____
Number _____

Chemical Compatibility

Media _____
pH _____
Concentration _____
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: _____
_____
_____

Common Abbreviations

SI - International Metric Standard
Pa - Pascal
psi - pounds per square inch
psig - pounds per square inch gage
oz - ounce
g - gram
lbf - pound force
kgf - kilogram force
N - Newton
in - inch
ft - foot
yd - yard
m - meter
gal - gallon
l - liter

Prefixes

M (mega) = 1,000,000 = 10^6
k (kilo) = 1,000 = 10^3
c (centi) = 0.01 = 10^{-2}
m (milli) = 0.001 = 10^{-3}
u (micro) = 0.000001 = 10^{-6}

Metric Conversions

To Convert from:	To SI Units:	Multiply by:
Length		
mil	mm	0.0254
in	mm	25.4
in	cm	2.54
ft	m	0.3048
yd	m	0.9144
Weight		
oz	g	28.35
oz	kg	0.0283
lb	g	453.6
lb	kg	0.4536
lb	N	4.4482
Force		
lbf	N	4.448
kgf	N	9.8066
Area		
in^2	cm^2	6.4516
ft^2	m^2	0.0929
Pressure		
bar	psi	14.5
psi	Pa	6895
psi	kPa	6.89
psi	bar	0.069
psi	MPa	0.0069
N/m^2	Pa	1.00
N/mm^2	MPa	1.00
Torque		
in-lb	Nm	0.113
ft-lb	Nm	1.3558
Density		
oz/in^3	g/cm^3	1.73
g/cm^3	kg/m^3	1000
lb/ft^3	kg/m^3	16.02
lb/ft^3	g/cm^3	0.01602
Adhesion		
lb/in	kN/m	0.1751
Volume		
gal	l	3.7854
gal	m^3	0.0038

Advancing the Science of Sealing™

Hydraulic Components Technical Manual

Garlock
SEALING TECHNOLOGIES®

an EnPro Industries company

Garlock Hydraulic Components

Garlock has been the leading manufacturer of industrial sealing products since 1887. The Hydraulic Components division has the experience, technology and products to meet the demanding needs found in today's reciprocating equipment.

- CHEVRON®: the original vee ring packing, now available in Deep Vee Ring design
- Style 9220 GARTHANE® U-Seals: strong, flexible, and durable
- Polytop and SLUDGE-PAK® Sets: unique combinations for difficult service
- Roll Balance Packing: tough steel and aluminum mill packing

Contents

CHEVRON® Packing

Automatic Sealing System

Garlock CHEVRON® packing is the original automatic hydraulic and pneumatic design for sealing rods, pistons and plungers. The distinctive and exclusive hinge-like action of each CHEVRON® ring permits immediate reaction even to minor pressure changes. Each individual lip of a CHEVRON® packing set independently reacts to pressure, and automatically effects a seal. The multiple lip configuration automatically distributes pressure and an effective seal along the shaft. The proprietary design of Garlock CHEVRON® packing also permits an automatic reaction to pressure shock and overloads. Once Garlock CHEVRON® packing has been selected and installed, it will seal effectively… and automatically.

Features	Advantages
Multiple sealing lips	■ Automatically distribute system pressure ■ Offers “back-up” sealing rings
Hinged design	■ Vee rings automatically react to increasing/decreasing pressure ■ Makes rings easy to install
Wide range of materials and sizes	■ Packing can be used in virtually any kind of fluid ■ Offers flexibility in design
Special end rings	■ Prevent packing extrusion at elevated pressures
Split sets	■ Quick installation ■ Can be cut from solid rings or coil stock

Benefits

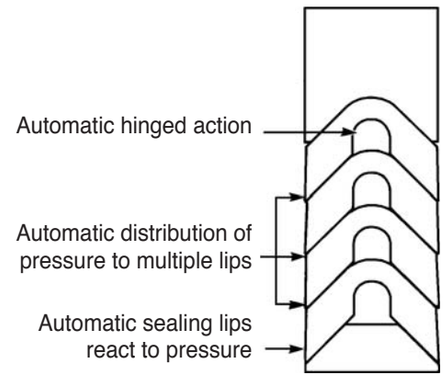
- Elimination of costly seal failure or blowouts
- Reduced installation costs
- Reduced equipment downtime with exact seal specifications
- Extended packing and seal life reduces maintenance and operating costs
- Reduced inventory costs

Applications

Since CHEVRON® products have been the industry standard for many years, they can be found as the sealing device in many different types of equipment. Although normally associated with reciprocating applications, CHEVRON® has been used successfully on slow rotating equipment as well.

The most common applications are:

- Accumulators
- Bailing Presses
- Extrusion Presses
- Fluid Transfer Pumps
- Forging Presses
- Homogenizers
- Hydraulic Cylinders
- Injection Molding Presses
- Intensifiers
- Jacks
- Lifts
- Pneumatic Cylinders
- Rubber Molding Presses
- Steam Hammers
- Valve Stem Packing
- Water Flood Pumps



Application Data Sheet

The first step in recommending CHEVRON® products is to determine as much as possible about the operating of the equipment, the stuffing box dimensions, environmental conditions, what product(s) have been used before and any related problems.

The data sheet below is provided to help simplify this process.

Equipment Type

Cylinder _____Press _____ Pump*_____

Other (explain)_____

Manufacturer _____ Model No. _____

Stuffing Box Data

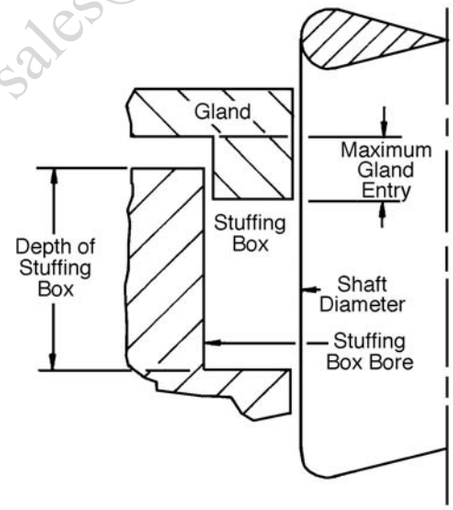
Shaft, Rod, Ram or Plunger Dia._____

Stuffing Box Bore_____

Depth of Box _____

Gland, ❑ Adjustable ❑ Nonadjustable

Maximum Gland Entry_____



Operating Conditions

Fluid Type _____

Manufacturer's No. _____

Pressure: _____ Min. _____ Max.

Temperature: _____ Min. _____ Max.

Motion: Reciprocating _____

Length of Stroke_____

Cycles/min. _____

To aid in selecting the proper CHEVRON® packing, please refer to the following pages where information on product compatibility, stack height, pressure ranges and clearances is available.

If factory assistance is required, copy the data sheet section above, fill in the blanks and fax or mail it directly to Garlock Hydraulic Components, fax 866.636.4275.

For other than reciprocating equipment (i.e. rotary, oscillating), contact Garlock for recommendations.

* See page E-10 for more detailed information on reciprocating equipment.

Recommended Styles for General Service

Fabric Reinforced Materials

Style/ Materials of Construction		260RH/ 261RH Cotton Fabric Natural Rubber Rockhard	432/435 Cotton Fabric Nitrile Elastomer	433 Cotton Fabric Butyl Elastomer	532 PolyCotton Fabric Nitrile Elastomer	7960 PolyCotton Fabric Fluoro-elastomer	7532 High Temperature Fabric Nitrile Elastomer	7857RH Cotton Fabric SBR Elastomer Rockhard	7910 PTFE with Hi-Temp Aramid / Fiber Fabric
Available Forms	Vee-Rings		•	•	•	•	•	•	•
	Adapters	•	• (432)	•	•	•	•	•	
Recom-mended for Use Against	Air	•	•		•			•	•
	Acids	•				•			•
	Aliphatic Solutions	•	•		•	•	•		•
	Alkalies	•		•		•		•	•
	Aromatic Solutions					•			•
	Hydrocarbons	•	•		•	•	•	•	•
	Ketones								•
	Phosphate Esters	•		•		•		•	•
	Steam				• Up to 300°F		• Up to 350°F		•
	Water Glycol	•	•	•	•	•	•	•	•
	Water in Oil	•	•		•	•	•	•	•
Temperature	Minimum	-40°F (-40°C)	-40°F (-40°C)	-40°F (-40°C)	-40°F (-40°C)	-20°F (-29°C)	-30°F (-34°C)	-40°F (-40°C)	Cryogenic
	Maximum	+275°F (+135°C)	+250°F (+121°C)	+250°F (+121°C)	+300°F (+149°C)	+300°F (+149°C)	+325°F (+162°C)	+250°F (+121°C)	+450°F (+232°C)
Heat Resistance		Good	Good	Good	Very Good	Very Good	Very Good	Good	Very Good
Pressure Rating[1]		Medium to High	Low to High	Low to High	Low to High	Low to High	Low to High	Medium to High	Medium to High
Abrasion Resistance		Excellent	Good	Fair	Good	Good	Good	Very Good	Good
Relative Hardness/ Flexibility		Very Hard/ Rigid	Firm but Flexible	Firm but Flexible	Firm but Flexible	Firm/ Very Flexible	Firm but Rigid	Very Hard/ Rigid	Hard
Generally Recommended For		Worn or misaligned equipment where extru-sion resistant adapters are needed.	General hydraulic oils, water emulsions. Multi-purpose.	Straight phosphate-ester fluids having no oil or hydro-carbon additives	Moderate to high temperature, oil or steam.	Chemical service, most fire-resistant fluids.	High temperature, oil or steam.	Excellent for water and high pressure service.	All except very low pH fluids. A problem solver.

1. Pressure ratings are affected by actual condition of equipment, clearances and tolerances, leakage acceptability and other factors. Complete application data could result in slightly different recom-mendations. Contact the factory with specific questions and/or problems. Other styles available.

Homogeneous Materials

	8452 Homogeneous Nitrile Elastomer	8455 Homogeneous Silicone Elastomer	9188 Homogeneous Butyl Elastomer	9511 Homogeneous Nitrile Elastomer	9600 Homogeneous Fluoro-elastomer	7500 PTFE	7600 PTFE and Graphite	9003/9005 Glass Filled Nylon MARBLOCK®
	•	•	•	•	•	•	•	
						•	•	•
	•	•	•	•	•	•	•	•
		•	•		•	•	•	
	•			•	•	•	•	•
		•	•		•	•	•	
					•	•	•	
	•	•		•	•	•	•	•
						•	•	
		•	•		•	•	•	•
						•	•	
	•	•	•	•	•	•	•	•
	•	•		•	•	•	•	•
	0°F (-17°C)	-70°F (-57°C)	-40°F (-40°C)	-20°F (-29°C)	-20°F (-29°C)	Cryogenic	Cryogenic	-65°F (-54°C)
	+225°F (+107°C)	+500°F (+260°C)	+250°F (+121°C)	+250°F (+121°C)	+400°F (+204°C)	+500°F (+260°C)	+500°F (+260°C)	+300°F (+149°C)
	Good	Excellent	Good	Good	Very Good	Excellent	Excellent	Good
	Vacuum to Low	Vacuum to Low	Vacuum to Low	Vacuum to Low	Vacuum to Low	Low to Medium	Low to Medium	High
	Good	Fair	Good	Good	Good	Very Good	Very Good	Excellent
	90 Duro Flexible	80 Duro Flexible	90 Duro Flexible	70 Duro Flexible	80 Duro Flexible	Firm/ Rigid	Hard/ Rigid	Very Hard/ Rigid
	MIL-R-3065, General purpose oil, air and water service.	Most fluids except strong acids and alkalies or steam.	Same as style 433. For low pressure service.	General purpose—air, oil and water service.	Low pressure seals in high temperature, and chemical service.	Excellent for all fluids, non-lubricated service or food processing.	Especially suitable for soot blowers.	Excellent bearing material for hydraulic cylinders. Low break-away friction. High strength.

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.

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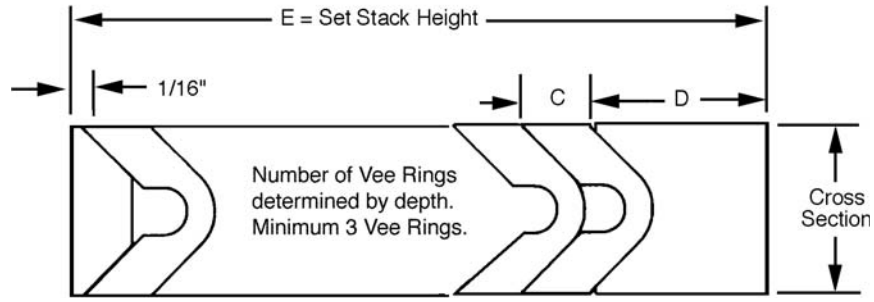
CHEVRON® Stack Height Table



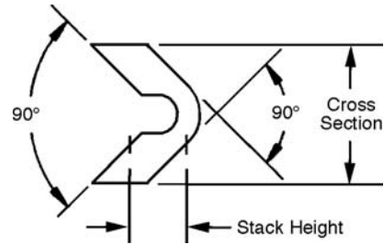
Cross-section	STACK HEIGHT CHEVRON "C"	STACK HEIGHT Adapter Set "D"+1/16"	TOTAL DEPTH "E" (includes the adapter set plus the number of CHEVRON x "C") 1	2	3	4	5	6	7	8	9	10
3/16" 0.188"	7/64" 0.109"	5/16" 0.313"	27/64" 0.422"	17/32" 0.531"	41/64" 0.641"	3/4" 0.750"	55/64" 0.859"	31/32" 0.969"	1-5/64" 1.078"	1-3/16" 1.188"	1-19/64" 1.297"	1-13/32" 1.406"
7/32" 0.219"	7/64" 0.109"	5/16" 0.313"	27/64" 0.422"	17/32" 0.531"	41/64" 0.641"	3/4" 0.750"	55/64" 0.859"	31/32" 0.969"	1-5/64" 1.078"	1-3/16" 1.188"	1-19/64" 1.297"	1-13/32" 1.406"
1/4" 0.250"	7/64" 0.109"	5/16" 0.313"	27/64" 0.422"	17/32" 0.531"	41/64" 0.641"	3/4" 0.750"	55/64" 0.859"	31/32" 0.969"	1-5/64" 1.078"	1-3/16" 1.188"	1-19/64" 1.297"	1-13/32" 1.406"
9/32" 0.281"	5/32" 0.156"	11/32" 0.344"	1/2" 0.500"	21/32" 0.656"	13/16" 0.813"	31/32" 0.969"	1-1/8" 1.125"	1-9/32" 1.281"	1-7/16" 1.438"	1-19/32" 1.594"	1-3/4" 1.750"	1-29/32" 1.906"
5/16" 0.313"	11/64" 0.172"	3/8" 0.375"	35/64" 0.547"	23/32" 0.719"	57/64" 0.891"	1-1/16" 1.063"	1-15/64" 1.234"	1-13/32" 1.406"	1-37/64" 1.578"	1-3/4" 1.750"	1-59/64" 1.922"	2-3/32" 2.094"
11/32" 0.344"	3/16" 0.188"	13/32" 0.406"	19/32" 0.594"	25/32" 0.781"	31/32" 0.969"	1-5/32" 1.156"	1-11/32" 1.344"	1-17/32" 1.531"	1-23/32" 0.719"	1-29/32" 1.906"	2-3/32" 2.094"	2-9/32" 2281"
3/8" 0.375"	3/16" 0.188"	7/16" 0.438"	5/8" 0.625"	13/16" 0.813"	1" 1.000"	1-3/16" 1.188"	1-3/8" 1.375"	1-9/16" 1.563"	1-3/4" 1.750"	1-15/16" 1.938"	2-1/8" 2.125"	2-5/16" 2.313"
13/32" 0.406"	3/16" 0.188"	15/32" 0.469"	21/32" 0.656"	27/32" 0.844"	1-1/32" 1.031"	1-7/32" 1.219"	1-13/32" 1.406"	1-19/32" 1.594"	1-25/32" 1.781"	1-31/32" 1.969"	2-5/32" 2.156"	2-11/32" 2.344"
7/16" 0.438"	15/64" 0.234"	1/2" 0.500"	47/64" 0.734"	31/32" 0.969"	1-13/64" 1.203"	1-7/16" 1.438"	1-43/64" 1.472"	1-29/32" 1.906"	2-9/64" 2.141"	2-3/8" 2.375"	2-39/64" 2.609"	2-27/32" 2.844"
15/32" 0.469"	15/64" 0.234"	9/16" 0.563"	51/64" 0.797"	1-1/32" 1.031"	1-17/64" 1.266"	1-1/2" 1.500"	1-47/64" 1.734"	1-31/32" 1.969"	2-13/64" 2.203"	2-7/16" 2.438"	2-43/64" 2.672"	2-29/32" 2.906"
1/2" 0.500"	15/64" 0.234"	19/32" 0.594"	53/64" 0.828"	1-1/16" 1.063"	1-19/64" 1.297"	1-17/32" 1.531"	1-49/64" 0.766"	2" 2.000"	2-15/64" 2.234"	2-15/32" 2.469"	2-45/64" 2.703"	2-15/16" 2.938"
17/32" 0.219"	15/64" 0.234"	5/8" 0.625"	55/64" 0.859"	1-3/32" 1.094"	1-21/64" 1.328"	1-9/16" 1.563"	1-51/64" 1.797"	2-1/32" 2.031"	2-17/64" 2.266"	2-1/2" 2.500"	2-47/64" 2.734"	2-31/32" 2.969"
9/16" 0.563"	15/64" 0.234"	21/32" 0.656"	57/64" 0.891"	1-1/8" 1.125"	1-23/64" 1.359"	1-19/32" 1.594"	1-53/64" 1.828"	2-1/16" 2.063"	2-19/64" 2.297"	2-17/32" 2.531"	2-49/64" 2.766"	3" 3.000"
5/8" 0.625"	9/32" 0.281"	23/32" 0.719"	1" 1.000"	1-9/32" 1.281"	1-9/16" 1.563"	1-27/32" 1.844"	2-1/8" 2.125"	2-13/32" 2.406"	2-11/16" 2.688"	2-31/32" 2.969"	3-1/4" 3.250"	3-17/32" 3.531"
11/16" 0.688"	9/32" 0.281"	25/32" 0.781"	1-1/16" 1.063"	1-11/32" 1.344"	1-5/8" 1.625"	1-29/32" 1.906"	2-3/16" 2.188"	2-15/32" 2.469"	2-3/4" 2.750"	3-1/32" 3.031"	3-5/16" 3.313"	3-19/32" 3.594"
3/4" 0.750"	21/64" 0.328"	27/32" 0.844"	1-11/64" 1.172"	1-1/2" 1.500"	1-53/64" 1.828"	2-5/32" 2.156"	2-31/64" 2.484"	2-13/16" 2.813"	3-9/64" 3.141"	3-15/32" 3.469"	3-51/64" 3.797"	4-1/8" 4.125"
13/16" 0.813"	21/64" 0.328"	29/32" 0.844"	1-15/64" 1.234"	1-9/16" 1.563"	1-57/64" 1.891"	2-7/32" 2.219"	2-35/64" 2.547"	2-7/8" 2.875"	3-13/64" 3.203"	3-17/32" 3.531"	3-55/64" 3.859"	4-3/16" 4.188"
7/8" 0.875"	3/8" 0.375"	1" 1.000"	1-3/8" 1.375"	1-3/4" 1.750"	2-1/8" 2.125"	2-1/2" 2.500"	2-7/8" 2.875"	3-1/4" 3.250"	3-5/8" 3.625"	4" 4.000"	4-3/8" 4.375"	4-3/4" 4.750"
15/16" 0.938"	3/8" 0.375"	1-1/16" 1.063"	1-7/16" 1.438"	1-13/16" 1.813"	2-3/16" 2.188"	2-9/16" 2.563"	2-15/16" 2.938"	3-5/16" 3.313"	3-11/16" 3.688"	4-1/16" 4.063"	4-7/16" 4.438"	4-13/16" 4.813"
1" 1.000"	13/32" 0.406"	1-1/8" 1.125"	1-17/32" 1.531"	1-15/16" 1.938"	2-11/32" 2.344"	2-3/4" 2.750"	3-5/32" 3.156"	3-9/16" 3.563"	3-31/32" 3.969"	4-3/8" 4.375"	4-25/32" 4.781"	5-3/16" 5.188"
1-1/16" 1.063"	13/32" 0.406"	1-3/16" 1.188"	1-19/32" 1.594"	2" 2.000"	2-13/32" 2.406"	2-13/16" 2.813"	3-7/32" 3.219"	3-5/8" 3.625"	4-1/32" 4.031"	4-7/16" 4.438"	4-27/32" 4.844"	5-1/4" 5.250"
1-1/8" 1.125"	29/64" 0.453"	1-1/4" 1.250"	1-45/64" 1.703"	2-5/32" 2.156"	2-39/64" 2.609"	3-1/16" 3.063"	3-33/64" 3.516"	3-31/32" 3.969"	4-27/64" 4.578"	4-7/8" 4.875"	5-21/64" 5.328"	5-25/32" 5.781"
1-3/16" 1.188"	1/2" 0.500"	1-5/16" 1.313"	1-13/16" 1.813"	2-5/16" 2.313"	2-13/16" 2.813"	3-5/16" 3.313"	3-13/16" 3.813"	4-5/16" 4.313"	4-13/16" 4.813"	5-5/16" 5.313"	5-13/16" 5.813"	6-5/16" 6.313"
1-1/4" 1.250"	1 /2" 0.500"	1-3/8" 1.375"	1-7/8" 1.875"	2-3/8" 2.375"	2-7/8" 2.875"	3-3/8" 3.375"	3-7/8" 3.875"	4-3/8" 4.375"	4-7/8" 4.875"	5-3/8" 5.375"	5-7/8" 5.875"	6-3/8" 6.375"

Notes:

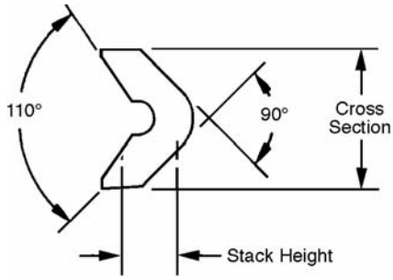
1. Heights are approximate. Exact height cannot be guaranteed.
2. Table applies to fabric-reinforced CHEVRON® sets only.
3. Due to space restrictions we cannot list all of our size capabilities such as large cross sections, metric sizes, optional stack heights, and a multitude of size variations cut from coil.

Vee Ring and Adapter Designs

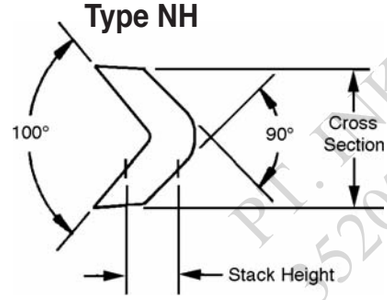
A. Fabric - Hinge - Type XE



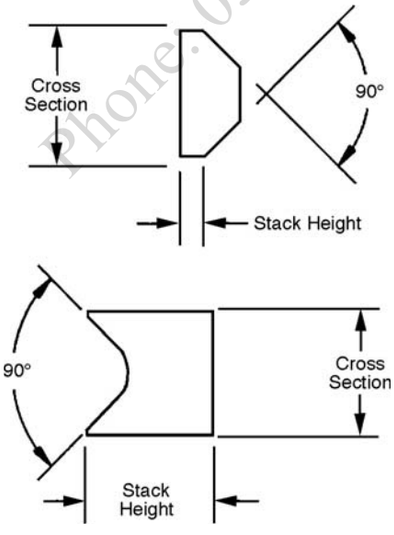
B. Fabric - Modified Hinge - Type GX



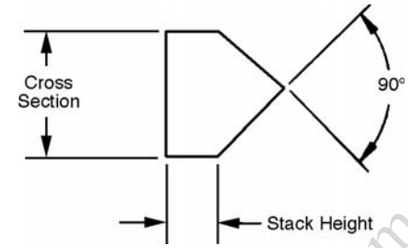
C. Homogeneous Rubber - No Hinge - Type NH



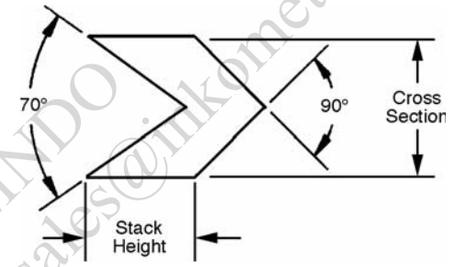
D. Fabric and Metal Adapters



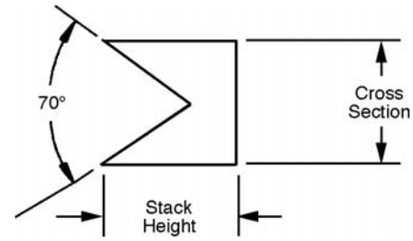
E. PTFE Male Adapter



F. PTFE Vee Ring



G. PTFE Female Adapter



Cross Section	Male (E) Std./J.I.C.	Vee Ring (F) Std./J.I.C.	Female (G) Std. or J.I.C.
0.188	0.075 / 0.063	0.150 / 0.083	0.188
0.219	0.088 / 0.063	0.175 / 0.083	0.219
0.250	0.100 / 0.063	0.200 / 0.083	0.250
0.313	0.125 / 0.063	0.250 / 0.140	0.313
0.375	0.150 / 0.063	0.300 / 0.156	0.375
0.438	0.175 / 0.063	0.350 / 0.197	0.438
0.500	0.200 / 0.063	0.400 / 0.197	0.500
0.563	0.225 / 0.063	0.450 / 0.197	0.563
0.625	0.250 / 0.063	0.500 / 0.250	0.625
0.750	0.300 / 0.063	0.600 / 0.297	0.750

PTFE Stack Heights (inches)

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Design Parameters

Number of Vee Rings by Application

Piston Applications

Diameter of Cylinder	Zero to 1,000 psi		1,000-2,500 psi		2,500-4,000 psi		4,000 psi and Up	
	Cross Section	Vee Rings per Set	Cross Section	Vee Rings per Set	Cross Section	Vee Rings per Set	Cross Section	Vee Rings per Set
1" to 2"	1/4"	3	1/4"	4	5/16"	4	3/8"	5
2" to 3"	5/16"	3	5/16"	4	5/16"	4	3/8"	5
3" to 6"	3/8"	3	3/8"	4	3/8"	4	3/8"	5
6" to 8"	1/2"	3	1/2"	4	1/2"	4	1/2"	5
8" to 14"	5/8"	3	5/8"	4	5/8"	4	5/8"	5

Rod, Plunger or Ram Applications

Diameter of Rod Plunger or Ram	Zero to 1,000 psi		1,000-2,500 psi		2,500-4,000 psi		4,000 psi and Up	
	Cross Section	Vee Rings per Set	Cross Section	Vee Rings per Set	Cross Section	Vee Rings per Set	Cross Section	Vee Rings per Set
1" to 3"	1/4"	4	1/4"	5	5/16"	5	5/16"	6
3" to 6"	1/4"	4	5/16"	5	3/8"	5	3/8"	6
6" to 8"	5/16"	4	3/8"	5	1/2"	5	1/2"	6
8" to 14"	3/8"	4	1/2"	5	1/2"	5	5/8"	6
14" to 24"	1/2"	4	5/8"	5	5/8"	5	3/4"	6
24" to 36"	5/8"	4	3/4"	5	3/4"	5	1"	6
36" and Up	3/4"	4	1"	5	1"	5	1"	6

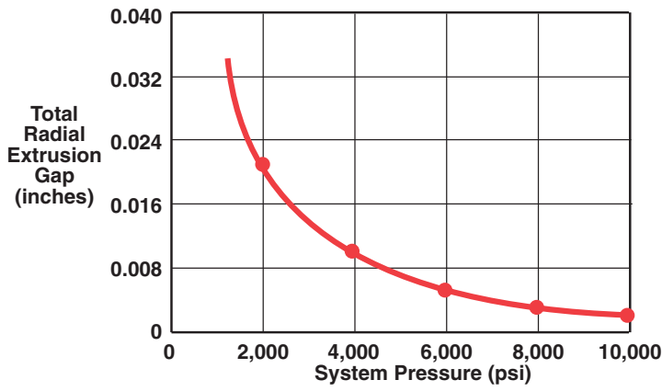
Recommended Adapters for Pressure Ranges

Adapter Type	1,000 psi	2,000 psi	3,000 psi	5,000 psi
Standard Fabric	■	■		
Rockhard Fabric		■	■	
Bronze			■	■
MARBLOCK®	■	■	■	

Note:
See Stack Height Table on page E-6 for the height of the Vee rings plus male and female adapter rings per set. This table is for general guidance. Many satisfactory Garlock CHEVRON® packing installations can be made with variations in the recommended equipment or packing guidelines.

Clearances

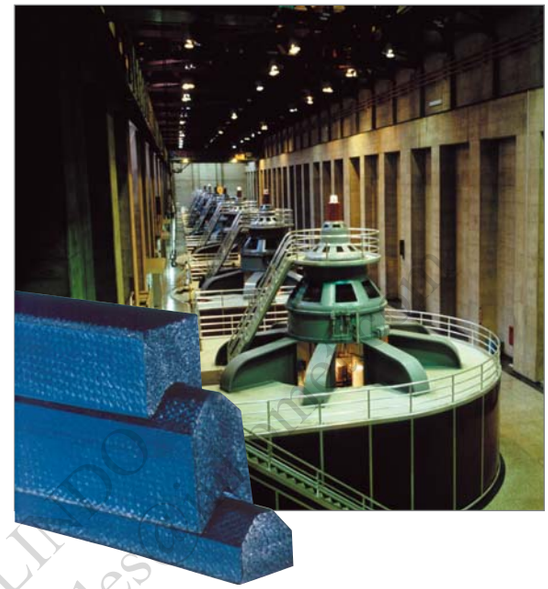
If excessive clearance exists between the cylinder wall or the shaft and the component supporting the female adapter, operating pressure will extrude the adapter into the clearance. The greater the pressure and clearance, the more quickly extrusion will occur. In a clean system, where concentricity requirements are met, and where minimum clearances are held, optimum seal life can be expected.



Deep Vee CHEVRON® Packing

For Large Diameter, Deep Stuffing Box Applications

- Easier installation—fewer rings required
- Quicker turnaround—rings won't "roll-over" during installation
- Wide variety of styles—choose from the many popular fabric and rubber styles available from Garlock to suit your application
- Few size restrictions—made in our continuous process, so large diameters are no problem
- Most popular cross sections are: 5/8", 3/4", 7/8", 1"



CHEVRON® Packings for High Pressure Service

In unusually high pressure applications, CHEVRON® packing might need to be reinforced to prevent undue distortion from this extreme pressure. The following are examples of some design considerations that can be used to overcome problems experienced with standard components (such as 432, 433, etc.).

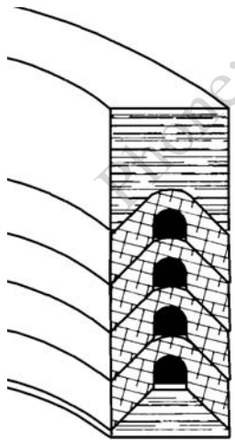
"D" filler rings can be installed in the groove of the hinge-type CHEVRON® Vee Rings to prevent distortion of the packing without interfering with the automatic hinge action of the rings. If the CHEVRON® Vee Rings still tend to telescope into each other, metal separators (lead or bronze) can be installed between the CHEVRON® Vee Rings.

"D" fillers can be used only with 3/8" cross sections and up with hinge type "XE" CHEVRON® rings per illustration A, page E-7.

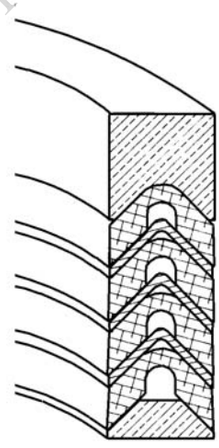
When pressure ranges exceed those normally satisfied with standard Style 432, 433 or 532 adapters, the stronger rockhard adapters such as 260RH, 261RH and 7857RH should be considered.

When a problem relates to excessive clearances, as discussed on page E-8, a close tolerance phenolic (Style 155) or bronze bushing installed behind the female adapter will act as additional support and reduce the extrusion gap. A phenolic or bronze female adapter will serve the same purpose.

These configurations have been used successfully to extend the life of CHEVRON® packing sets. However, specific applications should be considered on an individual basis, taking into account the type of equipment, size, temperature, media being sealed, pressure, surface speed, condition of equipment and any other contributing factors.



CHEVRON® packing with "D" shaped filler rings.



CHEVRON® packing with metal separators and adapters

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Seals for Reciprocating Plunger Pump Applications

Garlock has long been a leader in the development of seals and packings for reciprocating equipment. The CHEVRON® trade name for vee packing was registered over 75 years ago; and although it is very popular for use in such applications as hydraulic cylinders and hydraulic presses, it also is capable of providing excellent performance for the demanding service conditions found in plunger pumps.

However, it is important to be able to offer alternative packing recommendations. With hundreds of tooled sizes available in numerous materials, Garlock CHEVRON® provides the options necessary to meet the changing needs of Simplex and Multiplex pumps.

Over the years Garlock has developed styles specifically for plunger pump applications. Although other materials are available, one of the following packing styles will most likely provide satisfactory service:

- **8024:** SBR rubber/cotton fabric, rockhard cure
- **8064:** SBR rubber/cotton fabric, standard cure
- **8140:** SBR rubber/polyester-cotton fabric, rockhard cure
- **8150:** NBR/PTFE/polyester-cotton fabric, standard cure
- **8872**: Nitrile/polyester-cotton fabric

In addition to selecting the proper material for an application, the packing arrangement and design of the other packing set components are equally important. Bronze is the material of choice for male and female adapters or lantern rings to provide plunger alignment through the sealing CHEVRON®, as well as prevent its extrusion. Figures 1 through 4 illustrate some common packing assemblies.

Since stuffing box spaces vary with pump models, it may be necessary to have Garlock design the packing set. The minimum information necessary to do so should include the operating conditions and details of the packing area, which may be best covered by a drawing.

Garlock has the products, experience and quality to satisfy your plunger pump packing needs.

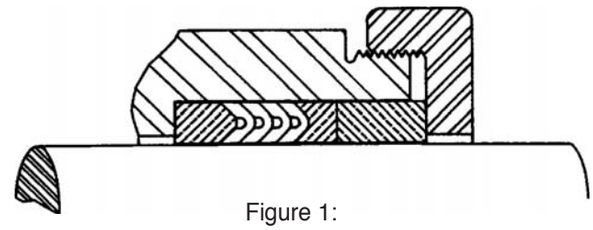

Figure 1:
Non-lubricated box
Adjustable CHEVRON® set

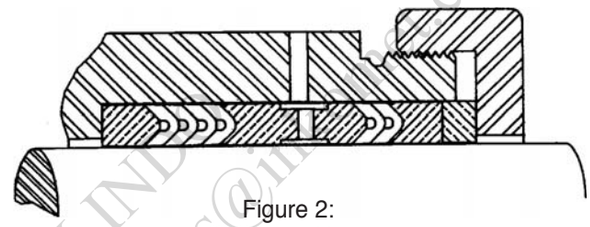

Figure 2:
Lubricated box
Adjustable primary and
secondary CHEVRON® sets

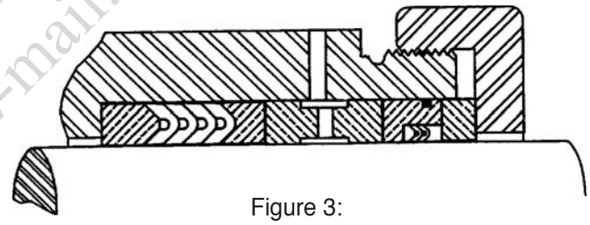

Figure 3:
Lubricated box
Adjustable primary CHEVRON® set
Non-adjustable secondary CHEVRON® set

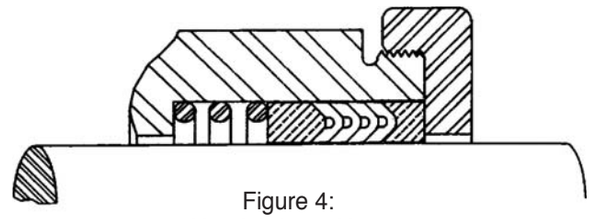

Figure 4:
Non-lubricated box
Spring-loaded self-adjusting
CHEVRON® set

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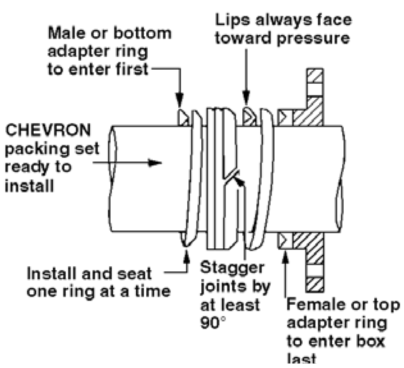
CHEVRON® Installation and Adjustment

Protect your investment. Do not hang Garlock CHEVRON® packing on nails or under any excessive stack pressure that might deform the concentricity of the product. Do not stock in extreme weather conditions. Avoid constant sunlight. The elastomer compounds used in CHEVRON® packing are highly technical and, while reliable, they are subject to handling stress.



1. Packing on a moving ram should be endless rings, if possible, for best service life.

2. If rams are grooved, worn, rusted or corroded, they should be reconditioned or replaced. No packing stands up to these conditions. Use boots to protect rams if abrasive dust is a problem.

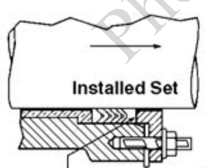
3. On high pressure jobs, make clearance between rod and gland as close as possible to prevent extrusion.

4. If lubrication is not getting into a Garlock CHEVRON® packing set, the gland may be drawn up too tightly and should be loosened appropriately. To avoid over-tightening and/or cocking of the gland, place a shim under the gland.

5. If a stuffing box is very deep, spacer(s) can be used to take up the space of additional CHEVRON® rings that are not needed. This saves replacement time and cost.

6. Use the correct style. For example, don't use butyl against a petroleum base oil, or a nitrile against a phosphate ester.

7. Use the right size. In emergencies, "off-size" parts can be distorted and made to work for a short period of time, but do not expect them to last or work as efficiently as the correct size.



Adjustable gland should fit snugly against packing—Use shims as necessary to prevent crushing the rings

8. Make sure all rings are seat-ed with no voids in the set.

9. Use lubrication when installing the rings, as it makes installation much easier and helps during the break-in period.

10. Make sure sections of the lips of the rings are not turned over or twisted. This is easy to do, especially in blind installation, and will result in premature leakage and failure.

11. Make sure the packings are facing in the direction of the medium being sealed—whether liquid, air, dust, etc.

12. Consider metal structure. Many times a packing is blamed for leakage when the real culprit is porous metal—either the rod or the housing.

13. Let Garlock help you. Tell us about the application. If a forging press is under shock load, then packing must be a more rugged type, for example. Or, if low pressures are involved, the packing selection must be more flexible than for high pressure.

14. Don't use sharp metal tools like screwdrivers when installing packings. Hardwood tools are best and will not score rod or stuffing box.

For installation of endless CHEVRON® packing, gland pressure should be only sufficient to snug rings within the confining cavity.

On split ring installations, adjustment practice will vary depending on service conditions.

For horizontal packing installations, nominally light gland pressure is necessary to seal the ring joints. Adjustment is made by turns of 1/4 flat on gland bolts.

On vertical applications of split rings, it is desirable to provide increased gland pressure for the effective seal of ring joints.

9220 GARTHANE® U-Seals

Strength/Durability

- Four times the tensile strength / tear resistance of conventional seals
- High modulus counteracts extrusion and shear forces
- Withstands shocks over a wide range of temperatures and pressures
- Exceptional abrasion resistance
- Outstanding endurance under difficult operating conditions

Flexibility

- Excellent elasticity
- Excellent resilience
- Withstands high degree of deformation

Temperature and Chemical Resistance

- Excellent for use against petroleum-based fluids to 225°F (107°C), air, warm water and water glycol to 180°F (82°C)
- Withstands dilute acetic and alkaline solutions, aliphatic alcohols and hydrocarbons, salts and solutions of aromatics and solids in concentrations under 80%
- Not recommended for use with very strong oxidizers, highly concentrated acids or bases, pure aromatic compounds, esters, ketones, automotive brake fluid or steam

Pressure Resistance

- Compounded to withstand a wide range of pressure conditions
  - Normally used as hydraulic cylinder or large ram press seals to 3,500 psi (242 bar)
  - Successfully used for slow-moving equipment to 8,000 psi (552 bar), and static applications to 30,000 psi (2,070 bar) on specially adapted equipment

Benefits

- Increased seal life and performances
- Less equipment downtime
- Fewer sizes save inventory expense
- Eliminates chance of costly premature equipment failure

Features	Advantages
90 Durometer Urethane	■ High tensile strength ■ High tear resistance
Reverse bevel lip design	■ Less friction ■ Responds immediately to pressure
Balanced design	■ Can function as a rod or piston seal
Clear Urethane	■ No hidden defects in seal
Extensive tooling list	■ Greater size availability — both inch and metric

Recommended Tolerances and Finishes

- Shaft hardness: 30 Rockwell C (minimum)
- Groove length (axial): Height of U-seal plus 10% of cross section (0.032 minimum)
- Dynamic surface finish: 10 to 20 RMS
  Tolerance: ±0.003 (maximum)
- Static surface finish: 60 RMS (maximum)
  Tolerance: ±0.005 (maximum)

Standard Design Cross Section

Metric Design Cross Section

Polytop Sets

These unique set configurations have found widespread popularity due to their high sealing efficiency.

A Garlock Polytop CHEVRON® set utilizes both squeeze and multiple lip type seals. Used in a set configuration, these two proven designs combine to provide maximum sealing performance.

Squeeze seals, such as the Garlock 9220 polyurethane U-Seal, provide excellent low pressure sealing performance. Lip seals, such as Garlock 432 CHEVRON®, provide low friction rates while maintaining responsiveness to pressure fluctuations.

Compounded from the highest quality urethane, the Garlock 9220 U-Seal is strong and abrasion-resistant. In the Polytop configuration, it replaces the traditional top adapter used with vee sets and provides an additional sealing lip.

The fabric and rubber composition of Garlock 432 CHEVRON® provides a strong, yet flexible, sealing system that dampens any pressure surges.

Unlike typical vee sets, Garlock Polytop sets need no axial preload or adjustment after startup, virtually eliminating the fear of catastrophic failure.

Polytop Sets and SLUDGE-PAK® Packing

Polytop sets and SLUDGE-PAK® are similar in design because they combine different styles of packing. In performance, where it counts, these unique sets offer some significant features and benefits.

SLUDGE-PAK® Packing

For Vertical Sludge Pumps

These unique, combination sets from Garlock for use in Carter, Marlow, Komline Sanderson and Passavant vertical sludge pumps have gained wide acceptance in the waste treatment industry.

SLUDGE-PAK® hydraulic packing sets are designed to reduce the friction and abrasion so often associated with vertical sludge pumps. This unique packing arrangement decreases the chance of scoring plungers as might occur with the use of a packing set consisting only of braided packing.

The set's function is based upon the qualities of three types of packing. In the bottom of the stuffing box is Style 8921-K. Next is Style 432 CHEVRON® sealing rings. Topping off the set is a Style 9220 GARTHANE® (urethane) U-seal.

Garlock SLUDGE-PAK® packing is the best of three worlds... braided packing, CHEVRON® rings and urethane U-seals. The performance is unbeatable and necessary in today's waste treatment industry.

Features	Benefits
The best properties of each component improve sealability	■ Longer life, fewer repacks
Combined styles react better to varying pressure conditions	■ Less chance of costly premature failure
Individual components do not cause equipment damage	■ Reduces expensive downtime and wear on spare parts

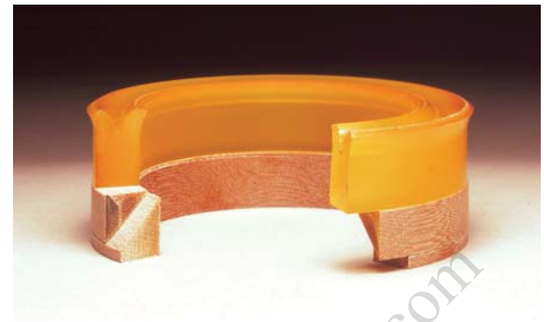
Roll Balance

Unique combination sets for the steel and aluminum industries

Roll Balance is commonly found in mills where molten metal slab is reduced to a gauged strip.

Roll Balance sets consist of a CHEVRON® set or a GARTHANE® U-seal to act as the sealing component, and a special diagonal cut ring to act as a piston bearing and anti-extrusion ring for the CHEVRON® set or U-seal.

As pressure is applied, the 155 diagonal cut ring acts in opposite outward directions for positive support of the piston, while reducing the extrusion gap behind the CHEVRON® set or GARTHANE® U-seal.



Features	Advantages
9220 U-seal	■ Reverse bevel lip ■ Balanced design ■ Clear 90 Duro urethane composition
155 diagonal cut ring	■ Bearing/backup ring ■ Prevents extrusion by closing gap

Benefits

- Product loss minimized
- Prolonged packing life reduces overall labor costs
- Less equipment downtime
- Reduced cylinder wear, lower operational costs
- Available in sizes to fit most Mesta, United and Blaw-Knox roll balance cylinders
- Complete set is asbestos-free

Specifications

Pressures: 3,000 psi (205 bar) average operating with surges exceeding the operating pressure

Temperature: 150°F (65°C) to 200°F (95°C)

Medium: Hydraulic oil with the presence of water

Index

By Style Number / Letter

By Trade Name

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

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Garlock
SEALING TECHNOLOGIES®
an EnPro Industries company

Garlock Sealing Technologies
1666 Division Street
Palmyra, New York 14522 USA
+1.315.597.4811
Toll Free 1.800.448.6688
Toll Free Fax: 1.800.543.0598
+1.315.597.3039

www.garlock.com

Other Garlock facilities are located in:

Columbia, SC, USA	Phone +1.803.783.1880	Fax +1.803.783.4279
Houston, TX, USA	Phone +1.281.840.4800	Fax +1.281.840.4756
Sydney, Australia	Phone +61.2.9793.2511	Fax +61.2.9793.2544
São Paulo, Brazil	Phone +55.11.4352.6161	Fax +55.11.4352.8181
Sherbrooke, Canada	Phone +1.819.563.8080	Fax +1.819.563.5620
W. Yorkshire, England	Phone +44.1422.313600	Fax +44.1422.313601
Saint-Étienne, France	Phone +33.4.7743.5100	Fax +33.4.7743.5151
Neuss, Germany	Phone +49.2131.3490	Fax +49.2131.349.222
Mexico City, Mexico	Phone +52.55.50.78.46.00	Fax +52.555.368.0418
Singapore	Phone +65.6285.9322	Fax +65.6284.5843
Shanghai, China	Phone +86.021.62789702	Fax +86.021.62787826
Dubai, UAE	Phone +971.4.8833652	Fax +971.4.8833682
Pune, India	Phone +91.20.3061.6608	Fax +91.20.3061.6699

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