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COMPRESSION PACKING TECHNICAL MANUAL



Garlock

SEALING TECHNOLOGIES®

Garlock Sealing Technologies

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.

Our test facilities include a high temperature and high pressure valve stand with full cycling capabilities. We also have a fire test stand on-site that is capable of testing packings and gasketing to API-607 and API-589 standards and also against kerosene.

We continue to research new fibers and new technologies in order to bring to our customers the cutting edge of sealing systems.



Cert. #005477

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GRAPH-LOCK®, MILL-RIGHT®, QUICKSET®, and SYNTHEPAK® are registered trademarks of Garlock Inc.

Flexible Graphite Packings

Style 1303-FEP

Superior performance

- Compliance with the most stringent VOC and VHAP emissions regulations
- Thermally conductive; resists heat, pressure and chemicals
- Fire safe
- Dimensionally stable, impervious to gases and fluids
- Non-scoring, self-lubricating, non-hardening
- Ideal for the hydrocarbon, chemical processing and power generation industries

Convenience

- Spool stock reduces inventory and downtime
- Handles easily, retains integrity when cut and formed
- No end rings required

Specifications

Construction:	100% GRAPH-LOCK® flexible graphite and 0.004" INCONEL* filament
Temperature:	-328°F (-200°C) to +850°F (+455°C) atmosphere; to +1200°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.



Style 1304

Tough and versatile

- Handles both rotary and valve service
- Non-hardening, self-lubricating, dimensionally stable
- Easy to cut and install
- Ideally suited for the pulp and paper, mining, primary metals and power generation industries
- Dry running capability—see Stealth Packing, pg 22

Specifications

Construction:	Proprietary, high-purity flexible GRAPH-LOCK® braided yarn, encapsulated by an aramid jacket
Temperature:	-328°F (-200°C) to +700°F (+370°C)
pH range:	0-14 (except strong oxidizers)
Pressure:	To 3,000 psi (200 bar) valves; To 500 psi (34 bar) rotary
Shaft speed:	4,000 fpm (20 m/s) rotary

Style 1333-G

Economical and easy to use

- Offset square design makes installation easy; ensures tight seal in worn or oversize stuffing boxes
- All-graphite, PTFE-free construction:
 - Maximizes reliability and stability in high temperatures; also provides excellent chemical resistance
 - Dissipates heat quickly, so equipment runs cooler and requires less flush water
- Graphite filament reinforcement resists extrusion in high pressure applications
- Convenient spool stock reduces inventory, downtime
- Ideal for valves, steam service, rotary applications

Specifications

Construction:	Square flexible graphite braid reinforced with graphite filament
Temperature:	-400°F (-240°C) to +850°F (+455°C) atmosphere; +1200°F (+650°C) steam
pH range:	0-14 (except strong oxidizers)
Pressure:	To 4,000 psi (275 bar) valves, no end rings; To 500 psi (35 bar) rotary
Shaft speed:	To 4,800 fpm (23 m/s) rotary

GRAPH-LOCK® Engineered Sets

The Garlock patented cup & cone design of die-formed graphite rings, used in 9000 EVSP and QUICKSET® 9001 valve packing sets and in DSA series pump packing sets, offers unique advantages:

- I.D. and O.D.-specific pure graphite rings mean low friction and superior sealing at high temperatures
- The cup & cone design increases radial expansion of the sealing rings up to 1/8" (3.2 mm) or more

- Better sealing and room for later adjustment; prolongs the life of the packing
- Varying densities of the graphite rings allow for direct loading of the center seal rings by the gland follower

Flat die-formed rings cannot achieve the superior results of Garlock die-formed cup & cone engineered valve and pump packing sets.

QUICKSET® 9001

Top performance

- Five-ring set of die-formed cup and cone graphite rings and high-density end rings ensure tight seal
- Meets global emissions standards
- Lowest stem friction ever for graphite packing sets means longer equipment life

Ultra convenience

- Preassembled and ready to install
- No measuring, no cutting, no waste
- Forty popular sizes fit the majority of valves
- Available in a wall-mounted rack or floor display for easy access and better inventory management



QUICKSET® 9001 is precut and assembled in convenient packages

Versatility

- QUICKBUSHINGS® in matching sizes can retrofit deeper stuffing boxes

Specifications

Construction:	Die-formed cup and cone rings combined with die-formed, high-density Style 1303-Dry end rings
Temperature:	-328°F (-200°C) to +850°F (+455°C) atmosphere; to +1200°F (+650°C) steam
pH range:	0-14 (except strong oxidizers)
Pressure:	To 10,000 psi plus (690 bar)

WARNING:

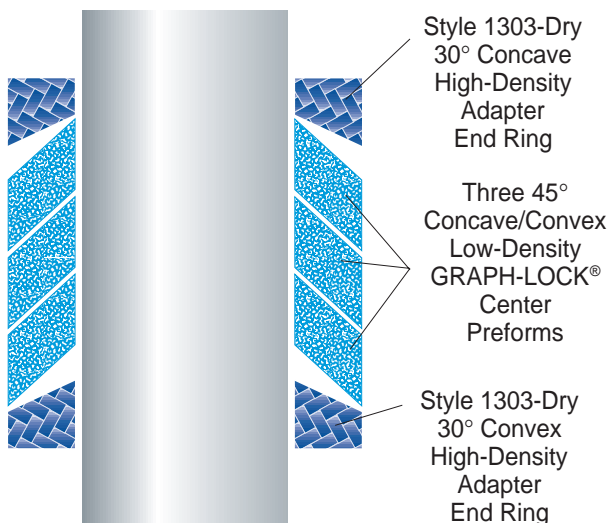
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QUICKSET® 9001 Typical Ring Arrangement



9000 EVSP* Simplified

Excellent sealing

- Patented "cup & cone" design permits selective component compression and controlled radial flow for effective sealing on I.D. and O.D.
- End rings act as wiper rings to restrict graphite particle transfer, prevent extrusion and provide extra resiliency

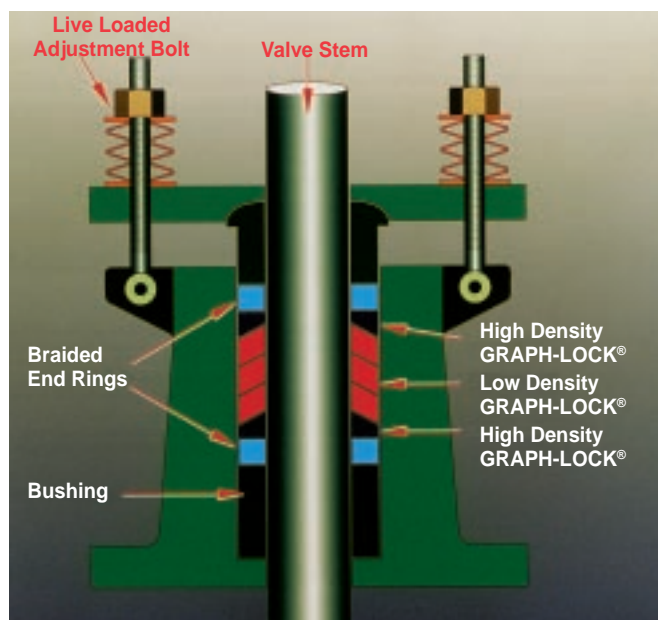
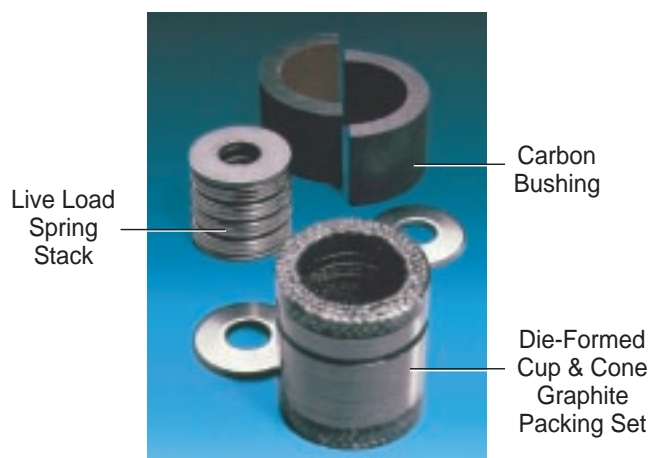
Custom design capability

- Patented cup & cone design can provide sealability in valves as shallow as three-ring cross sections
- For deep stuffing boxes requiring more than a 7-ring set, machined / split carbon bushings can shorten the box depth
 - Grade 250 (Style #4525) for general services
 - Grade 580 (Style #4540) for nuclear services
- Choice of end rings: Style 98 (general service) or Styles G-700 or 1398 (nuclear service)
- Consult Garlock Engineering with details of your application.

Specifications

Construction:	GRAPH-LOCK® rings of high-purity diamond texturized graphite tape, in "cup & cone" configuration; end rings made from Garlock Style 98
Temperature:	-328°F (-200°C) to +850°F (+455°C) atmosphere; to +1200°F (+650°C) steam
pH Range:	0-14 (except strong oxidizers)
Pressure:	To 10,000 psi plus (690 bar)

*Patent #4,328,974



Live loading

Live loading can provide gland load retention for in-service consolidation of the packing. A set of disc-spring washers placed on each gland stud bolt between the gland flange and gland bolt nut helps exert a continuous compressive force on the gland follower flange and, therefore, on the packing set.

Live loading is recommended where any one of these five criteria is present:

- 5,000 or more complete valve stem actuations are anticipated before the next scheduled repacking, or the valve stem is in a state of constant modulation
- Standard installation procedures cannot be followed
- The valve is critical to the operation of the process
- Multiple thermal cycling of the valve is anticipated due to the process system
- The valve is inaccessible for future adjustment

Our live loading program is specifically designed to compensate for the reduced in-service consolidation needs of today's asbestos-free graphite or carbon-based packing sets. It consists of even numbers of opposing disc-spring washers sandwiched between standard flat washers.

Nuclear Applications

Style 1398

High purity valve stem packing

- Extremely low coefficient of friction
- High-purity graphite, contains no PTFE
- Suitable material for end rings, or bushings to fill excess stuffing box depth

Specifications

Construction:	Square braid of high-purity flexible graphite reinforced with INCONEL* filament
Temperature:	-328°F (-200°C) to +925°F (+500°C) atmosphere; to +1200°F (+650°C) steam
pH range:	0-14 (except strong oxidizers)
Pressure:	To 3,000 psi (200 bar)

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

Style 1399

Meets nuclear specifications

- Can be certified to GE Spec. D50YP12 Rev. 2
- Pure graphite, contains no PTFE

Convenient

- No end rings needed
- Convenient spool stock consolidates inventories—no I.D.- or O.D.-specific rings to inventory

Specifications

Construction:	Square braid of pure flexible graphite reinforced with INCONEL filament
Temperature:	-328°F (-200°C) to +925°F (+500°C) atmosphere; to +1200°F (+650°C) steam
pH range:	0-14 (except strong oxidizers)
Pressure:	To 3,000 psi (200 bar)

Style G-700

Highest standards

- 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 dated 10/92.
- Excellent used as end rings (anti-extrusion) in combination sets with GRAPH-LOCK® material
- Contains no PTFE or other lubricants
- Totally 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

** Used as end rings *ONLY*.



Pump Packing

Styles 8093 DSA, 8094 DSA

Superior performance

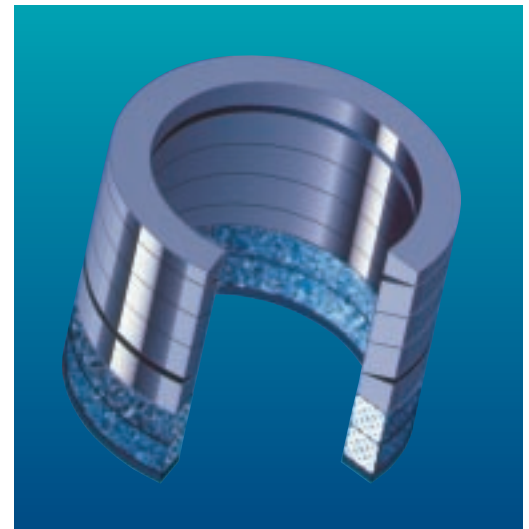
- Patented cup & cone rings expand radially to form a positive seal against both shaft and box bore
- Requires less axial force to effect a seal
- Withstands a wide range of chemicals

Reduced costs

- Reduced equipment wear and maintenance
- Flexible graphite rings conduct heat away from the shaft, so equipment runs cooler and longer
- Significant reduction in leakage

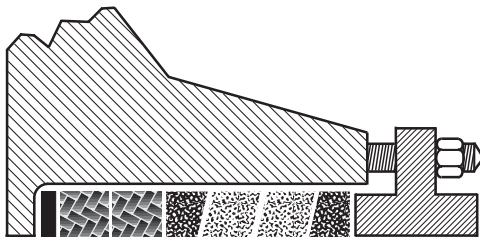
Versatile





- Style 8093 DSA for service in clean media
- Style 8094 DSA with split lip seal for abrasive service



8093 DSA Specifications

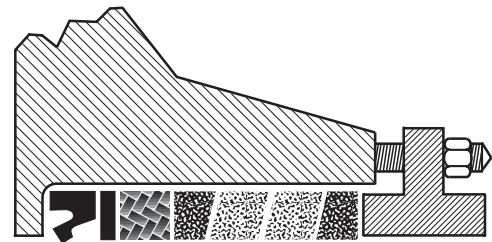
Construction:	Typical set: gasket spacer, braided rings, flexible graphite adapters and preforms
Media:	Condensate, boiler feed water, light paper stock, white water, feed water
Temperature:	To +500°F (+260°C)
pH range:	0-14* (except strong oxidizers)
Shaft speed:	To 4,000 fpm plus (20 m/s)
Pressure: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








-  Gasket spacer (Style 3530 or G-9900)
-  Braided ring (Style 98, 1304, 5000 or 8921-K)
-  Low density GRAPH-LOCK® preforms
-  High density GRAPH-LOCK® adapters

8094 DSA Specifications

Construction:	Typical set: Model 26 lip seal, gasket spacer, braided rings, flexible graphite adapters and preforms
Media:	Abrasive service
Temperature:	To +200°F (+93°C)
pH range:	2-12*
Shaft speed:	To 4,000 fpm plus (20 m/s)
Pressure:	To 300 psi (20 bar)



-  Model 26 lip seal
-  Gasket spacer (Style 3530 or G-9900)
-  Braided ring (Style 98, 1304, 5000 or 8921-K)
-  Low density GRAPH-LOCK® preforms
-  High density GRAPH-LOCK® adapters

* Depends on braid choice

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Carbon Packings

Styles 98, 98-VC

Tough and versatile

- 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
- Style 98-VC ideal for high-runout, low-speed rotary applications

Style 98 Specifications

Construction:	LATTICE BRAID® carbon fiber
Media:	Acids, strong caustics, hot oils, solvents, boiler feed
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 +1200°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 98-VC Specifications

Construction:	LATTICE BRAID® carbon fiber over resilient VITON* core
Media:	Acids, strong caustics, solvents
Equipment:	Centrifugal pumps, mixers, agitators
Temperature:	-200°F (-130°C) to +400°F (+200°C)
pH range:	0-14 (except strong oxidizers)
Shaft speed:	To 800 fpm (4 m/s)
Pressure:	To 300 psi (21 bar) rotary

* VITON is a registered trademark of DuPont Dow Elastomers.

** PBI is a registered trademark of Celanese Corporation.

Graphite Packing

Style G-200

High performance

- Withstands elevated temperatures and aggressive chemicals
- Low coefficient of friction reduces shaft wear
- Ideal end ring (with GRAPH-LOCK® center rings) in valve service
- Low chloride certification available

Specifications

Construction:	LATTICE BRAID® GARFITE® graphite yarn
Media:	Acids, natural petroleum, synthetic oils, solvents, steam, water
Equipment:	Boiler feed pumps, agitators, mixers, crystallizers, filters, continuous digesters, reciprocating pump rods
Temperature:	-328°F (-200°C) to +850°F (+455°C) atmosphere; to +1200°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

Style 5000

Durable, non-contaminating

- 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

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

PTFE Packings

Style 5888

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 2000 psi (138 bar) valves

For oxygen service, specify Style 5898.

Style 5889

Non-abrasive

- 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

Rugged and nontoxic

- Ideal for food processing applications
- Pliable, wear-resistant and dimensionally stable
- Resists most caustic media
- 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

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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 12-13 for specifications



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Lantern Rings

Style 1004 Coil**

Economical and easy to handle

- Costs up to 50% less than OE-supplied lantern rings
- Easily cut with knife or saw, and short lengths splice together, eliminating waste
- Easy to install† and remove from stuffing box—reduces costly downtime
- Has gland water filtering capability
- High-purity PTFE offers chemical resistance in a broad range of rotary services

Specifications

Construction:	Wear-resistant high-grade PTFE
Equipment:	Pumps
Temperature:	Up 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 by up to 90%
- Extends equipment life by protecting sleeve and packing from media attack
- Split design installs easily, without equipment disassembly

Specifications

Construction:	Moly / glass-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.

Blended Packing

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 (35 bar) rotary/centrifugal

[†] Patent #4,994,303



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

** PBI is a registered trademark of Celanese Corporation.

Soot Blower Sets



Exceptional reliability

- Die-formed conical center rings (45°) and top and bottom adapters simplify installation and ensure accurate fit
- Rugged materials give extended service life and reduced downtime and maintenance

GRAPH-LOCK[®] Sets

Construction:	High-purity graphite tape, density of 87.5 lbs/ft ³ (1,400 kg/m ³)
Temperature:	+1200°F (+650°C) steam, +850°F (+455°C) atmosphere

Style 7501

Construction:	Style 1298: INCONEL* wire reinforced PBI** over carbon fiber core
Temperature:	Same as above

Style 6501

Construction:	Style 1200-PBI: INCONEL wire reinforced PBI over homogeneous core
Temperature:	Same as above

Style 5501-AFP

Construction:	Style 127-AFP: INCONEL wire reinforced carbon over homogeneous core
Temperature:	+1200°F (+650°C) steam, +650°F (+345°C) atmosphere

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	
98-VC	Carbon filament over VITON ² core	Graphite dispersion	LATTICE BRAID® over core	X		
G-100	Graphite filament	Graphite dispersion	Square braid	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	
934	Copper strand	Graphite	Die-formed	X	X	X
1200-PBI	INCONEL wire-reinforced PBI over homogeneous core	Graphite & tungsten disulfide	Braid over core			X
1298	INCONEL wire-reinforced PBI over carbon yarn core	Graphite & tungsten disulfide	Braid over core			X
1300	Flexible graphite	None	Square braid	X		X
1303-FEP	INCONEL filament-reinforced flexible graphite	Graphite dispersion	Square braid			X
1304	Aramid filament-reinforced flexible graphite	Graphite dispersion	Square braid	X	X	X
1333-G	Graphite filament-reinforced flexible graphite	Graphite	Square braid	X		X
1398 ⁴	INCONEL filament-reinforced flexible graphite	None	Square braid			X
1399	INCONEL filament-reinforced flexible graphite	None	Square braid			X
1850	KYNOL ⁵	PTFE & snow-white petrolatum	LATTICE BRAID®	X	X	
1925	Fiber-infused PTFE	PTFE suspensoid and snow-white petrolatum	LATTICE BRAID®	X		
20/01	Expanded PTFE/graphite, fiber-infused PTFE in corners	PTFE suspensoid	LATTICE BRAID®	X	X	
20/50	Pan-based carbon ribbon	Graphite dispersion w/ PTFE	LATTICE BRAID®	X	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 ⁶	Silicone	LATTICE BRAID®	X	X	X

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. KYNOL is a trademark of American Kynol, Inc.

6. GFO is a trademark of WL Gore.

* 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

	Temperature		Pressure (psi)		Pressure (bar)		Shaft Speed		pH
	Fahrenheit	Centigrade	Rotary	Valve	Rotary	Valve	fpm	m/s	
+220°	+105°		150		10		1,200	6	5-9
+220°	+105°		300		20		1,200	6	5-9
-328° to +850° atmosphere +1200° steam	-200° to +455° atmosphere +650° steam		500	2,500	35	173	4,000	20	0-14*
+650° atmosphere +1200° steam	+345° atmosphere +650° steam		500		35		4,000	20	1-12
+400°	+205°		300		20		800	4	0-14*
-328° to +850° atmosphere +1200° steam	-200° to +455° atmosphere +650° steam		500		35		4,000	20	0-14*
+850° atmosphere +1200° steam	+455° atmosphere +650° steam			1,200		82			1-12
-328° to +850° atmosphere +1200° steam	-200° to +455° atmosphere +650° steam		500		35		4,000	20	0-14*
+850° atmosphere +1200° steam	+455° atmosphere +650° steam			4,000		275			0-14*
+220°	+105°		150		10		1,200	6	5-9
+220°	+105°		250		17		1,200	6	5-9
+1500°	+815°			4,500		310	2,500	12	4-10
+850° atmosphere +1200° steam	+455° atmosphere +650° steam			2,500		173			1-12
+850° atmosphere +1200° steam	+455° atmosphere +650° steam			4,500		310			1-12
328° to +850° atmosphere +1200° steam	-200° to +455° atmosphere +650° steam		500	3,000	35	200	4,000	20	0-14*
-328° to +850° atmosphere +1200° steam	-200° to +455° atmosphere +650° steam			4,500		310			0-14*
-328° to +700°	-200° to +370°		500	3,000	35	200	4,000	20	0-14*
-328° to +850° atmosphere +1200° steam	-200° to +455° atmosphere +650° steam		500	4,000	35	275	4,800	23	0-14*
-328° to +925° atmosphere +1200° steam	-200° to +500° atmosphere +650° steam			3,000		200			0-14*
-328° to +925° atmosphere +1200° steam	-200° to +500° atmosphere +650° steam			3,000		200			0-14*
-170° to +500°	-110° to +260°		500		35		2,000	10	1-13
-450° to +500°	-270° to +260°		300		20		2,500	12	1-13
-200° to +500°	-130° to +260°		300		20		2,000	10	1-13
-200° to +500°	-130° to +260°		500		35		3,000	15	0-14*
-328° to +600°	-200° to +315°		500		35		3,000	15	0-14*
-328° to +600°	-200° to +315°		500		35		3,000	15	1-12
-200° to +550°	-130° to +288°		300	2,000	20	138	3,000	15	0-14*

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Style Index (cont'd)

Style	Material Classification	Lubrication	Construction	Rotary	Service	
					Recip.	Valve
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			
5501	INCONEL ³ wire-reinforced spun carbon over homogeneous core	Graphite & zinc	Die-formed sets			Soot blower
5888	PTFE filament	PTFE suspensoid	LATTICE BRAID®	X	X	X
5889	PTFE filament	PTFE dispersion & silicone	LATTICE BRAID®	X	X	
5898	PTFE filament	PTFE dispersion	LATTICE BRAID®	X	X	X
5904	PTFE filament—FDA	PTFE dispersion / mineral oil	LATTICE BRAID®	X	X	
6501	INCONEL wire-reinforced spun carbon over homogeneous core	Graphite & tungsten disulfide	Die-formed sets			Soot blower
7501	INCONEL wire-reinforced PBI ¹ over carbon yarn core	Graphite & tungsten disulfide	Die-formed sets			Soot blower
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	PTFE suspensoid & snow-white petrolatum	LATTICE BRAID®	X	X	X
8922	Spun synthetic	PTFE suspensoid & snow-white petrolatum	LATTICE BRAID®	X	X	
8922-PBI	Spun synthetic / PBI corners	PTFE suspensoid & snow-white petrolatum	LATTICE BRAID®	X	X	
8968	Spun carbon over fiberglass	Graphite dispersion & 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
GRAPH-LOCK®	Flexible graphite	N/A	Die-formed sets, tape	X		X
PM†-1	Spun synthetic	PTFE suspensoid & snow-white petrolatum	LATTICE BRAID®	X	X	
PM-2	Spun synthetic	Petroleum oils & graphite	LATTICE BRAID®	X	X	
PM-3	Spun synthetic	Petroleum oils & graphite	Square braid	X	X	
PM-5	Aramid filament	Silicone	LATTICE BRAID®	X	X	
PM-6	Expanded PTFE/graphite	Silicone	LATTICE BRAID®	X	X	
PM-6K	Expanded PTFE filament—aramid filament	Silicone	LATTICE BRAID®	X	X	
PM-7	PTFE filament	PTFE suspensoid	LATTICE BRAID®	X	X	X
PM-8	PTFE filament	Silicone	LATTICE BRAID®	X		

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. KYNOL is a trademark of American Kynol, Inc.

6. GFO is a trademark of WL Gore.

* 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®

	Temperature		Pressure (psi)		Pressure (bar)		Shaft Speed		pH
	Fahrenheit	Centigrade	Rotary	Valve	Rotary	Valve	fpm	m/s	
	-420° to +500°	-250° to +260°	500		35		2,500	12	2-12
	+250°	+121°	200		14		1,200	6	5-9
	+1000°	+540°		10		1			2-11
	+1000°	+540°		10		1			2-11
	+650° atmosphere +1200° steam	+345° atmosphere +650° steam							1-12
	-450° to +500°	-270° to +260°	300	2,000	20	138	1,000	5	0-14
	-450° to +500°	-270° to +260°	300		20		1,500	8	0-14**
	-450° to +500°	-270° to +260°	300	2,000	20	138	1,000	5	0-14
	-450° to +500°	-270° to +260°	300		20		1,500	8	0-14
	+850° atmosphere +1200° steam	+455° atmosphere +650° steam							1-12
	+850° atmosphere +1200° steam	+455° atmosphere +650° steam							1-12
	+500°	+260°	500		35		4,000	20	0-14*
	+200°	+93°	300		20		4,000	20	2-12
	-170° to +500°	-110° to +260°	300		20		1,500	8	4-10
	-170° to +500°	-110° to +260°	300		20		1,500	8	4-10
	-170° to +550°	-110° to +288°	500	2,500	35	173	2,250	11	0-12
	-170° to +550°	-110° to +288°	500		35		2,500	12	0-12
	-170° to +550°	-110° to +288°	500		35		2,250	11	1-12
	-170° to +550° atmosphere +625° steam	-110° to +288° atmosphere +332° steam	300		20		2,500	12	2-12
	-328° to +850° atmosphere +1200° steam	-200° to +455° atmosphere +650° steam		10,000		690			0-14*
	-328° to +850° atmosphere +1200° steam	-200° to +455° atmosphere +650° steam		10,000		690			0-14*
	-328° to +850° atmosphere +1200° steam	-200° to +455° atmosphere +650° steam	***	***	***	***	***	***	0-14*
	-170° to +500°	-110° to +260°	300		20		1,500	8	4-10
	-170° to +500°	-110° to +260°	300		20		1,500	8	4-10
	-170° to +500°	-110° to +260°	200		14		1,000	5	4-10
	-420° to +500°	-250° to +260°	500		35		2,500	12	2-12
	-200° to +550°	-130° to +288°	300		20		3,000	15	0-14**
	-200° to +550°	-130° to +288°	500		35		1,900	10	3-12
	-450° to 500°	-270° to +260°	300	2,000	20	138	1,000	5	0-14
	-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.

Asbestos

Asbestos is a mined mineral containing approximately 30% water by volume. High temperatures and high pressure resistance made asbestos the packing standard for pumps and valves for years. The tendency of asbestos to lose volume and become hard in stuffing boxes along with its carcinogenic rating has led to an industry shift to non-asbestos sealing products.

Carbon/Graphite Filament Packings

Garlock carbon filament products are made from carbon yarns having a 95% minimum carbon assay. These pitch-based yarns possess life expectancies and thermal characteristics not found in similar products. 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).

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

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.

PBI

PBI is a registered trademark of Celanese Corporation, and is an acronym for the term “polybenzimidazole”, 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—good dimensional stability, 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.

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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 including 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.

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.



Figure 1



Figure 2



Figure 3



Figure 4

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 equipment 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.

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 compressed 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:

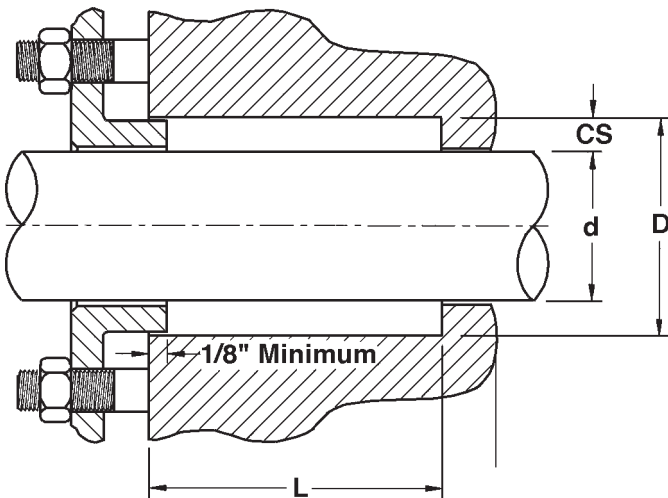
Stem Diameter	Runout (TIR / ft)
Up to and including 1.500" (38.1 mm)	±0.010"
1.501" to 3.000" (38.1 mm to 76.2 mm)	±0.020"
3.001" (76.2 mm) and above	±0.040"

- 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.

Stuffing box dimensions



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)

$$D = d + (2 \times CS)$$

- **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

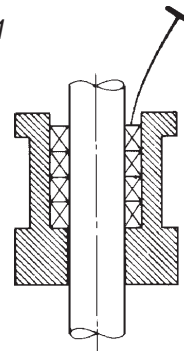
Valve Stem Packing

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.

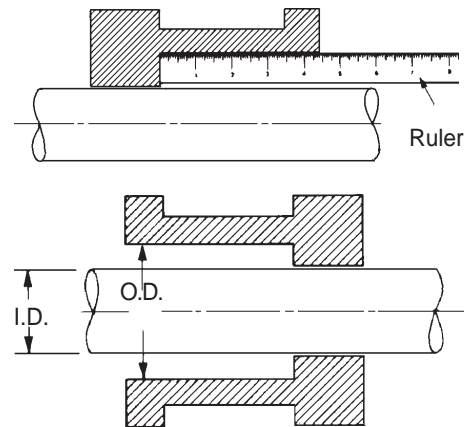
Hold the packing tightly on the mandrel, but do not stretch excessively. Cut the ring and insert it into the stuffing box, making certain that it fits the packing space properly. Each additional ring can be cut in the same manner.

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 previously recorded torque value after each full actuation.

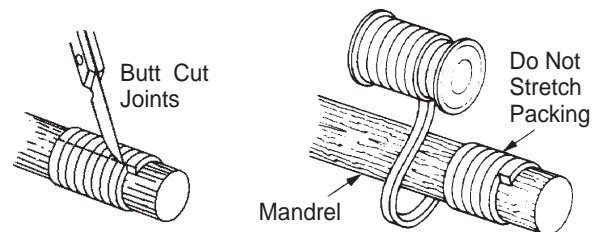
Step 1



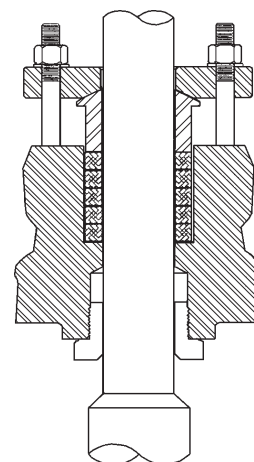
Step 2



Step 3



Steps 4 and 5

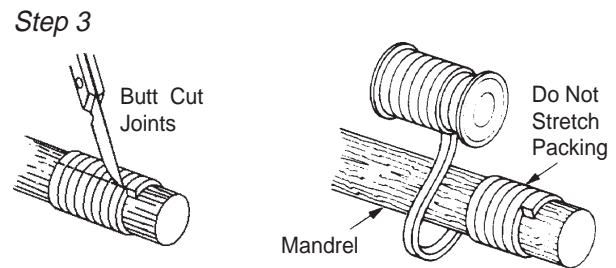
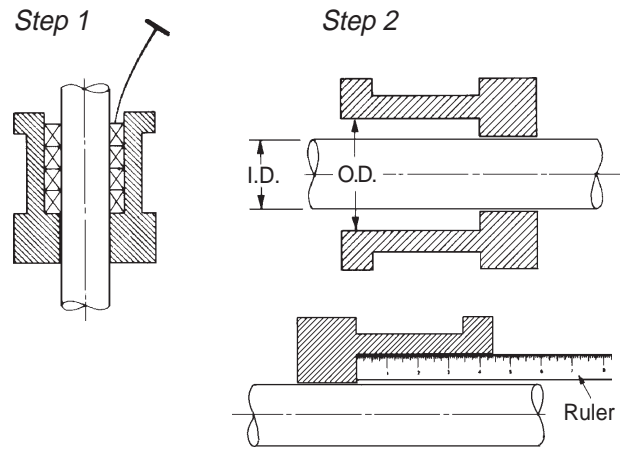


Pump Packing

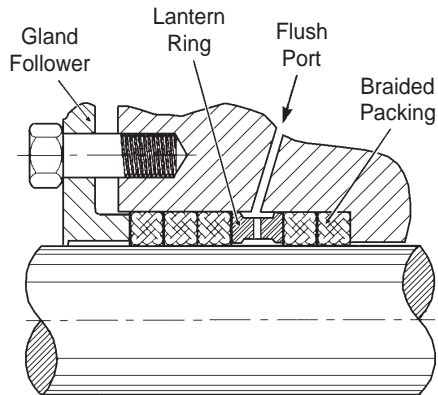
1. Remove all the old packing with packing hooks, being careful not to damage the shaft or sleeve. This means all rings, even the lantern ring and the rings below the lantern. Clean the stuffing box and examine the shaft and sleeve. Replace any worn parts that are scored or deeply grooved.
2. Measure 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.



Steps 5 and 6



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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)

Valve Fire Test Fixtures

The Garlock Fire Test Fixture has been specifically designed to test compression packing and gasketing arrangements in an ANSI 6" 300 pound class gate valve, but is capable of being modified to handle smaller valve installations. The system is also designed to use either water or kerosene as the test medium. The piping/safety relief valves are sized to handle system pressures during burn periods of up to 600 psi (41 bar).

In most fire test exercises, temperatures are monitored and recorded by way of thermocouples that are implanted in the walls of the test valve's body and bonnet. The fixture also has the capability of temperature monitoring by way of calorimeter block-type thermocouples that can be arranged in a pattern surrounding the valve body. The burner system can heat a valve from ambient to 1200°F (650°C) in approximately eight (8) minutes. A monitoring station is located alongside the fixture so that a technician can record and control all temperature and pressure conditions during the course of the test.



Garlock Valve Test Fixture

Fire Test Specification Compliance

- API 6FA, 1st Edition (water)
- API 607 (water)
- API 589 (water)

British Spec BS 6755: Part 2: 1987 (kerosene)

Exxon EXES 3-14-1-2A (kerosene)

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.

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

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)

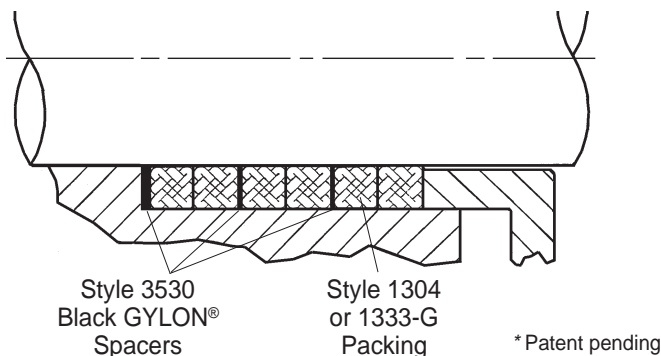
In applications involving high stuffing box pressures (particularly reciprocating pumps) gasket spacers are also used to:

- 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 Style 1304 or 1333-G cut rings
- Contact Garlock Technical Services 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 72 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

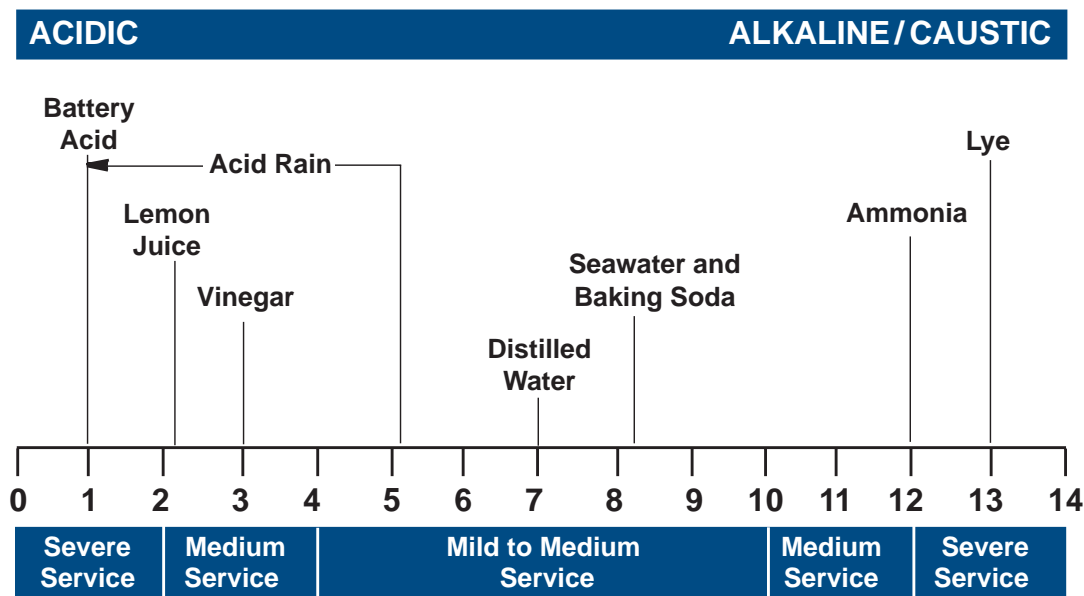
The load factor is determined by the following:

- For a 9000-EVSP Simplified set, a 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 Engineering.)

- (a) Fluorine, used as an oxidizer or rocket fuel.
- (b) Sodium 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 oxygen 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.

Ordering Information

Braided Packing

Size

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

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).



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 9002-94 registration for Industrial Gas-keting, Compression Packing, KLOZURE® Oil Seals, Bearing Protectors, Expansion Joints, Hydraulic Components, Mechanical Seals, 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.

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BF Goodrich

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Columbia, SC, USA	1-803-783-1880	Fax: 1-803-783-4279
Houston, TX, USA	1-281-459-7200	Fax: 1-281-458-0502
Sydney, Australia	61-2-9793-2511	Fax: 61-2-9793-2544
São Paulo, Brazil	55-11-884-9680	Fax: 55-11-884-9680
Oakville, Canada	1-905-829-3200	Fax: 1-905-829-3333
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Neuss, Germany	49-2131-3490	Fax: 49-2131-349-222
Seoul, Korea	822-554-6341	Fax: 822-554-6343
Mexico City, Mexico	52-5-567-7011	Fax: 52-5-368-0418
Singapore	65-254-7372	Fax: 65-254-6708