Garlock Compression Packing

Compression Packing Products were once used to seal visible 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.

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GARFITE®, GRAPH-LOCK®, LATTICE BRAID®, MILL-RIGHT®, PACKMASTER®, QUICKBUSHINGS®, QUICKSET®, and SYNTHEPAK® are registered trademarks of Garlock Inc.
Graphite Packings

**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 +1200°F (650°C) 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 1333-G Square is available upon request*

**For technical assistance, call 1-877-GARLOCK or email questions to: compressionpacking@garlock.com**
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

<table>
<thead>
<tr>
<th>Construction:</th>
<th>GFO® with Silicon lubrication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature:</td>
<td>-200°F (-130°C) to +550°F (+288°C)</td>
</tr>
<tr>
<td>pH range:</td>
<td>0-14**</td>
</tr>
<tr>
<td>Pressure:</td>
<td>To 300 psi (20 bar) rotary/centrifugal</td>
</tr>
<tr>
<td></td>
<td>To 2,000 psi (138 bar) in valves</td>
</tr>
<tr>
<td>Shaft speed:</td>
<td>To 4,000 fpm</td>
</tr>
</tbody>
</table>

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

For technical assistance, call 1-877-GARLOCK or email questions to: compressionpacking@garlock.com

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

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

* Style 1333-G Square is available upon request

WARNING:
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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: -328°F (-200°C) to 1,200°F (650°C) steam* 850°F (455°C) atmosphere

pH range: 0-14 (except strong oxidizers)

Pressure, Max.: To 4,500 psig (310 bar)

*NOTE: For applications over 1,000°F (538°C), please contact Garlock Applications Engineering

212-ULE Box Ordering Information

<table>
<thead>
<tr>
<th>Packing Cross Section</th>
<th>Style B</th>
<th>Style A</th>
<th>Average Stem Diameter</th>
<th>Avg Number of Valves Packed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches</td>
<td>Ft</td>
<td>Lbs</td>
<td>Ft</td>
<td>Lbs</td>
</tr>
<tr>
<td>1/8</td>
<td>65.5</td>
<td>0.8</td>
<td>16.4</td>
<td>0.3</td>
</tr>
<tr>
<td>3/16</td>
<td>127.6</td>
<td>3.6</td>
<td>31.9</td>
<td>0.9</td>
</tr>
<tr>
<td>1/4</td>
<td>98.2</td>
<td>4.3</td>
<td>24.5</td>
<td>0.9</td>
</tr>
<tr>
<td>5/16</td>
<td>50.7</td>
<td>3.0</td>
<td>12.7</td>
<td>0.8</td>
</tr>
<tr>
<td>3/8</td>
<td>45.2</td>
<td>3.5</td>
<td>11.3</td>
<td>1.0</td>
</tr>
<tr>
<td>7/16</td>
<td>38.6</td>
<td>4.3</td>
<td>9.7</td>
<td>1.0</td>
</tr>
<tr>
<td>1/2</td>
<td>22.3</td>
<td>3.8</td>
<td>5.6</td>
<td>0.7</td>
</tr>
<tr>
<td>9/16</td>
<td>26.5</td>
<td>4.9</td>
<td>6.6</td>
<td>1.2</td>
</tr>
<tr>
<td>5/8</td>
<td>29.5</td>
<td>7.4</td>
<td>7.4</td>
<td>1.5</td>
</tr>
</tbody>
</table>

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.

*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.

For technical assistance, call 1-877-GARLOCK or email questions to: compressionpacking@garlock.com
**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**

<table>
<thead>
<tr>
<th>Construction:</th>
<th>INCONEL® reinforced fiberglass wire with graphite finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature:</td>
<td>-328°F (-200°C) to +850°F (+455°C)</td>
</tr>
<tr>
<td>pH range:</td>
<td>0-14 (except strong oxidizers)</td>
</tr>
</tbody>
</table>

*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**

<table>
<thead>
<tr>
<th>Construction:</th>
<th>High-purity GRAPH-LOCK® flexible graphite and 0.004&quot; INCONEL® filament</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature:</td>
<td>-328°F (-200°C) to +850°F (+455°C) atmosphere; to +1,200°F (+650°C) steam**</td>
</tr>
<tr>
<td>pH range:</td>
<td>0-14 (except strong oxidizers)</td>
</tr>
<tr>
<td>Pressure:</td>
<td>To 4,500 psi (310 bar)</td>
</tr>
</tbody>
</table>

*INCONEL® is a registered trademark of Inco Alloys International, Inc.
** For applications over 1,000°F (538°C), please contact Garlock Applications Engineering

For technical assistance, call 1-877-GARLOCK or email questions to: compressionpacking@garlock.com
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

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)

For technical assistance, call 1-877-GARLOCK or email questions to: compressionpacking@garlock.com
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.

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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

<table>
<thead>
<tr>
<th>Construction</th>
<th>Highest grade graphite filament with an exclusive graphite dispersion, in LATTICE BRAID® construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>-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</td>
</tr>
<tr>
<td>pH range</td>
<td>0-14 (except strong oxidizers)</td>
</tr>
<tr>
<td>Pressure</td>
<td>To 4,000 psi (275 bar) plus, when used with GRAPH-LOCK® center rings</td>
</tr>
</tbody>
</table>

* 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.

For technical assistance, call 1-877-GARLOCK or email questions to: compressionpacking@garlock.com

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Seals for Rotating Service

Style 8091

HydraJust™ 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

For technical assistance, call 1-877-GARLOCK or email questions to: compressionpacking@garlock.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.

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

For technical assistance, call 1-877-GARLOCK or email questions to: compressionpacking@garlock.com
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

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

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

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

For technical assistance, call 1-877-GARLOCK or email questions to: compressionpacking@garlock.com
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†

Style 108 Specifications

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/ft³ [1,400 kg/m³]) with 1303-FEP or 98 end rings
- **Temperature:** To +850°F (+455°C) atmosphere, +1,200°F (+650°C) steam

For technical assistance, call 1-877-GARLOCK or email questions to: compressionpacking@garlock.com
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

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

* 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

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

* Patent #4,994,303

For technical assistance, call 1-877-GARLOCK or email questions to: compressionpacking@garlock.com
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

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

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

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

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

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

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

<table>
<thead>
<tr>
<th>Construction</th>
<th>LATTICE BRAID® Aramid filament lubricated with a PTFE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>-420°F (-250°C) to +500°F (+260°C)</td>
</tr>
<tr>
<td>pH range</td>
<td>2 – 12</td>
</tr>
<tr>
<td>Pressure</td>
<td>To 500 psi (35 bar) rotary</td>
</tr>
<tr>
<td>Shaft speed</td>
<td>To 2500 fpm</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Construction</th>
<th>LATTICE BRAID®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>-170°F (-110°C) to +550°F (+290°C)</td>
</tr>
<tr>
<td>pH range</td>
<td>1 - 13</td>
</tr>
<tr>
<td>Pressure</td>
<td>To 300 psi (20 bar) rotary/centrifugal</td>
</tr>
<tr>
<td>Shaft speed</td>
<td>To 2,000 fpm</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Construction</th>
<th>LATTICE BRAID®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>-170°F (-110°C) to +550°F (+290°C)</td>
</tr>
<tr>
<td>pH range</td>
<td>1 - 13</td>
</tr>
<tr>
<td>Pressure</td>
<td>To 500 psi (20 bar) rotary/centrifugal</td>
</tr>
<tr>
<td>Shaft speed</td>
<td>To 2,000 fpm</td>
</tr>
</tbody>
</table>

* KYNOL is a trademark of American KYNOL, inc.

For technical assistance, call 1-877-GARLOCK or email questions to: compressionpacking@garlock.com
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 braid 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 yarns 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 |

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 distillation 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® Aramide 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:  | -200°F (-130°C) to +550°F (+288°C) |
| 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 +500°F (+260°C) |
| pH range:     | 0 - 14 |
| Pressure:     | To 300 psi (20 bar) rotary/centrifugal |
| Shaft speed:  | To 1,000 fpm |

*Not recommended for chlorine service

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 treatment

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

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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)

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

For technical assistance, call 1-877-GARLOCK or email questions to: compressionpacking@garlock.com

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.
Packing Tools

A complete integrated line of U.S. made tools designed to handle your packing maintenance with ease. The unique interchangeability of tips with flex or rigid holders allows a versatility not available elsewhere. Worn or damaged tips may be replaced at minimum cost rather than sacrificing the entire tool.

Flexible Extractor: Size F00
- With non-removable tip
- F00: Length 7", Shaft Diam 3/32"

Flexible Extractor: Sizes F1, F2, F3
- With removable tips
- F1: Length 7", Thread 8-32, Shaft Diam 5/32"
- F2: Length 11", Thread 1/4-20, Shaft Diam 1/4"
- F3: Length 14", Thread 1/4-20, Shaft Diam 1/4"

Packing Tools Set "B" includes:
- (2) F1
- (2) F2
- (2) F3
- (1) P7
- (1) P8
- (1) P9
- Wrench
- (3) C1
- (3) C2
- (3) C3
- (1) W1
- (1) W2
- (1) W3

Replacement Corkscrew Tips
- C-1: No. 1 Corkscrew Tip
- C-2: No. 2 Corkscrew Tip
- C-3: No. 3 Corkscrew Tip
Solid Shaft Extractors with Non-Replaceable Tips: Sizes SN1, SN2, SN3
- SN1: Length 6", Shaft Diam 5/32
- SN2: Length 10", Shaft Diam 1/4"
- SN3: Length 14", Shaft Diam 1/4"

Guillotine Packing Cutter
Easily cuts all packing including KEVLAR® fiber, copper sheathhead, and wire core packing to 1" diameter at 45° or butt angles. 4" max shaft size direct-reading diameter/circumference scales eliminate expensive time and material waste from costly trial-and-error fitting. Complete with mounting screws, wrenches, stop blocks for 45° and butt cutting, and a vernier caliper for accurate shaft and stuffing box measurement. Heat-treated spare tool steel blades are available.

Photos courtesy of Garco
Lubricating Compounds

Luball
- Petroleum-based grease with molybdenum disulfide
- No graphite or fillers, completely waterproof
- Rated to 500°F

No. 2 Lubricating Compound
- Graphite-filled, mineral oil base (45% graphite by weight)
- Although rated to 500°F, it will start to flow somewhat between 300°F and 400°F

START-UP™ Run-in Lubricant
- White, water based lubricant for pumps
- Non-staining, non-contaminating and harmless to skin, it contains no graphite
- Ally START-UP lubricant to packing rings for easier installation and run-in
- Rings of packing will then slide around the shaft without resistance
- In service START-UP lubricant leaves no residue to collect between the rings so service life is extended
- Removal of old packing becomes easier
**Style Index**

<table>
<thead>
<tr>
<th>Style</th>
<th>Material Classification</th>
<th>Lubrication</th>
<th>Construction</th>
<th>Rotary</th>
<th>Service Recip</th>
<th>Valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>Flax roving</td>
<td>Petrolatum &amp; paraffin</td>
<td>Square braid</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
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<td>Flax roving</td>
<td>Marine &amp; petro wax/graphite</td>
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<td>X</td>
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<td>98</td>
<td>Carbon filament</td>
<td>Graphite dispersion</td>
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<td>98-PBI</td>
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<td>105 (CARBAE”)</td>
<td>Carbon filament</td>
<td>PTFE &amp; snow-white petrolatum</td>
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<td>X</td>
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<td>108 (CARBAE™)</td>
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<td>Graphite dispersion</td>
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<td>X</td>
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<tr>
<td>127-AFP</td>
<td>INCONEL® wire-reinforced spun carbon over homogeneous core</td>
<td>Graphite</td>
<td>Braid over core</td>
<td></td>
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<tr>
<td>1298</td>
<td>INCONEL® wire-reinforced PBI over carbon yarn core</td>
<td>Graphite &amp; tungsten disulfide</td>
<td>Braid over core</td>
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<tr>
<td>1300-E</td>
<td>Flexible graphite</td>
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<td>1303-FEP</td>
<td>INCONEL® filament-reinforced flexible graphite</td>
<td>Graphite dispersion</td>
<td>Square braid</td>
<td></td>
<td></td>
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<tr>
<td>1333-G</td>
<td>Graphite filament-reinforced flexible graphite</td>
<td>Graphite</td>
<td>Square braid</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1812</td>
<td>Spun NOMEX® / synthetic</td>
<td>PTFE &amp; snow-white petrolatum</td>
<td>LATTICE BRAID®</td>
<td>X</td>
<td>X</td>
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<tr>
<td>1850</td>
<td>KYNOL®</td>
<td>PTFE &amp; snow-white petrolatum</td>
<td>LATTICE BRAID®</td>
<td>X</td>
<td>X</td>
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<tr>
<td>1925</td>
<td>Fiber-infused PTFE</td>
<td>PTFE suspensoid and snow-white petrolatum</td>
<td>LATTICE BRAID®</td>
<td>X</td>
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<tr>
<td>1947</td>
<td>NOMEX® fiber</td>
<td>PTFE &amp; silicone</td>
<td>LATTICE BRAID®</td>
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<tr>
<td>1965</td>
<td>Fiber-infused PTFE</td>
<td>Graphite</td>
<td>LATTICE BRAID®</td>
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<tr>
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<tr>
<td>5000-PBI</td>
<td>Carbon filament w/ PBI corners</td>
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1. PBI is a registered trademark of Celanese Corporation.
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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.
7. GFO is a trademark of WL Gore.

* 0-14 except strong oxidizers
### Style Index (cont'd)

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

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

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

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

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* 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)

<table>
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<th>Temperature Fahrenheit</th>
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<th>Pressure (psi) Rotary Valve</th>
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<td>35</td>
<td>2,500</td>
<td>12 2-12</td>
</tr>
<tr>
<td>PM-6</td>
<td>-200° to +550°</td>
<td>-130° to +288°</td>
<td>300</td>
<td>20</td>
<td>3,000</td>
<td>15 0-14**</td>
</tr>
<tr>
<td>PM-6K</td>
<td>-200° to +550°</td>
<td>-130° to +288°</td>
<td>500</td>
<td>35</td>
<td>1,900</td>
<td>10 3-12</td>
</tr>
<tr>
<td>PM-7</td>
<td>-450° to +500°</td>
<td>-270° to +260°</td>
<td>300</td>
<td>2,000</td>
<td>20</td>
<td>138</td>
</tr>
<tr>
<td>PM-8</td>
<td>-450° to +500°</td>
<td>-270° to +260°</td>
<td>300</td>
<td>20</td>
<td>1,500</td>
<td>8 0-14**</td>
</tr>
</tbody>
</table>

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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 “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—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 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.

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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 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:

<table>
<thead>
<tr>
<th>Stem Diameter</th>
<th>Runout (TIR / ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to and including 1.500&quot; (38.1 mm)</td>
<td>±0.010&quot;</td>
</tr>
<tr>
<td>1.501&quot; to 3.000&quot; (38.1 mm to 76.2 mm)</td>
<td>±0.020&quot;</td>
</tr>
<tr>
<td>3.001&quot; (76.2 mm) and above</td>
<td>±0.040&quot;</td>
</tr>
</tbody>
</table>

- 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.

Stuffing box dimensions

Pumps

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

<table>
<thead>
<tr>
<th>Shaft Diameter</th>
<th>Recommended Cross Section (CS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches</td>
<td>mm</td>
</tr>
<tr>
<td>5/8&quot; to 1-1/8&quot;</td>
<td>15.8 to 28.6</td>
</tr>
<tr>
<td>Over 1-1/8&quot; to 1-7/8&quot;</td>
<td>28.6 to 47.6</td>
</tr>
<tr>
<td>Over 1-7/8&quot; to 3&quot;</td>
<td>47.6 to 76.2</td>
</tr>
<tr>
<td>Over 3&quot; to 4-3/4&quot;</td>
<td>76.2 to 120.7</td>
</tr>
<tr>
<td>Over 4-3/4&quot; to 12&quot;</td>
<td>120.7 to 304.8</td>
</tr>
</tbody>
</table>

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 previously recorded torque value after each full actuation.
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.
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.

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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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 QUICKSET® 9001 30% compression
- 70#/ft³ density GRAPH-LOCK® 25% 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:
  \[\text{LF} = 1.5 \text{ system pressure or 3,800 psi (whichever is greater)}\]
- When using any other Garlock packing:
  \[\text{LF} = 1.5 \text{ system pressure or 5,500 psi (whichever is greater)}\]
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.

<table>
<thead>
<tr>
<th>ACIDIC</th>
<th>ALKALINE/CAUSTIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery Acid</td>
<td>Lye</td>
</tr>
<tr>
<td>Acid Rain</td>
<td>Seawater and Baking Soda</td>
</tr>
<tr>
<td>Lemon Juice</td>
<td>Ammonia</td>
</tr>
<tr>
<td>Vinegar</td>
<td>Distilled Water</td>
</tr>
<tr>
<td>Acid Rain</td>
<td></td>
</tr>
<tr>
<td>Severe Service</td>
<td>Medium Service</td>
</tr>
<tr>
<td>Medium Service</td>
<td>Mild to Medium Service</td>
</tr>
<tr>
<td>Severe Service</td>
<td>Medium Service</td>
</tr>
<tr>
<td>Severe Service</td>
<td>Medium Service</td>
</tr>
<tr>
<td>Severe Service</td>
<td>Medium Service</td>
</tr>
<tr>
<td>Severe Service</td>
<td>Medium Service</td>
</tr>
</tbody>
</table>

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

### Notes:
1. This table lists the required torque values for a 3,800 psi gland load. This is not a suitable gland load for all styles of packing.
2. Torque values are given for a valve with two gland studs.

<table>
<thead>
<tr>
<th>Bore Diameter (inches)</th>
<th>Stem Diameter (inches)</th>
<th>Torque (in ft-lbs per inch of bolt diameter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.375</td>
<td>0.395</td>
<td>0.625</td>
</tr>
<tr>
<td>0.438</td>
<td>0.464</td>
<td>0.688</td>
</tr>
<tr>
<td>0.500</td>
<td>0.531</td>
<td>0.750</td>
</tr>
</tbody>
</table>

- The values in this table are given for a valve with two gland studs.
- These torque values are valid only if gland studs are in good condition and well-lubricated.
- The values are not valid for valves with screw type packing nuts, or for valves with more than two gland studs.
- 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.

**Bore Diameter**
- 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

**Stem Diameter**
- 0.395
- 0.464
- 0.531
- 0.600
- 0.668
- 0.736
- 0.805
- 0.873
- 0.941
- 1.009
- 1.078
- 1.146
- 1.214
- 1.283
- 1.351
- 1.419
- 1.488
- 1.556
- 1.624
- 1.692
- 1.760
- 1.828
- 1.906
- 1.984
- 2.062
- 2.140
- 2.218
- 2.296
- 2.374
- 2.452
- 2.530
- 2.608
- 2.686
- 2.764
- 2.842
- 2.920
- 2.998
- 3.076
- 3.154
- 3.232
- 3.310
- 3.388
- 3.466
- 3.544
- 3.622
- 3.700
- 3.778
- 3.856
- 3.934
- 4.012

**Torque**
- 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

The table lists the required torque values for a 3,800 psi gland load. This is not a suitable gland load for all styles of packing. These torque values are valid only if gland studs are in good condition and well-lubricated. 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.
### Ordering Information

**Braided Packing Sizes**

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<th>Inches</th>
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</table>

*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

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<th>Shaft Diameter (in)</th>
<th>0.500</th>
<th>0.750</th>
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<th>1.250</th>
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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 ____________________________________________________________
______________________________________________________________________________________
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:

- 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.

WARNING:
Properties/applications shown throughout this brochure are typical. Your specific application should not be undertaken without independent study and evaluation for suitability. For specific application recommendations consult Garlock. Failure to select the proper sealing products could result in property damage and/or serious personal injury. Performance data published in this brochure has been developed from field testing, customer field reports and/or in-house testing. While the utmost care has been used in compiling this brochure, we assume no responsibility for errors. Specifications subject to change without notice. This edition cancels all previous issues. Subject to change without notice.

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Fax +61.2.9793.2544

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Pune, India
Phone +91.20.3061.6608
Fax +91.20.3061.6699

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