

Compression Packing

The way to more operating efficiency



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Garlock Compression Packing

One of the oldest sealing methods is the use of braided fibers. Due to continual industrial development, the required standards for sealing technologies in general as well as those in the compression packing sector have increased accordingly. Which has resulted in the development of new materials and led to less packing diversity. To satisfy these demands, application oriented research and the use of new fiber technologies have become vital.

The advantages of Garlock Compression Packing at a glance:

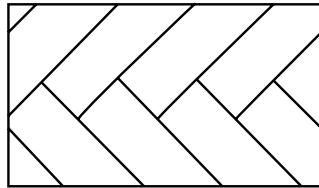
- » Simple installation and service
- » Easy storage
- » Long service-life
- » Shaft-preserving fiber quality
- » Excellent leakproof force distribution

Structure and mesh design



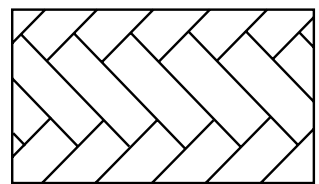
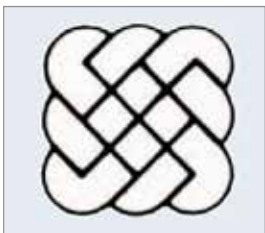
LATTICE BRAID®

LATTICE BRAID® is Garlock's proprietary name for a diagonal mesh that was originally developed in 1940. Each yarn passes through the packing with a 45° angle thus strengthening the packing as a whole. This makes LATTICE BRAID® an extremely homogenous, flexible and wear-free mesh. Due to its high elasticity, it exhibits no change in its quadratic cross-section even when bent around the tightest of radii.



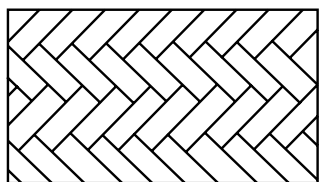
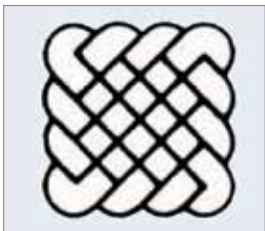
Twofold Diagonal Mesh (Braided Mesh)

- » Coarse, wear-free surface



Threefold Diagonal Mesh

- » Tight mesh structure with high volume stability



Fourfold Diagonal Mesh

- » Tight mesh structure with high volume stability, smooth surface, high elasticity, very high volume stability.

Choosing the Packing

Style	Description	Areas of application		↻	↔	⊥
PACKMASTER 1 	The combination of asbestos-free fibers and PTFE offers an economical standard packing for pumps.	Pumps in mild acids and alkalis, air and dry industrial gases, petroleum and synthetic oils, aromatic and aliphatic solutions, cooling water, salt water and steam.	pH	-	4-10	-
			P (bar)	20	20	-
			T (°C)	-	-110 °C up to +260 °C	-
			v (m/s)	8	2	-
PACKMASTER 6 	An adaptable packing made of PTFE-Graphite-Yarn woven in a Lattice Braid® mesh.	For pump and agitator applications with low friction values.	pH		0-14*	
			P (bar)	20	20	-
			T (°C)		-130 °C up to +280 °C	-
			v (m/s)	15	3	-
5889 	PTFE-Packing with high temperature lubrication for use in rotary service.	Pumps, mixers and agitators for virtually all chemicals.	pH	-	0-14	-
			P (bar)	20	20	-
			T (°C)		-270 °C up to +260 °C	
			v (m/s)	8	2	-
5904 	PTFE-Fiber Packing with good lubrication and abrasion-resistant properties. Complies with FDA specifications.	Machines used in the food and pharmaceutical industry. Pumps, mixer, agitators and dryers.	pH	-	0-14	-
			P (bar)	20	20	-
			T (°C)		-270 °C up to +260 °C	
			v (m/s)	8	2	-
1925 	This packing combines the wear and temperature resistance properties of impregnated PTFE-Fiber-Yarns with the elasticity of synthetic yarns. A packing that combines highest mechanical stability with the chemical resistance of PTFE.	Excellent properties allow usage at high temperatures, and with abrasive and aggressive media. For pumps, valves and fittings, mixers and agitators in virtually all branches of industry.	pH	-	1-13	-
			P (bar)	20	-	200
			T (°C)	-	-270 °C up to 260 °C	-
			v (m/s)	12	-	-
5200 	High abrasion-resistant Aramid-Fiber-Packing with PTFE-Impregnation and high temperature lubrication.	For pumps in abrasive media e.g. sand and slurry as well as for chamber rings in coarse media.	pH	-	2-12	-
			P (bar)	35	35	-
			T (°C)	-	-250 °C up to +260 °C	-
			v (m/s)	12	2	-

*except in highly oxidizing media

Rotary ↻ Reciprocating ↔ Valve ⊥

Choosing the Packing

Style	Description	Areas of application		↻	↔	⊥
SYNTHEPAK 8921-K 	A synthetic packing with Aramid Corners and PTFE Impregnation (Infusion), for use in abrasive media with minimal leakage. Also suitable as a valve packing.	For sand, slurry and salt solutions where a long service life is required.	pH	-	0-12	-
			P (bar)	35	35	175
			T (°C)	-	-110 °C up to +280 °C	-
			v (m/s)	12	2	-
SYNTHEPAK 8922 	An Organic Polymer Fiber Packing developed by Garlock. Before and after the weaving process every fiber is PTFE impregnated, making it a perfect general-purpose packing for pumps and valves.	Pumps and agitators in strong acids, solutions, alkalis, oils, gases, steam, water and mineral oil products.	pH	-	0-12	-
			P (bar)	35	35	-
			T (°C)	-	-110 °C up to +280 °C	-
			v (m/s)	12	2	-
1333-G 	A packing braided from flexible graphite yarns reinforced with graphite fiber providing greater tensile strength. The use of the graphite filament yarns increase abrasion resistance for rotary services and anti-extrusion resistance for valve applications.	Pumps, valves and agitators in strong acids, solutions, alkalis, oils, gases, steam, water and mineral oil products. Also in high pressure / temperature environments due to its PTFE-free construction.	pH	-	0-14* ¹	-
			P (bar)	34	34	275
			T (°C)	-	-240 °C up to +455 °C* ²	-
			v (m/s)	23	-	-
98 	This Carbon Yarn Packing offers the maximum of possibilities and profitability in virtually all high speed chemical applications. Style 98 is also an excellent valve packing.	Pumps, valves and agitators in strong acids and alkalis, boiler and feed water pumps.	pH	-	0-14* ¹	-
			P (bar)	35	35	173
			T (°C)	-	-200 °C up to 455 °C* ²	-
			v (m/s)	20	2	-
1300-E 	A packing consisting of expanded and flexible pure graphite for maximum leak-tightness and dimensional stability. Ideal for pump and valve sealing in a wide field of applications.	Boiler and feed water pumps, acid pumps and valves, agitators and mixers.	pH	-	0-14* ¹	-
			P (bar)	35	35	200
			T (°C)	-	-200 °C up to 455 °C* ²	-
			v (m/s)	20	2	-
1303-FEP 	This graphite packing is manufactured from a proprietary yarn consisting of several strands of high purity GRAPH-LOCK® contained by an INCONEL filament jacket, making the finished braid non-scoring and thermally conductive.	Pumps, valves and agitators in strong acids and alkalis. Boiler and feed water pumps. » TA-Luft as a 5 ring set » API 622 as a 5 ring set	pH	-	0-14* ¹	-
			P (bar)	-	-	310
			T (°C)	-	-200 °C up to 455 °C* ²	-
			v (m/s)	-	-	-

*1 except in highly oxidizing media
*2 650 °C in steam




Choosing the Packing

Style	Description	Areas of application		↻	↔	⌚
1200-PBI 	A high-pressure packing comprised of an extruded graphite-compound core with Celanese PBI® fibers, strengthened by integrated INCONEL stainless steel and a tungsten-disulfide coating as anticorrosive.	Valves where high temperature, pressure and chemical stability is required. e.g. in salt applications.	pH	-	0-12* ¹	-
			P (bar)	-	-	172
			T (°C)	-	-220 °C up to +435 °C	-
			v (m/s)	-	-	-
5888 	A PTFE packing with a high temperature lubrication for use in valves and linear services.	Valves and plungers with virtually all chemicals. » TA-Luft as a 5 ring set	pH	-	0-14	-
			P (bar)	20	-	138
			T (°C)	-	-270 °C up to +260 °C	-
			v (m/s)	-	5	-
127-AFP 	An excellent valve stem packing for use in high temperatures and pressures. An outer jacket of carbon yarn encapsulates the INCONEL alloy wire reinforcement woven around a flexible core.	Steam in power stations and chemical plants. Good resistance to chemical and petrochemical products.	pH	-	1-12	-
			P (bar)	-	-	82
			T (°C)	-	-240 °C up to +455 °C* ²	-
			v (m/s)	-	-	-
2091 	A braided construction of expanded, flexible pure graphite yarn around a reinforced stainless steel wire. It combines the easy installation features of compression packing with the superior sealing properties of expanded pure graphite rings.	Steam with high temperature pressure combinations. Good resistance to chemical and petrochemical products.	pH	-	0-14* ¹	-
			P (bar)	-	-	350
			T (°C)	-	-240 °C up to 455 °C* ²	-
			v (m/s)	-	-	-
5882 	A packing constructed from a high quality carbon fiber core and a PTFE shell. This combination exploits the low friction qualities of PTFE and the structural integrity of high quality carbon fibers, reducing wear whilst retaining the superior qualities of a valve packing.	Control valves, regulator valves where low valve stem friction is called for.	pH	-	0-14* ¹	-
			P (bar)	-	-	242
			T (°C)	-	-200 °C up to 288 °C	-
			v (m/s)	-	-	-

*¹ except in highly oxidizing media
 **² 650 °C in steam

Choosing the Packing

This chart shows plant engineers and designers the choice of packings for standard as well as custom applications. Together with our engineers, customers can either choose the most suitable packings for their requirements or develop tailor-made solutions.

Media		Packing style		PACKMASTER 1	PACKMASTER 6	5889	5904	1925	5200	SYTHEPAK 8922	SYTHEPAK 8921-K	1333-G	98	5898	1300-E	1303-FEP	1200-PBI	5888	127-AFP	2091	GRAPH-LOCK	5882	
		mild	strong																				
Acids	mild	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	strong		✓	✓	✓					✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓
Bases	mild	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	strong		✓	✓	✓					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Gases	air exhaust	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	oxygen												✓									✓	
Oils	mineral	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	synthetic		✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Solvents	aromatic	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	aliphatic	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Steam		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Water / salt-solutions		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Media, where contamination is not an option		✓		✓	✓	✓	✓	✓	✓	✓					✓					✓			
Maximum temperature in °C		260	280	280	280	260	280	290	280	455*	455*	280	455*	455*	455*	280	455*	455*	3000	288			
Motion	rotary 	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓									
	reciprocating 												✓	✓		✓	✓	✓	✓	✓	✓	✓	
	valve 					✓					✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓

* 650 °C in steam

Weight table

mm	Inch	PKM1	PKM6	5889	5904	1925	5200	STP 8922	STP 8921-K	1333-G	98	1300-E	1303-FEP	1200-PBI	5888 / 5898	127-AFP	2091	5882
3	1/8	56,0	-	40,0	26,0	71,0	49,0	63,0	-	68,1	66,0	-	52,3	57,3	58,4	59,0	-	44,4
5	3/16	32,0	-	17,5	18,0	32,0	22,0	38,0	-	39,7	42,0	36,0	24,0	31,5	22,3	40,0	36,0	24,8
6	1/4	15,0	12,0	11,4	13,0	16,0	15,0	18,0	12,5	20,8	20,0	22,0	15,4	14,6	15,0	17,0	22,0	16,0
8	5/16	11,2	8,0	6,7	10,0	11,0	10,0	13,0	9,5	14,3	15,0	13,5	11,5	8,7	8,9	10,0	13,5	10,6
10	3/8	8,0	5,2	5,4	6,6	8,0	6,8	9,5	7,9	9,9	11,0	9,0	8,7	6,7	6,3	6,8	9,0	7,4
11	7/16	5,5	4,6	3,8	4,8	6,0	6,0	6,8	6,7	7,7	8,0	7,0	6,0	5,5	5,0	5,0	7,0	6,1
12	1/2	4,0	3,5	3,2	3,6	4,8	4,5	5,1	5,0	6,2	5,8	5,5	3,9	4,2	3,9	4,0	5,5	4,1
14	9/16	3,6	2,4	2,4	3,0	3,6	3,4	4,2	3,9	4,7	5,0	4,5	3,6	3,3	3,2	3,4	4,5	3,5
16	5/8	2,9	2,0	1,9	2,5	2,9	2,6	3,2	3,2	4,3	3,8	3,5	2,7	2,8	2,7	3,0	3,5	-
18	11/16	2,4	1,7	1,6	2,1	2,4	2,3	2,7	2,5	3,5	3,2	2,5	2,3	-	2,3	2,4	2,5	-
19	3/4	2,1	1,5	1,3	1,8	2,0	2,0	2,3	2,0	3,1	2,7	-	1,9	2,0	1,9	2,1	-	-
20	13/16	1,9	1,3	1,2	-	-	1,8	2,1	1,8	-	2,4	2,3	-	-	-	-	2,3	-
22	7/8	1,5	1,1	1,0	1,4	1,5	1,3	1,5	1,5	2,1	2,0	1,8	1,5	1,4	1,3	1,8	1,8	-
25	1	1,25	0,8	0,8	1,1	1,2	0,8	1,4	1,2	1,4	1,7	1,4	1,1	1,2	0,9	1,2	1,4	-

in m / kg

GRAPH-LOCK® Pure Graphite Seals

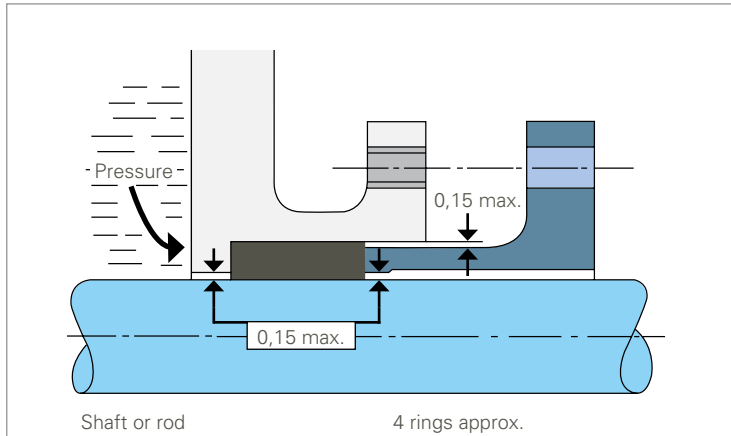
Pure graphite packing rings are pre-pressed special packings for high stress valve stem sealing. Pure graphite is a binder-free sealing material with exceptional chemical and physical properties. The main application areas are the sealing of steam, hot water, heat transfer oils, acids, alkalis, solvents, oxygen and gases.



Technical data	
Temperature	-240 °C up to +3000 °C*
pH	0-14
Pressure	1000 bar

* 500 °C in atmosphere, 650 °C in steam, 3000 °C in an inert environment.

Surface finish		Individual tolerance
Shaft	$R_a \leq 0,5 \mu\text{m}$	maximum stroke = 1/1000 of shaft- ϕ
	$R_{\text{max}} \leq 2,0 \mu\text{m}$	
Housing	$R_a \leq 2,0 \mu\text{m}$	
	$R_{\text{max}} \leq 0,8 \mu\text{m}$	



Modell 212-ULE (Ultra-Low-Emissions)

Braided valve stem packing

This modern packing set consists of two different compression packings that are available either in prefabricated sets or in dispensing boxes with color coded braid. The spool boxes reduce storage costs and production outage without compromising sealing performance. Outage planning is easier than ever now that each 212-ULE box indicates how many typical valves can be repacked by one box.

Benefits 212-ULE

- » Environmentally friendly performance and packaging
- » Double corrosion resistance
- » User friendly dispensing box or prefabricated sets
- » Pack stuffing boxes without specialized seal sets
- » „Fire-tested“ API 589
- » Low stem friction
- » ISO 15848
- » API 622
- » TA-Luft

Ideal for

- » Valves
- » Critical service
- » Efficient outage planning
- » Hydrocarbon processing industry
- » Chemical processing industry

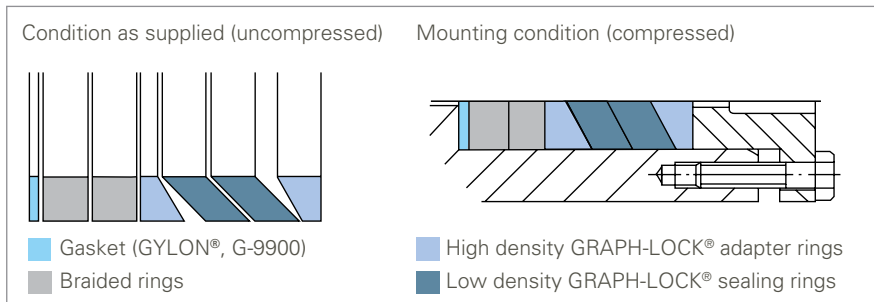
Technical data	
Temperature	-200 °C to 650 °C in steam 455 °C in ambient air
pH	0 – 14 (except in highly oxidizing media)
Pressure	310 bar



8093 DSA Pump Packing

8093 DSA Pump Packing

Suitable for high-speed installation and adjustment to obtain 'minimum-leakage'. By combining the properties of flexible graphite rings and braided packings, the Garlock 8093 DSA is the ideal fusion of these two separate conventional sealing systems.



Benefits 8093 DSA Pump Packing

- » High chemical resistance
- » Easy installation, no equipment modification required
- » No wear of shaft or sleeve
- » Split seal design makes on site installation possible even in difficult situations
- » Minimum leakage
- » Eliminates flush water

Technical Data	
Maximum temperature	260 °C (455 °C with Graphit Gasket)
pH	0-14, except in highly oxidizing media
Shaft speed	20 m/s
Pressure	35 bar

9000 EVSP Valve Stem Packing

Valve stem packing for emission reduction

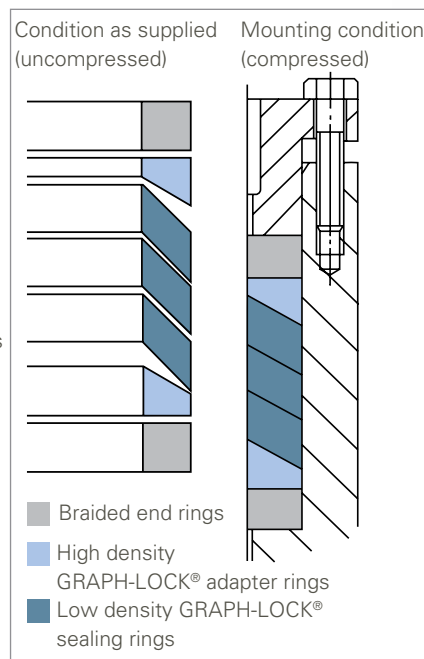
The Cup and Cone configuration of adapter and sealing rings allows a high radial expansion of both inner and outer diameters, a compression with low force requirements, which reduces valve stem friction. A readjustment of the packing by proven volume-loss (by packing or valve stem damage) is possible.

Sealing structure

- » Three low density Cup and Cone GRAPH-LOCK® sealing rings
- » Two high density Cup and Cone GRAPH-LOCK® adapter rings
- » Two pure graphite scraper and anti-extrusion braided end rings

Benefits 9000 EVSP Valve Stem Packing

- » Complies with VOC regulations to API 622
- » Fire safe according to API 607 and API 589
- » Also available in nuclear quality
- » Low friction



Technical Data	
Maximum temperature	650 °C in steam (455 °C in atmosphere)
pH	0-14, except in highly oxidizing media
Pressure	690 bar

QUICKSET® 9001

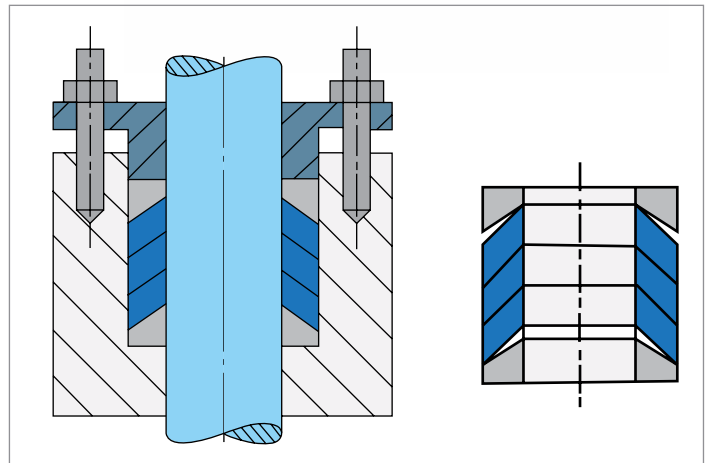
QUICKSET® 9001 combines the advantages of the 9000 EVSP Valve Stem Packing in an improved, even more compact design. This set is primarily designed for control valves where simplified installation and a minimum of friction is required. QUICKSET® combines two tested, emission-reducing materials within this set: 1303-FEP Packing and 9000 EVSP. The system consists of 5 rings. Three low density pure graphite rings are held by two preformed high density 1303-FEP adapter rings. The reduction of all the rings is based on the Cup and Cone design similar to that of the 9000 EVSP. The varying graphite densities allow for both selective component compression and controlled radial expansion.



Benefits QUICKSET® 9001

- » One-step-installation
- » Low emission performance
- » Minimum coefficient of friction
- » Retorquable
- » Complies with VOC regulations to API 622
- » Fire safe according to API 607 and API 589

Technical Data	
Maximum temperature	650 °C in steam (455 °C in atmosphere)
pH	0-14, except in highly oxidizing media
Pressure	690 bar



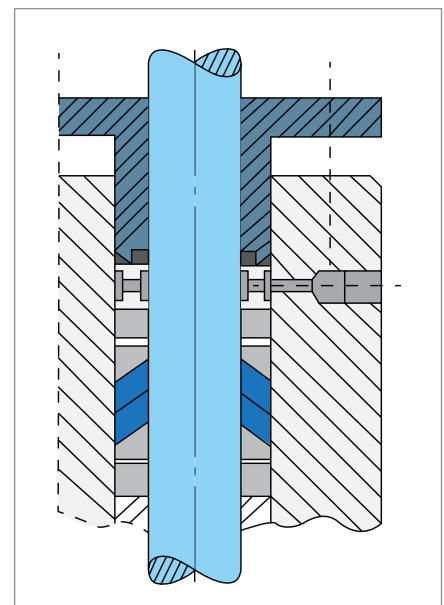
QUICKSET® 9001-M

This valve packing is a modification of the successful QUICKSET® 9001. A proprietary diffusion blocker fulfills TA-Luft regulations, while maintaining minimum friction due to Garlock's proprietary 'cup and cone' design.

Benefits QUICKSET® 9001-M

- » Minimum emission (TA-Luft)
- » One-step-installation
- » Minimum coefficient of friction

Technical Data	
Maximum temperature	400 °C
pH	0-14, except in highly oxidizing media
Pressure	690 bar



Construction and Application Examples

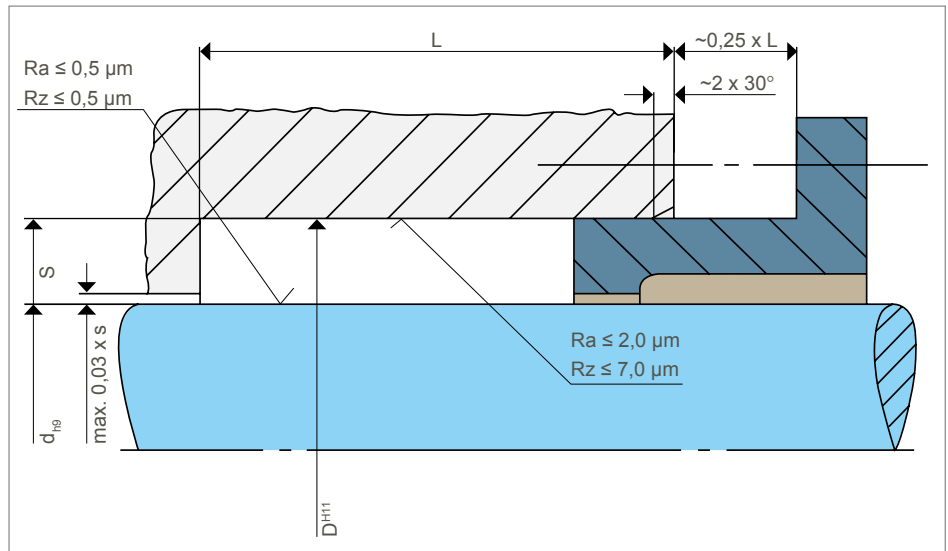
Packing cross section

The packing cross section should always be in relation with the shaft diameter. The following formula is recommended:

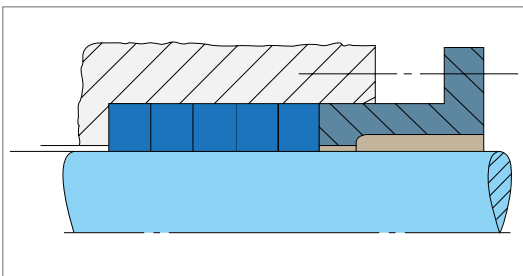
- » Pumps $s=1,4$ to $1,6 \times \sqrt{d}$
- » Valves $s=1,0$ to $1,4 \times \sqrt{d}$

Number of packing rings

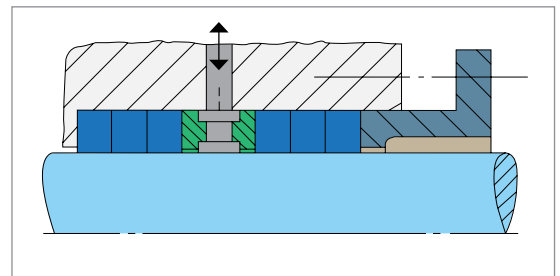
Normally 4-6 packing rings should be used. However when operating conditions call for special solutions a higher number of rings can be utilized. In this case each ring should be pre-pressed.



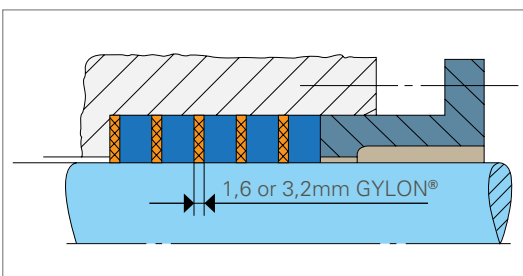
Standard Installation



Cooling, Flushing, Lubrication

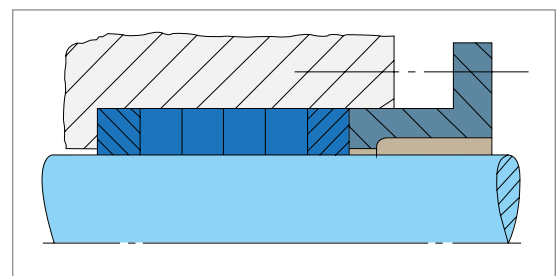


GYLON® Anti-extrusion discs

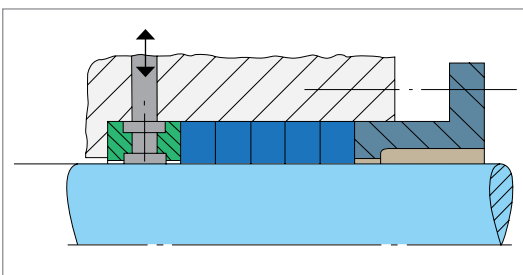


The GYLON® discs between the individual packing rings stop the extrusion of packing and lubricant.

Chamber ring deployment



Flushing



Flushing for the protection of packing arrangements. (for use with abrasive Media)

- » For use of packing with a risk of probable extrusion. The top and bottom ring protect the soft packing against extrusions.
- » For bridging larger sealing gaps

Installation Instructions

Preparation

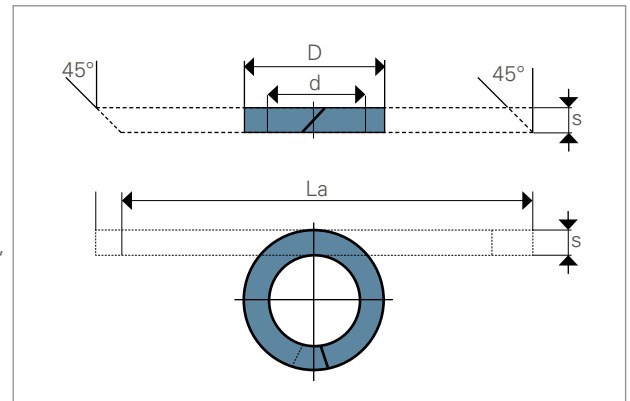
All old packing rings and residual material must be removed before commencing with a new installation. The stuffing box and shaft must be completely clean. Shafts and sleeves must be checked for wear and scoring, and if excessive, replacement is mandatory. If the sealing gap between shaft and housing is large then an anti-extrusion ring should be employed.

Valves

The following formula is recommended for the calculation of the correct packing-ring-length:

$L_a = (d + s) \times \pi \times 1,03$ (see sketch) and, where possible, a diagonal 45° cut should be used. Each ring should be individually pre-pressed and subsequently as set pressed by the gland follower into the end position. If compression is not possible, then a maximum of 4 rings (joints staggered and kept at least a 90° apart) should be employed. Finally the packing can be pressed by the gland follower (if necessary, where a deep stuffing box is involved, a mounting bush can be utilized). Using the same procedure, the rest of the required rings can then be pressed into position.

The required surface pressure should be approx. 2 x medium pressure, but at least 10 N/mm². Whilst tightening the gland, the stem should be repeatedly turned back and forth in order to determine valve stem forces.



Valve Installation

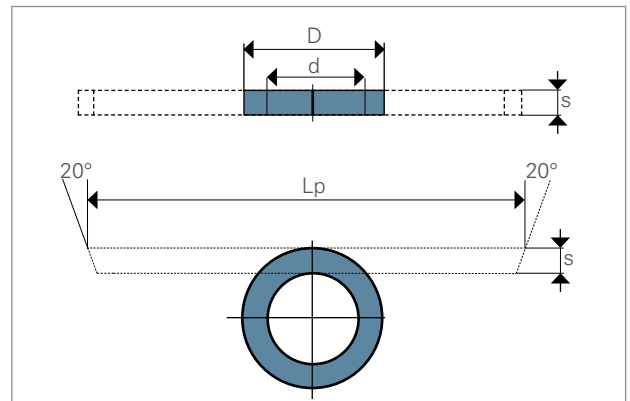
Pumps

The joints of the packing rings should be pressed together whilst parallel to each other. An angle of 20° is recommended whereby the length should be calculated using the following formula:

$L_p = (d + 1,5 \times s) \times \pi$ (see sketch).

Each ring should be installed one at a time with the joints up front. When pumps are sealed using compression packings it is both desirable and necessary that a minimal leakage should occur freely. This permits adequate cooling and lubrication.

At the start therefore, the gland bolts should only be finger-tight allowing relatively high leakage so that a sudden rise in temperature can be avoided. During this approximate 15 minute run in procedure the gland bolts should be gradually tightened so that leakage is reduced to a tolerable level. The temperature of shaft and stuffing box should be monitored continually. If temperatures rise too fast then the gland must be loosened immediately. Leakage amounts are highly dependent on service data and the quality of the packing in use.



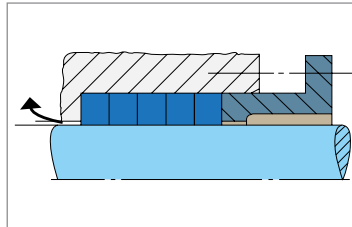
Pump Installation

Reasons for Packing Failure

It is not always clear why a packing fails, however by carefully checking the used rings the causes can often be found.

You find that...

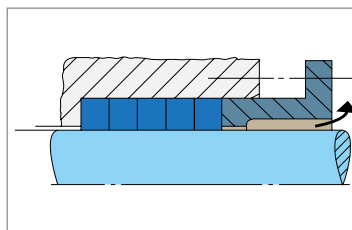
...one or more rings in the set are missing.



The reason is:

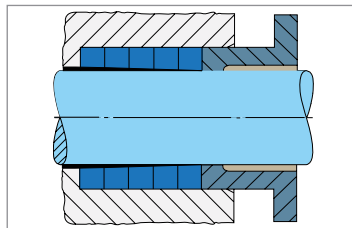
The play between shaft and housing is too large, allowing an extrusion of the packing into the handling system. Installing end rings is recommended or mounting bushings in the stuffing box.

...parts of the packing are found between shaft and gland follower.



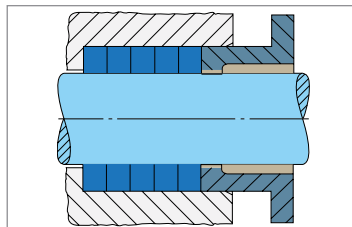
The play between shaft and gland follower is too large. Installing the correct anti-extrusion rings should solve the problem.

...compared to the installation data, the packing now exhibits a smaller radial thickness.



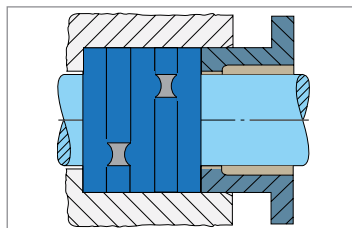
The shaft bearings are faulty, causing the shaft to run out of true and damage the packing.

...the radial thickness of the packing is uneven.



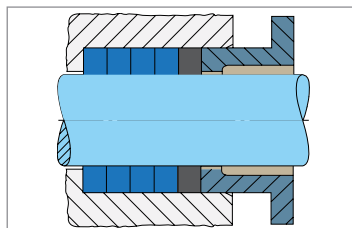
Shaft and bore axis are offset, and this imbalance causes severe wear and scoring.

...axial surface swelling of one more rings.



One or more rings have been cut too short causing the following ring to be pressed into the empty space.

...the end rings are intact, the top rings however severely damaged or the packing rings show wear on their outer diameters.



Bad end ring installation. The gland pressure required for the sealing is unable to be distributed evenly through the packing set (insufficient gland pressure).