Packing

Installation, Operation & Maintenance Instructions

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Packing selection criteria

The technical parameters in catalogs, such as pH, t (°C), p (bar) or v (m/s), are guideline values that mainly refer just to the materials in use . The practical application data of a packing made from these raw materials are usually much lower. Important practical application criteria are listed below to assist in the correct selection of a suitable packing type.

In **dynamic applications**, the shaft circumferential speed, product temperature and pressure add up to the considered total packing strain. Added to this is the quality of the shaft bearing and the condition of the shaft surface

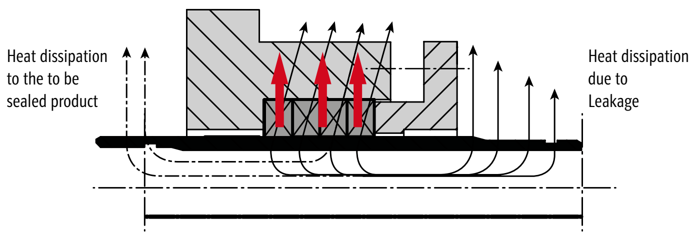
- A rough surface generates more frictional heat.
- A packing that seals a higher pressure is more compressed and creates more frictional heat.
- A fast rotating shaft creates more frictional heat.
- Lack of lubrication due to partial dry running creates more frictional heat

This in sum creates enormous demands on the thermal conductivity of the packing and is therefore a key factor in the selection.

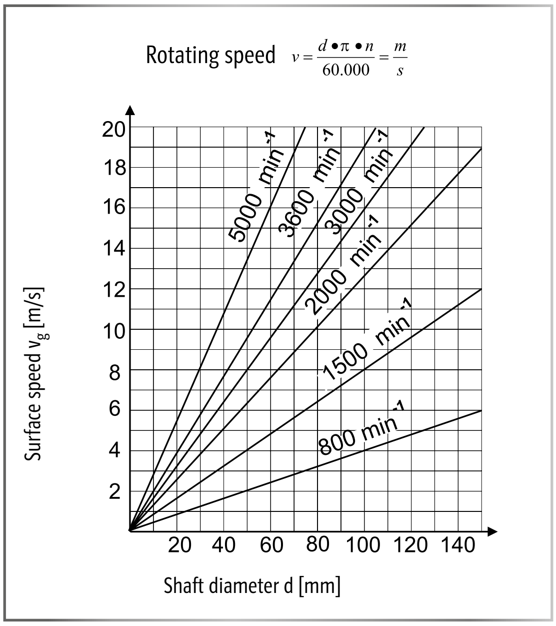
The generated frictional heat is dissipated on the one hand by leakage between packing and shaft running out of the stuffing box. Unfortunately, it will always be tried to keep this to a small amount.

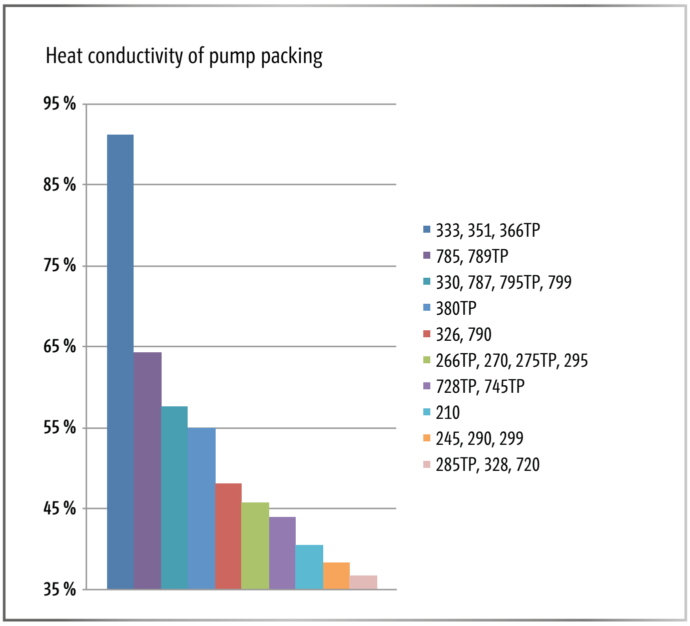
If the sealed product is colder than the created friction temperature between packing and shaft, heat can be dissipated via the shaft into the product.

The third path (drawn in red in the following picture) goes through the packing to the stuffing box housing and radiates the transferred heat from there to the surrounding area.



The heat dissipation to the housing depends on the packing material. *See diagram heat conductivity of pump packing*





Information & Instructions

An important parameter in achieving long service life is the surface hardness of the shaft material. Often simple stainless-steel sleeves are used with a hardness lower than HRC25. If crystallizing or abrasive products are sealed, the packing must be selected accordingly its wear resistance and requires a hardened sleeve. Consideration of the recommended shaft surface hardness per packing type *(See Surface Hardness Requirement diagram)* is important. In most cases, a compromise must be made between packing stability and shaft surface wear.

It is helpful to use the AESSTAR types
, which leave a „soft footprint" on the shaft and provide a good sealing effect even at low gland follower pressure.

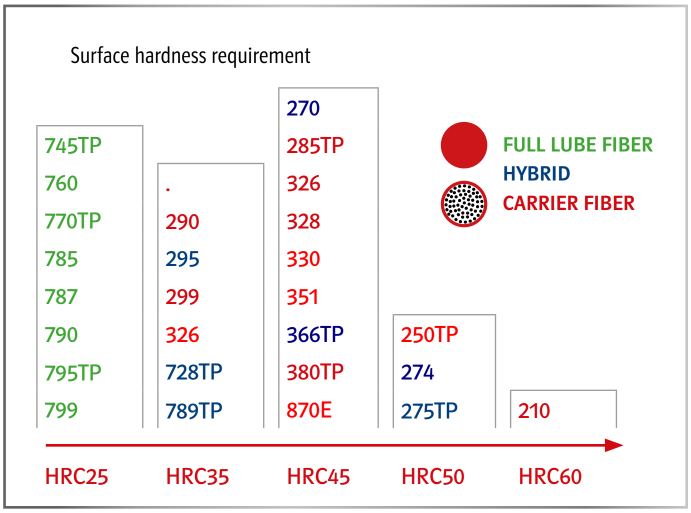
In **static applications**, the permissible product pressure depends primarily on the gap width of the stuffing box components. See packing space recommendations.
An Inconel matrix on the packing yarn produces extrusion-safe packing that can bridge gap widths.

A crucial factor is the thermal expansion behavior of packing. Graphite as a material is close to the expansion coefficient of the steel the valve is made of. PTFE, on the other hand, has an expansion coefficient 11 times higher. *(See diagram thermal expansion rate diagram.)*
When a valve is exposed to temperature, a PTFE packing will expand heavily and try to escape and extrude through the gaps of the stuffing box. On cooling, this process is not reversible, and the packing will leak.

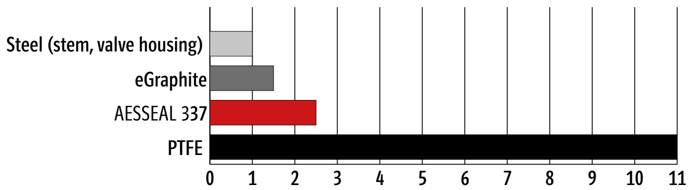
An often neglected factor in valve packing selection is the friction coefficient of the packing.
(See diagram adjusting force of various packing styles.)

This becomes especially important when the valve has frequent actuation such as a control valve. PTFE as a coating provides excellent low friction values. The packing must remain adjustable if abrasion or consolidation makes this necessary. Expanded, flexible graphite is a preferred material here, either as a pure graphite foil ring or as a hybrid with other materials.

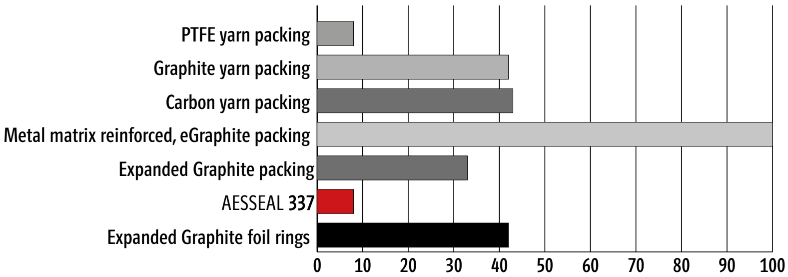
In applications with temperatures >300°C, the consolidation due to volume loss plays a significant role. If the need to compensate for volume loss by re-setting the gland follower is ignored, blow-out of the packing may result, leading to uncontrollable leakage. (*See diagram weight loss after exposure to temperature.*)
Low volume loss packings made of high-quality expanded graphite, with high purity content, are preferred at higher temperatures.



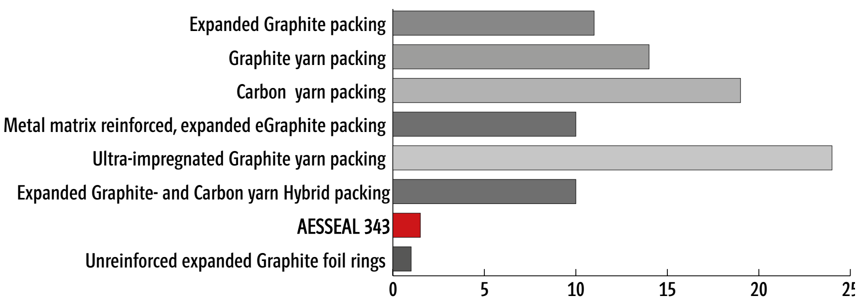
Thermal expansion rate



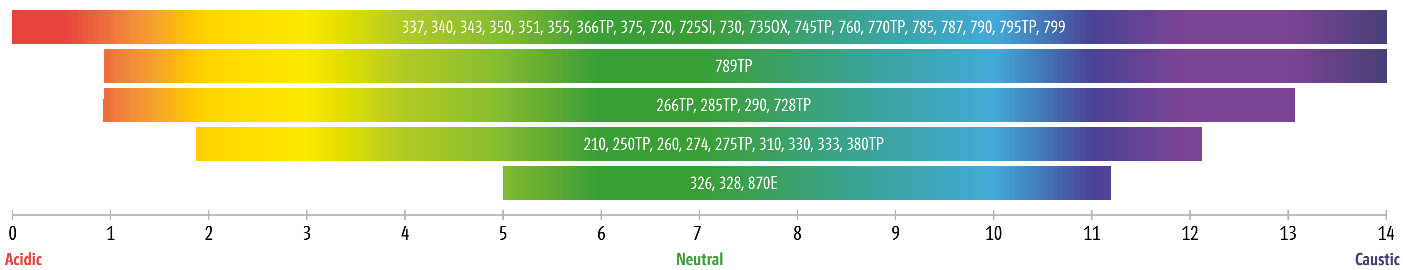
The adjusting force of various packing styles in % relation



Weight loss after the exposure to temperature of 600 °C in stuffingbox



Chemical resistance of packing expressed in pH value 0 - 14



Assembly and cutting

1. Preparation

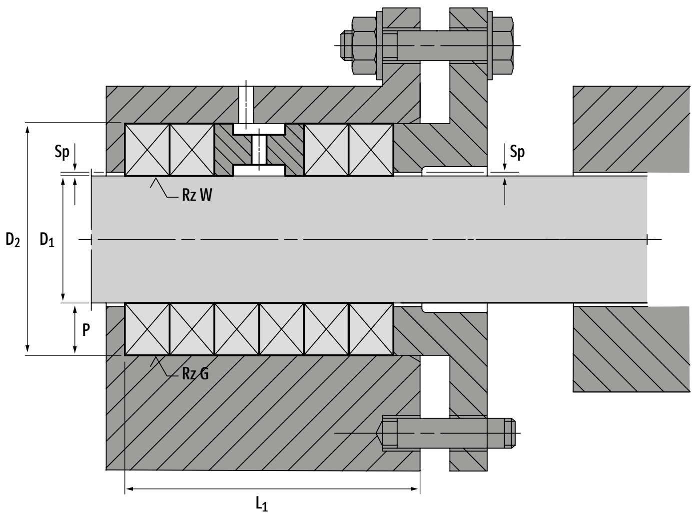
Remove all old packing rings from the stuffing box. Mark the rings immediately and individually as you pull them out: Example with 1 cut for the first ring, 2 cuts for the second ring, etc. *(See picture.)* This way you will know the position of each ring from the previous installation in the stuffing box and can figure out what caused the failure.

Failures may be for example: Extrusion, burning, wear marks, shrinkage, uneven compression.

2. Cleaning

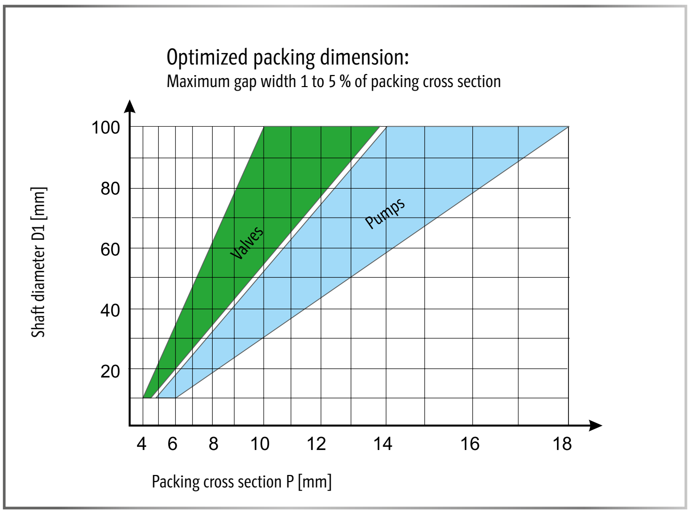
Clean the stuffing box thoroughly and remove all debris. Check the surfaces for damage. Use a mirror or a simple boroscope. If the shaft is coated, check for chipping. Also check the stuffing box base to see if washout or erosion has increased the gap widths. If you are using a flush port, make sure it is working and clean water is coming out.

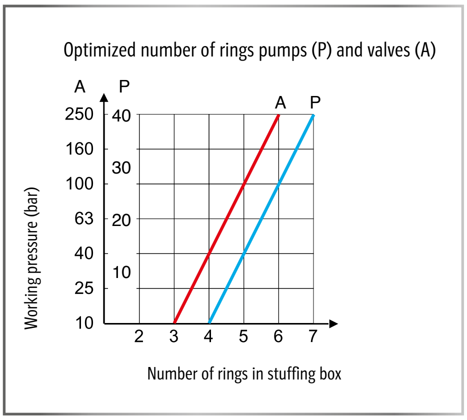
3. Inspection Packing chamber



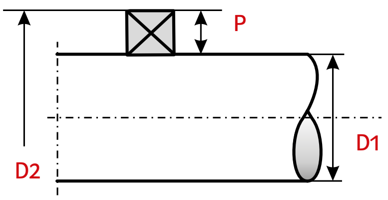
Standard stuffing box:

D_1 = Shaft / sleeve diameter
D_2 = Housing bore diameter
P = Packing dimension
Sp = Gap width
L_1 = Stuffing box depth
Roughness depth shaft Rz W = 0.6 µm valve / 2 µm agitator / 5 µm pump
Roughness housing Rz G = 6 µm valve / 16 µm pump and agitator





Measure the depth of the stuffing box L1, the bore of the stuffing box (D2) and the shaft diameter (D1). Calculate the packing cross-section (P). Do not trust that the previously used packing had the correct dimension. For example, it could be that a metric / inch pairing has taken place and the packing: stuffing box X-Section does not match.



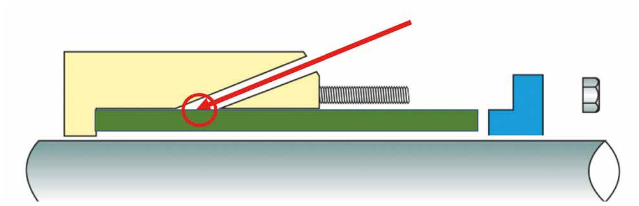
Calculation of X-Section	
P =	(D2-D1)/2

As a next step divide the depth of the stuffing box (L1) by the determined packing cross-section and compare whether the number of uninstalled rings (incl. lantern ring, if present) matches the calculated result.

4. Lantern ring / Flush- or Barrier Ring

If you do not use a lantern ring, continue with point 5.
To determine the position of the lantern ring in the stuffing box, insert a cardboard strip (shown in green) into the stuffing box until it touches the bottom. Run the strip directly along the stuffing box wall next to the flush port. Mark the stuffingbox face on the strip. Now insert a pointed object (shown in red) centrally through the flush port from the outside until you hit the cardboard and mark it.

Pull out the strip and check (considering the number of rings under the marking) the position of the lantern ring in relation to the connection port. If the lantern ring is not at the connection, correct this by inserting, for example, a 3 mm - gasket AESFLON D3.5 or D3.6 at the bottom of the stuffing box

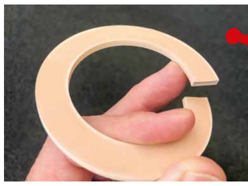


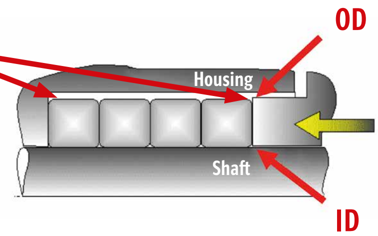
5. Inspecting gap widths

Check the size of the gaps between the stuffing box and the shaft or stem and, if you can, also the gap width at the bottom of the stuffing box.

To avoid gap extrusion, the gap width (Sp) between shaft, housing or gland should not exceed 1% of the packing cross-section (P) for piston pumps, 2% for valves and 5% for pumps or agitators.

For larger gap widths than those mentioned above, we recommend using bullrings of suitable material, e.g., AESFLON D3.5 or D3.6 in 3 mm as top and bottom ring in the stuffing box to protect the packing from extrusion into the gaps.





6. Cutting

Use the packing in the way it is spooled. Do not opposite the packing prebend of the spool. When performing a butt cut you must accept to recut a short piece of packing to bring it back to the prebend orientation. Marks on the OD (outside diameter) of the packing like a red arrow, a red "H" or a name print, will help you to allocate the right side of the packing facing into the direction to the stuffing box bore.

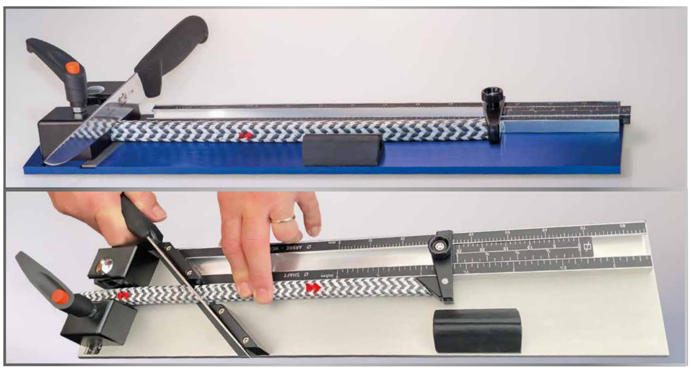
Use a sharp knife to cut the packing with one cut if possible (avoid „sawing" the packing to prevent fraying). Use a suitable cutting board to ensure a proper angle.

- Never use old rings as a master to cut new ones.
- Always cut only one ring to start with. If a shaft sleeve is not available and you use the calculation method below or a packing cutter, install the ring and check for fit in the stuffing box and correct closing of the cuts. Adjust the length if necessary.
- Never cut all the rings you need at once; the rings could be incorrect. The calculation methods and packing cutting boards on the market have only an average length value for all the different packing types and your rings may not fit properly.
- For continuous, reliable results and clean cutting angles, use a packing cutter as shown rigth side. Adjusted to the correct installation length, it continuously delivers good results.

Unroll packing correctly

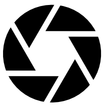
Right

Wrong

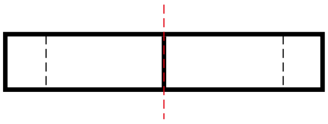


Cutting of Standard Packing

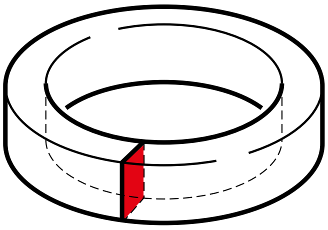
Successful installation of stuffing box packing requires a combination of basic mechanical knowledge and the following instructions.

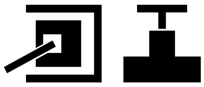


Pump and Mixers (Rotary)

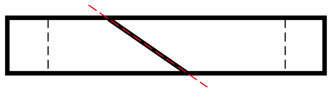


A butt cut is recommended, with approx. 75° degree.
Apply adding factor „x" in % of middle line circumference.

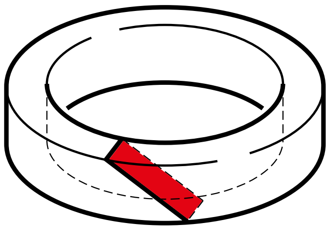


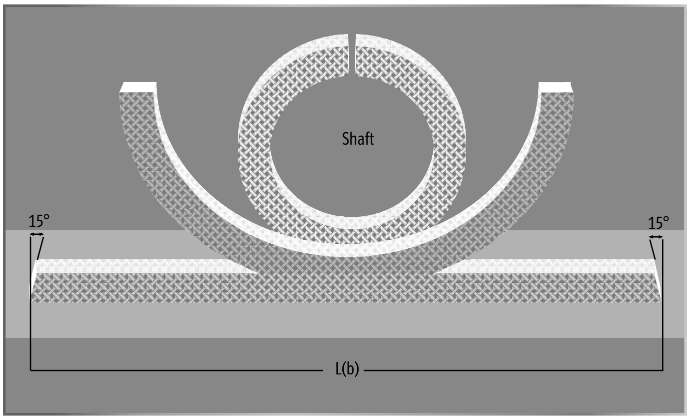


Valves (Static) & Plunger Pumps

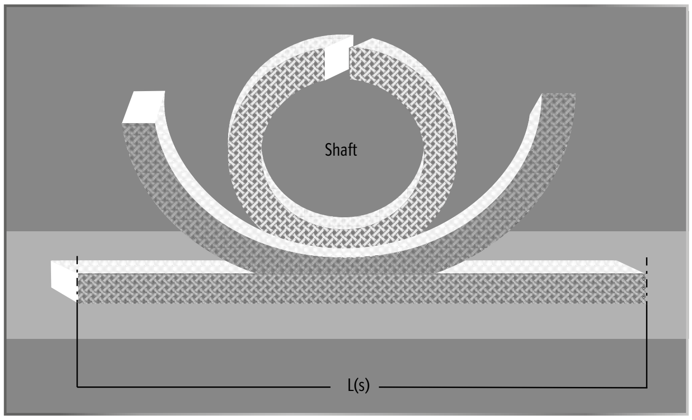


A skive cut with approx. 45° degree is recommended.
Apply adding factor „y" in % of the centerline circumference.

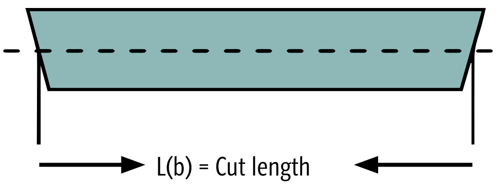


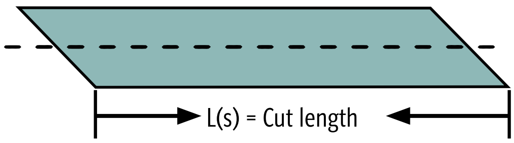


Butt cut



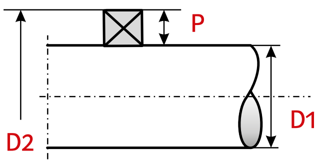
Skive cut





An addition of 2-8% extra length compensates for shrinkage of the packing under temperature.

Add factor



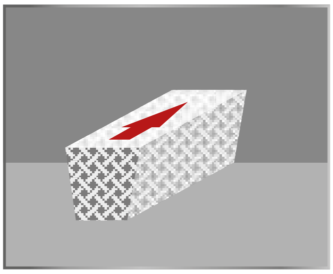
Calculation of butt cut length	
L(b) =	(D1+P) • 3,141 • x [mm]
P =	(D2-D1)/2
x =	Adding factor = 1,02 up to 1,08

Shaft diameter D1	Add
up to 50 mm / 2"	6-8 %
51 up to 100 mm / 2" up to 4"	4-6 %
101 up to 200 mm / 4" up to 8"	3-5 %
201 mm / 8" plus	2-4 %

Calculation of skive cut length	
L(s) =	(D1+P) • 3,141 • y [mm]
P =	(D2-D1)/2
y =	Adding factor = 1,02

Shaft diameter D1	Add
up to 50 mm / 2"	2 %
51 up to 100 mm / 2" up to 4"	2 %
101 up to 200 mm / 4" up to 8"	2 %
201 mm / 8" plus	2 %

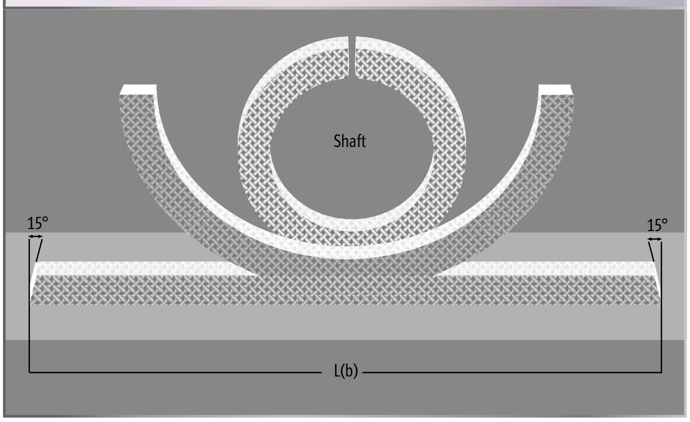
Cutting of *AESSTAR* Packing



Installation

- The rings must be installed always with the red arrow marked side to the housing
- Arrow marking in direction of shaft rotation

Butt cut 75° for rotating shafts



First Cut

- Put the packing on the cutter base with the red arrow marking oriented to the operator.
- Cut the end of the packing as shown in fig. 1

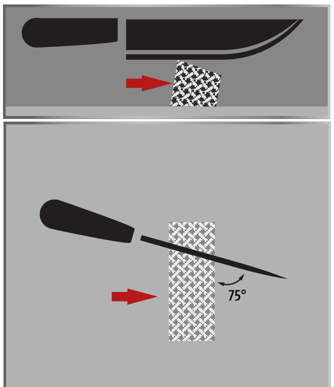


Fig. 1

Finish cut

- Turn the packing 180° on its own axis, printed side is facing away from user
- Adjust the exact cutting length L(b)
- Align the first cut now against the left stop and using the right hand support to align the knife in the right angle as shown in fig. 2

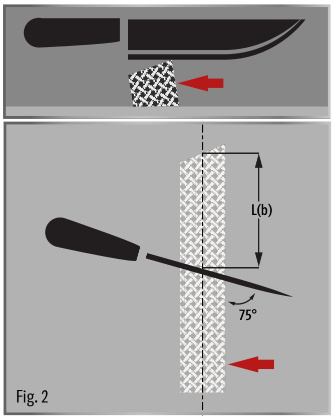
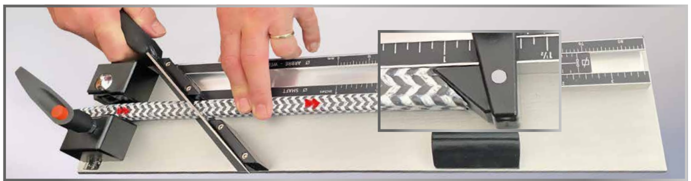
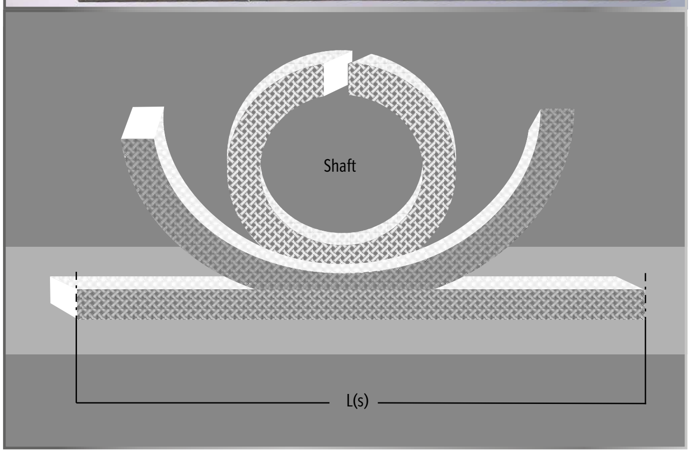


Fig. 2

Diagonal (Skive) cut 45° for valves and piston pumps





First Cut

- Put the packing on the cutter base with the red arrow mark facing up
- Cut the end of the packing in the right angle shown in fig. 3

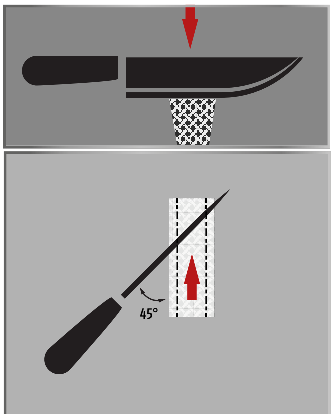


Fig. 3

Finish cut

- Adjust the exact cutting length L(s)
- Cut along the alignment bar shown in left picture

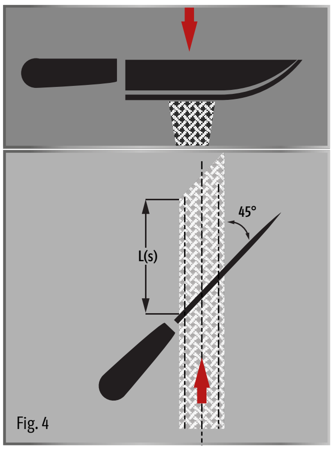


Fig. 4

Installation, start-up and operation of packing

The correct installation of the packing determines to a substantial extent the achievable service life of the application.

1. Correct compression of the packing

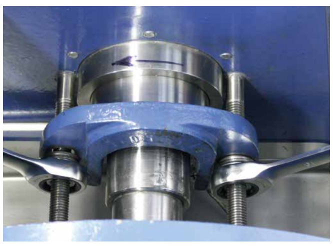
Compress each ring individually in the stuffing box using the gland follower and a suitable spacer tool. At least the two lowest rings or the rings in front of a lantern ring should be seated properly in this procedure.

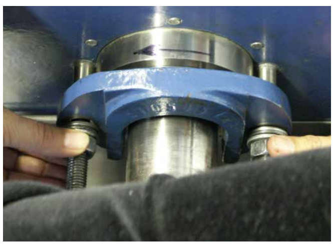
Do not try to compress all the rings at the same time with the gland follower. Due to the friction on the stuffing box bore, on the sleeve and inside the packing it will cause the lower rings to be insufficiently compressed and the gland-side rings to be over compressed.

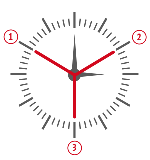
If the cross-section of a packing is larger than the gap between the shaft and the stuffing box wall, do not hit the packing with a hammer to flatten it, because this will damage the fibers. Take a round piece and roll this evenly on the packing until it fits. Better yet, use the calibration device in the W5PS-BU or W5PS-SK packing cutter.

2. Positioning of the rings

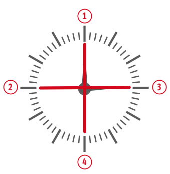
Place the packing cuts individually and with the cut ends first in the stuffing box. Depending on the number of rings, arrange the cuts symmetrically distributed around the circumference (see graph underneath) so that there is no continuous leakage path. Tighten the gland nuts evenly.



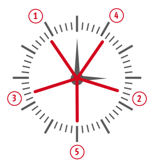




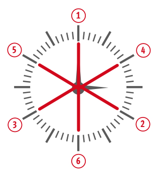
3 rings



4 rings



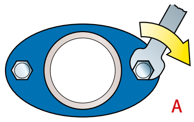
5 rings



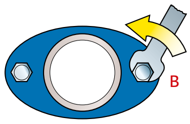
6 rings

① Interface first ring to stuffing box bottom

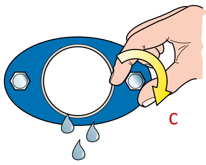
Installation of pump packing: Gland packing pressure should be applied evenly and alternately to the gland bolts. This ensures the gland follower does not tilt to one side. You should make sure that the rings have consolidated and, most importantly, are fully sealing against the stuffing box throat before starting up. (Step A). The packing stack will take some time to settle, and re-tightening may be necessary after a few minutes. If no further consolidation can be detected, the next step is performed.



Then loosen the nuts (Step B)

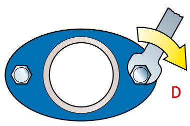


to lower the tension in the area next to the gland follower and then retighten them finger tight only (Step C).



Check where possible if the shaft can be rotated by hand.

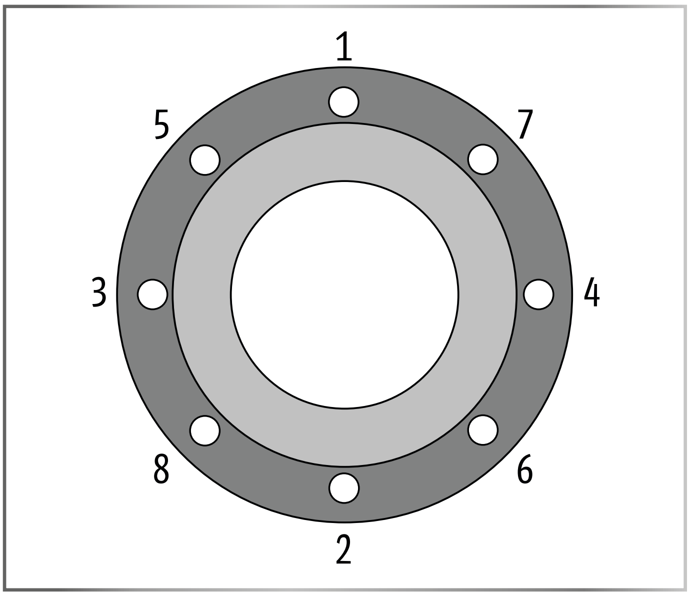
If a flushing connection is used, the water supply must now be turned on. Start the pump and let it run for 20 minutes before making further adjustments. When tightening the gland nuts, tighten them only 1/6 turn at a time and only every 5 to 10 minutes until the desired leakage has been achieved (Step D).



As a guide value, a leakage of 5 ml / min per 25 mm shaft diameter is recommended for safe standard operation. This quantity can be reduced depending on the mode of operation or, for example, can be higher in the case of high roughness of the sleeve, shaft runout and high thermal load on the packing.

Counting the leakage volume in drops is a common method.
In this case the considered leakage volume depends strongly on the viscosity character of the sealed product.

Installation Gasket sheets



Never - overtighten the gland nuts too quickly.
If the gland follower is tightened too far and to fast, the fluid film between the packing and the shaft will be disturbed and the packing life will be minimized.

Never - loosen the gland nuts under pressure!
The product pressure would cause the packing rings to lift off at the stuffing box base and uncontrollable leakage would occur. The forces on the gland follower would never re-seat the packing rings firmly against the stuffing box throat when re-tightened, rather the packing will overheat due to this compression near the gland. Likewise, the correct position of the lantern ring is thus affected, and the flow of flushing water may be interrupted.

Once the pump is stopped and restarted later, it is important to ensure that the lantern nuts are still finger tight when restarting. If the nuts have became loose due to cooling of the packing rings and you do not retighten them, the packing stack can loosen from the stuffing box base and lift off, which usually results in uncontrollable leakage.

If there is too much tension (gland nuts tightened more than finger tight) when starting up again, the necessary leakage cannot get between the packing and the shaft, and the packing is damaged by overheating. This can happen partially on the running surface. This causes a high leakage, usually after evaporation of the leakage film, or also can lead to a complete hardening of the packing, whereby it can no longer be adjusted and must be replaced.

Installation of valve packing: Packing for stem sealing should be compressed in the first installation step with the maximum possible force in order to minimize subsequent consolidation. However, it should be taken care not to damage either the gland bolts and screws or the gland itself. Precompress the packing at product pressures up to 50 bar with 2 times (for gaseous products with 5 times) the product pressure and a minimum of 5 N/mm^2 (for gaseous products 10 N/mm^2). For pressures above 50 bar with 1.5 times (gaseous products with 2 times) the product pressure. Installations according to VDI 2440 / TA Luft or ISO 15848 may require a compression of up to 70 N/mm^2.

Apply the required compression with the valve spindle in the closed position. Move the spindle to the open position and back to the closed position of the valve. Check that the required compression is still applied. If the packing has consolidated, repeat the steps a few more times until the required packing pressure remains constant.
.

Please note during installation:

- Clean sealing surface completely. Remove any dirt, corrosion, grease or remainders from old sealing materials.
- Position the gasket centric to the flange face.
- Take extra care on vertical assemblies. First hand-tighten, then tighten in at least 4 progressive torque sequences, crosswise (see diagram on left) with approx. 25%, 50%, 75% and 100% of the recommended surface pressure.
- Always use a torque wrench!
- Before commissioning the system, we recommend checking the Torque and Compression again.
- Please always observe the guidelines for correct gasket installation according to the current state of the art.
- Observe the flange manufacturer's instructions and recommended tightening torques for the sealing system (flange, bolt, gasket).

Installation instruction ePTFE Gasket Tape

The following must be observed during assembly:

1. Clean sealing surface
2. Remove cover strip from adhesive strip
3. Place gasket on flange
4. Overlap ends in front of bolt or clamping element by 1 cm/0,375"
5. Cut off the rest of the seal

Fig. 1

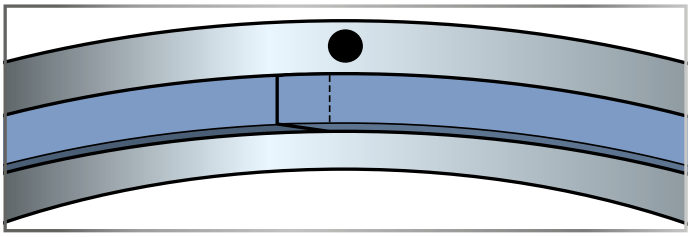


Fig. 2

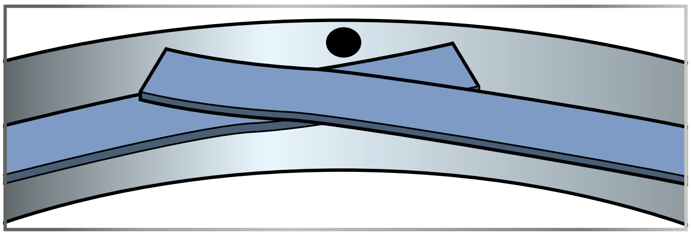


Fig. 3

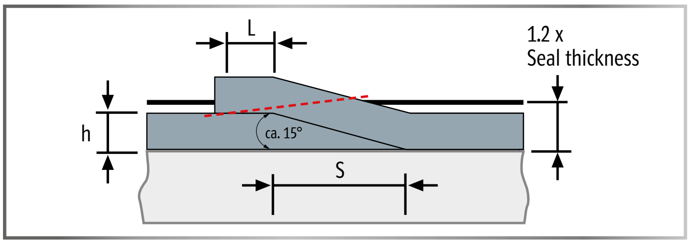


Fig. 4

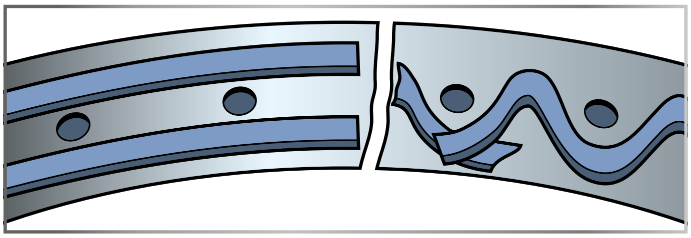
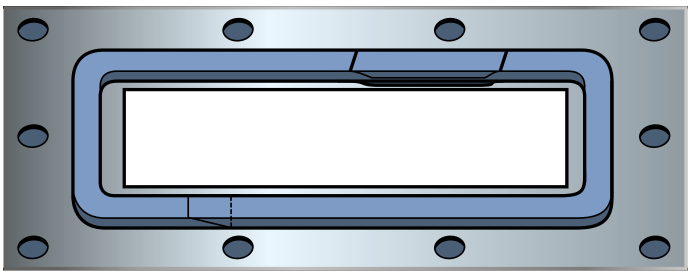


Fig. 5



Special Assembly

- Skive cut for tension sensitive components and for AESTEX D1 HD from 10 mm and AESBIAX D11, skive length (S) = 2 x gasket width
- Wavelike installation along and inside the pitch circle or an additional supporting layer outside the bolt pitch circle prevents tipping of flanges.
- Bedding or double layer in case of larger unevenness

Clean sealing surfaces completely.
Remove all impurities and residues of old seals.

For AESTEX D1 HD sealing tapes >10 mm and AESBIAX D11, skive one end of the gasket tape (Fig. 1 and 3).

Fig. 2
NOTE: This type of end connection is only suitable for AESTEX D1 and D1 HD with a sealing width of 3 mm and thicknesses of 0.3 mm and 0.7 mm.

Remove some masking paper from the adhesive backing and stick the seal on the pressure side, close to the bolt circle, starting close to a bolt hole.

Fig. 3
Remove only as much adhesive backing paper as can be bonded in one step! Place the seal at the end lengthwise over the shank and cut to length after the corresponding overlap and cut off the excess (as in Fig. 3). Use a sharp knife to cut a bevel to the shank with a length (S) of 2 times the gasket width, leaving a sharp edge towards the flange.

Select overlap length (L) approx. 2-3 times gasket thickness (h). Allow material overlap to taper with + 20% height allowance (h x 1.2) when cutting (Fig. 3).

Tighten bolts first hand-tight, then evenly crosswise in at least 4 steps until the recommended torque is reached. *(See page 91)*

To check and ensure permanent sealing performance, tighten bolts again at the end of the assembly process.

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