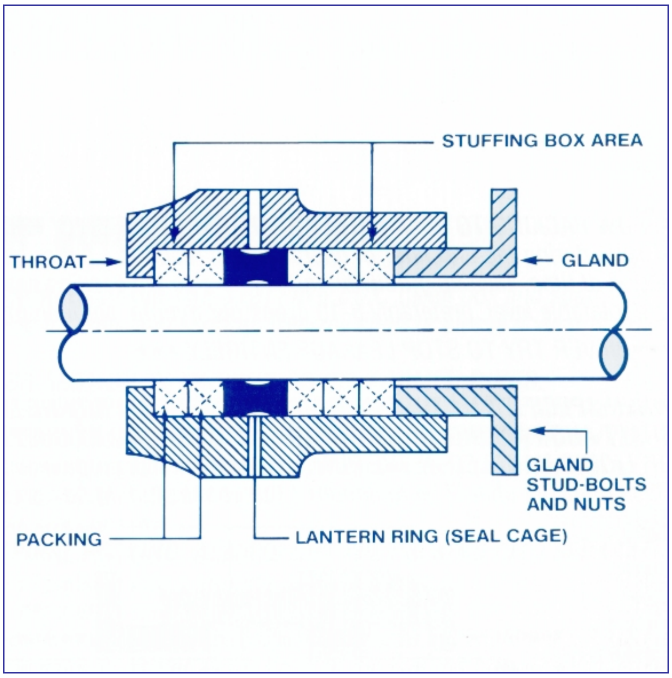


Stuffing Box Design and Installation of Compression Packings

The importance of packing glands correctly cannot be over-emphasised. Many packing failures are due to incorrect installation of the packing. The following steps have been devised to ensure effective installation of packings on pumps and valves.

Sealing Products

BS EN 9100:2003, ISO 9001:2008
Certificate no: FM 10571

KLINGER

STUFFING BOX DESIGN
GUIDELINES FOR STUFFING BOX DIMENSIONS

The Dimensions (A) shown on the drawing below is the total depth of the packing including lantern gland. The standard depth of 7W or 7 times the packing space has been established when a lantern gland is used. A depth of 5W is used when a lantern ring is not being used.

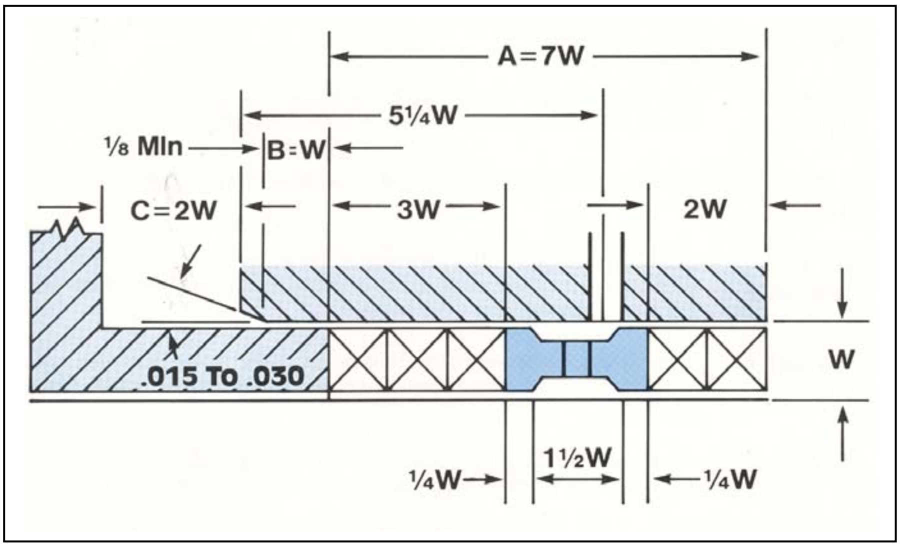


Figure 1 (dimensions in inches)

Inches		Metric	
Shaft Range	W	Shaft Range	W
5/8" to 1-1/8" Shaft	5/16"	16mm to 29mm Shaft	8mm
1-1/8" to 1-7/8" Shaft	3/8"	29mm to 48mm Shaft	10mm
1-7/8" to 3" Shaft	1/2"	48mm to 75mm Shaft	13mm
3" to 4-3/4" Shaft	5/8"	75mm to 120mm Shaft	16mm
4-3/4" to 12" Shaft	3/4"	120mm to 300mm Shaft	19mm

1. LANTERN GLAND POSITION

It should be noted that the illustration shows the dimensions of 2W on the pressure side of the lantern ring and the 3W on the gland end of the stuffing box.
While this is common practice, it should be noted that 3W on the pressure side and 2W on the gland end of the stuffing box can also be used.
Please consult the Technical Department of your choice for the proper set up to best suit your application.

2. GLAND TAKE-UP

This gland take-up is limited to 40% of the packing. The reason for this limitation is to include those packings which have a higher volume loss during installation. Additional take-up is not recommended, in order to prevent galling of the shaft.
This means that complete take up will take place before equipment is damaged, therefore packing replacement would be indicated. This is based on the theory that most damage is done to shafts, during the late running of packings.

3. LANTERN RING

The suggested depth or length of a lantern ring is set to 2W

4. CHAMFER DEPTH
A minimum of 1/8 (3mm) is recommended. It is felt that less than 1/8(3mm) will not contribute to easy entrance of the packing into the stuffing box.

5. CHAMFER ANGLE
Wedging or guiding action is best between 15 and 30 degrees.

6. GLAND ENTRANCE
It is recommended that a minimum of 1W be maintained to minimize the probability of gland cocking, and allow for general variations of soft packings, moulded, and other types.

7. SIZE LIMITATIONS
In designing equipment with shafts below 5/8 (16mm) diameter, consult with the Klinger Technical Department regarding the packing space required.

8. CLEARANCE
Clearance should be accepted machining practices, taking into consideration for thermal expansion and contracting metals. Typical extrusion gap examples are shown in figure 1.

9. FINISHES
The surface finish of both the stuffing box and the shaft/stem are vitally important to achieving a tight seal. If the stuffing box outer surface is too smooth the packing will not seat it's self into the wall; too rough and the packing will be difficult to install, resulting in a damage to the Outside Diameter (OD) of the packing before the system is in operation this could result in a potential leak path.
The recommended surface finish for the OD of packing box is 0.8µm Ra.

The correct surface finish on the shaft/stem is vitally important to aid the sealing. If the surface finish is too rough the packing will fail after a few cycles. The recommended surface finish for the shaft/stem is 0.2µm Ra.
To aid in sealing, the correct installation of the packing and start up procedure of the appliance will improve the life of the packing.

10. PRESSURES
These standard dimensions are intended for use up to approximately 1500psi (102bar)

11. PERFORMANCE
Performance at various high speeds is a function of material used rather than the stuffing box dimensions, and recommendations for speed limits are not considered here.
Consideration of high-speed problems should be referred to the Klinger Technical Department.

12. THE CORRECT SELECTION OF A PACKING
The proper selection of a packing for an application is important, if the wrong packing is chosen, the possibility of the packing failing on start-up is high; resulting in the packing having to be changed.

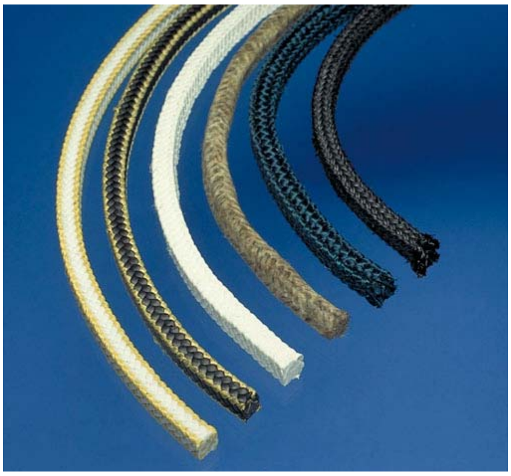
If the right packing is chosen from the start; these problems can be overcome. To determine which packing should be used, there are some questions that must be answered these include:

1) Chemical Condition (pH of fluid)
2) Temperature
3) Pressure
4) Shaft Speed
5) Dimensions of Stuffing Box

To aid in the selection of a packing the table at the end of this document shows all the packings supplied by Klinger UK, the table shows the packings best operating conditions, service and the material.

PACKING SELECTION

To aid the correct selection of the most appropriate TopLine grade and to ensure that a high integrity seal is achieved during application, Klinger recommend that the following fundamental questions are to be answered:



1) Application type i.e. valve, rotary pump etc
2) Media and concentration
3) Maximum Temperature
4) Maximum Pressure
5) Shaft Speed
6) Special conditions i.e. Fire-Safe, WRc, BAM approval
7) Dimensions & details of stuffing box

The success of a TopLine compression packing in sealing is a function of all of these factors and following these guidelines may generate a selection of suitable grades.

Also of equal importance in effective and trouble-free sealing is proper attention to good installation and break-in procedures. Klinger recommend that our current fitting procedures be followed at all times.

Again as general guidelines, the following features are desirable to aid the choice of valve, rotary and reciprocating pump packings:

VALVE PACKINGS
Dense, flexible, temperature resistant, volumetrically stable, extrusion proof, low friction, non-corrosive
K10, K3222, K35, K44, K49, K54S, K54F, K55

ROTARY PUMP PACKINGS
Resistant, long lasting, flexible, elastic & shaft-protecting
K10, K25, K3222, K4322, K4333, K46, K44, K49, K54H, K55

RECIPROCATING PUMP PACKINGS
Abrasion proof, wear-resistant, volumetrically stable, extrusion proof, low-friction
K25, K4313, K4333, K49, K55

KLINGER TOPLINE

Klinger TopLine - the optimised range of compression packings and graphite seals introduced to provide users with gland sealing products that meet today's demanding industrial services.

Environmental and financial constraints are placing a greater emphasis on tolerable sealing material leakage and emissions. However, as product throughput is maximised, process pressures, temperatures and speeds are often being increased.

Drawing upon more than 100 years packing experience coupled with modern production methodology and comprehensive test facilities, the Klinger TopLine range has been carefully structured to meet these current needs.

Klinger TopLine Range

· To provide a reliable and effective range of compression packings that have universal application throughout industry

· Utilising the most modern production techniques and materials

· To give the user predictable life expectancy

· Provide a complete range of packings to replace traditional products.

· To aid in the correct selection of the most appropriate packing for any given application

· To provide the user with the full technical support from full installation documentation through chemical compatibility and past application success

· To reduce inventory and stock holding costs

PACKING THE PUMP CORRECTLY

1. REMOVE ALL THE OLD PACKING FROM THE STUFFING BOX. Clean box and shaft thoroughly and examine shaft or sleeve for wear and scoring. Replace shafts or sleeve if wear is excessive.

2. USE THE CORRECT CROSS-SECTION OF PACKING OR DIE-FORMED RINGS. To determine the correct packing size, measure the diameter of the shaft (inside the stuffing box area if possible) and then measure the diameter of the stuffing box (to give the O.D. of the ring). Subtract the I.D. measurement from the O.D. measurement and divide by two. The result is the required size. CUT…DON'T WIND.

3. WHEN USING COIL OR SPIRAL PACKING, ALWAYS CUT THE PACKING INTO SEPARATE RINGS. Never wind coil packing into a stuffing box. Rings can be cut with butt (square), skive (or diagonal) joints, depending on the method used for cutting. The following illustration shows these methods of preparing bulk packing. The best way to cut packing rings is to cut them on a mandrel with the same diameter as the shaft in the stuffing box area. If there is no shaft 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 it fits the packing space properly. Each additional ring can be cut in the same manner, or the first ring can be used as a master from which the balance of the rings are cut.

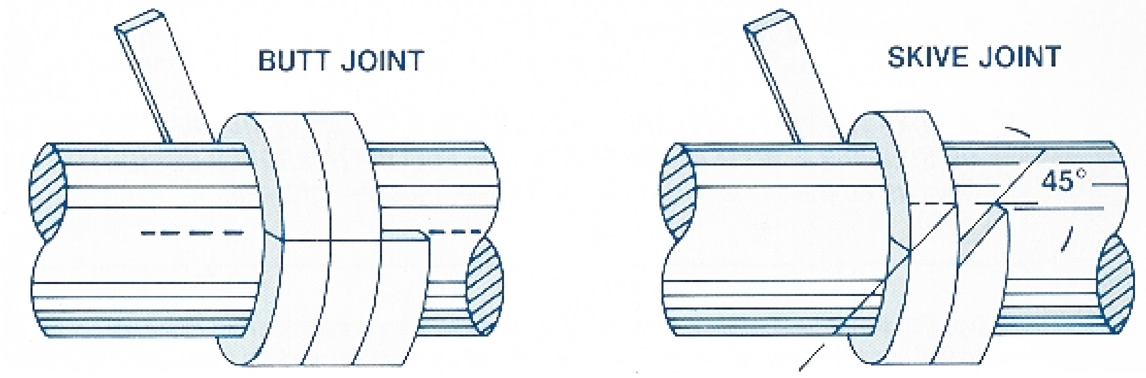


Figure 2

   If the butt cut rings are cut in a flat surface, be certain that the side of the master rings, and not the O.D. or I.D. surface, is laid on the rings to be cut. This necessary so that the end of the rings can be reduced.

   When cutting diagonal joints, use a mitre board so that each successive ring can be cut at the correct angle.

   It is necessary that the rings be cut to the correct size. Otherwise, service life is reduced. This is where die-cut rings are of great advantage, as they give you the exact size rings for the I.D of the shaft and the O.D of the stuffing box. There is no waste due to incorrectly cut rings.

4. INSTALL ONE RING AT A TIME. Make sure it is clean, and has not picked up any dirt in handling.
   Seat rings firmly (except PTFE filament and graphite yarn packings, which should be snugged up very gently, then tightened gradually after the pump is on stream). Joints of successive rings should be staggered and kept at least 90 degrees apart. Each individual ring should be firmly seated with a tampering tool. When enough rings have been individually seated so that the nose of the gland will reach them, individual tamping should be supplemented by the gland.

5. AFTER THE LAST RING IS INSTALLED, Take up bolts finger tight or very slightly snugged up. Do not jam the packing into place by excessive gland loading. Start pump, and take up bolts until leakage is decreased to a tolerable minimum. Make sure glands are taken up evenly
   STOPPING LEAKAGE ENTIRELY AT THIS POINT WILL CAUSE THE PACKING TO BURN UP.

6. *ALLOW PACKING TO LEAK FREELY STARTING UP A NEWLY PACKED PUMP.*
   Excessive leakage during the first hour of operation will result in a better packing job over a longer period of time. Take up gradually on the gland as the packing seats, until leakage is reduced to a tolerable level, preferably 8-10 drops per minute, per inch of shaft diameter.
   ************NEVER TRY TO STOP LEAKAGE ENTIRELY**************

7. *WHEN SPECIFIED BY THE PUMP MANUFACTURER, PROVIDE MEANS OF LUBRICATING THE SHAFT AND PACKING THROUGH THE LANTERN RING BY SUPPLYING WATER, OIL, GREASE OR LIQUID HANDLED IN THE PUMP.*
   Fittings for this Purposes are standard on many pumps. Flush pressure should be a minimum 1 bar above Stuffing box pressure.

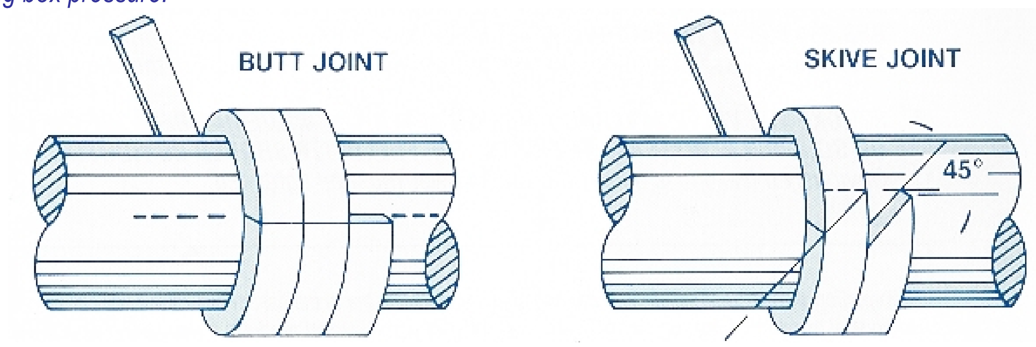


Figure 3

8. *IF THE STUFFING BOX HAS A LANTERN RING (SEE ILLUSTRATION ABOVE), make sure that the lantern ring, as installed, is slightly behind the fluid inlet so that it will move under the inlet as follower pressure is applied.*

9. *REPLACE PACKING WHEN LEAKAGE CANNOT BE CONTROLLED BY FURTHER TAKE-UP ON THE FOLLOWING GLAND. DO NOT ADD MORE PACKING RINGS.*

10. *ON BOTH CENTRIFUGAL AND RECIPROCATING PUMPS, about 70% of wear is on the outer two packings nearest the gland. However, each additional rig does throttle some fluid pressure. On most pumps, there must be enough rings so if one fails, another does the sealing, and the pump need not be shut down.*

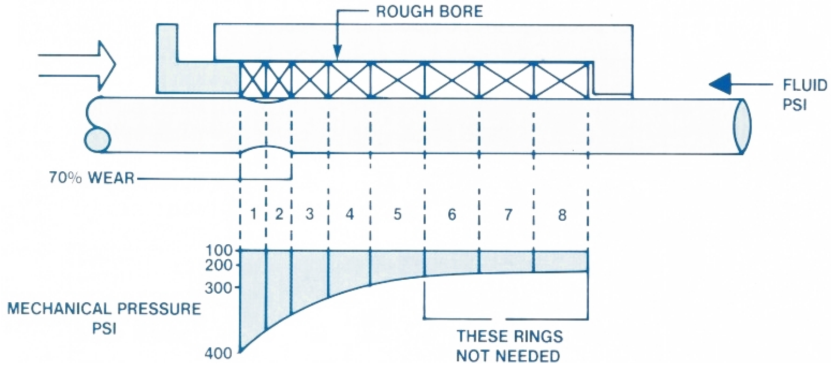


Figure 4

The mechanical pressure curve above shows eight packing rings. The first five rings do the majority of the sealing. The bottom three do little sealing, but are needed to fill the available space. The advantage of using fewer rings is less rod wear. Also, the stuffing box design is simpler and takes less material. But, wear isn't the only problem. With high temperatures, highs pressures, corrosive chemicals, or abrasive particles in the fluid, more rings may be the only solution for some services. In such cases, the bottom ring contacting the fluid may have the most wear from these severe service conditions.

PACKING VALVES CORRECTLY

As with pump packing, the first step in getting the most out of valve packing is correct installation. Here is the correct way to pack valves

1. *CAREFULLY PERFORM ALL OPERATIONS LISTED UNDER PUMP PACKING STEPS 1-5.*
   Rings used on valves and expansion joints are cut with a skive joint (illustrated before). If preparing butt or skive cut (45 degrees) rings, be sure that the first ring is cut carefully, and then tested on the stem.

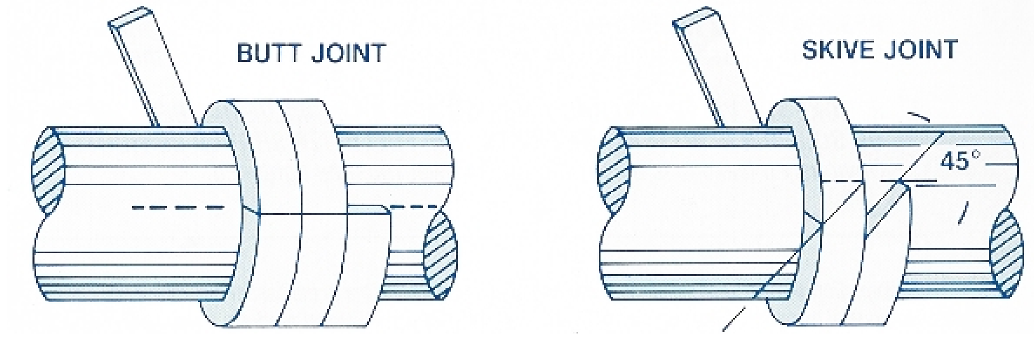


Figure 5

2. *BRING THE FOLLOWER DOWN ON THE PACKING TO THE POINT WHERE HEAVY RESISTANCE TO WRENCHING IS FELT. During this time, turn valve stem back and forth to determine ease of turning. Do not torque down to the point where the stem won't turn.*

3. *STROKE THE VALVE SEVERAL TIMES OR AFTER THE VALVE HAS BEEN ON THE LINE A DAY OR SO, EVEN IF NO LEAKAGE EXISTS, THE FOLLOWER SHOULD BE TIGHTENED SLIGHTLY. Obviously if leakage is occurring, the follower must be tightened.*

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