Hows and Whys of Packing and [redacted]

A working knowledge of their design and materials, installation and maintenance can extend their life, forestall emergency shutdowns and reduce maintenance costs.

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The pulp and paper industry, presents some of the most rugged and demanding applications for packing and gaskets. A better understanding of the "how to" and "why's" of packings—their design, materials used in their construction, installation and maintenance procedures—can enable pulp and paper engineering and maintenance personnel to extend packing and gasketing life by 50 per cent or more, forestall emergency shut-downs, increase overall process efficiency, and reduce operating and maintenance costs.

What follows are the "ABC's" of dynamic sealing (packing) and static sealing (gaskets) as they relate to the pulp and paper industry.

Dynamic Packing Materials

Dynamic packings seal moving parts: reciprocating, rotary, or helical. They are used from vacuum through high pressures, over a broad range of temperatures to retain all types of fluids and to exclude foreign materials. The five basic materials used in packing construction are: fibers, metals, plastics, rubber and leather, which are combined with various impregnants and lubricants depending on the application.

The function of packing is to throttle leakage between a moving and stationary part. Packing does not stop leaks; rather it controls leaks by throttling. If packings were permitted to run dry, the result would be heat, wear, destruction of the packing and scoring of the shaft. There must, in other words, be some leakage—to a point where it merely lubricates and permits cool operation of the packing but does not result in a serious loss of the fluid being sealed.

Asbestos is the most widely used of fiber materials, because of its strength, temperature resistance and versatility. White asbestos, mixed with an organic fiber to facilitate weaving, is normally used against alkaline, neutral or weak acid solutions. Blue asbestos, usually without any other fiber, is used against strong mineral acids. Graphite fibers also have excellent chemical and temperature resistance.

Vegetable fibers—flax, ramie, jute and cotton—lose their heat resistance above 200°F., and are primarily cold water packings. An advantage of flax and ramie is that their long, strong fibers get stronger as they get wetter.

Synthetic fibers such as rayon and nylon are used in water service with temperatures below 250°F. Teflon (TFE) fiber, with its low friction co-efficient and near-complete chemical resistance, is good to temperatures up to 500°F., has a life span many times that of other materials in use against highly corrosive fluids.

In compression packings, **metal** is usually in foil form, although it is sometimes used in braided and shredded forms. Lead, copper and aluminum are the commonly used metals. These packings serve as end rings, and as pressure or thermal barriers in high pressure or high temperature service.

Most common used **plastics** are Kel-F (Minnesota Mining & Manufacturing Trademark) and TFE (Teflon), both highly resistant to chemical attack. Kel-F is used within the temperature range of minus 400°F. to 390°F. in unplasticized form, up to 300°F. when plasticized. TFE, good within the range from minus 350°F. to 500°F., has the added virtue of its absolutely non-stick properties.

In addition to natural **rubber**, a few of the more popular synthetics are: synthesized natural and substitute natural elastomers with good rubber-like qualities; Buna-N and neoprene with excellent heat- and oil-resistant qualities; butyl with its impermeability to gases; and silicone which withstands temperature extremes from minus 100°F. to 500°F.

Leather packings have high tensile strength and can handle pressures up to 100,000 p.s.i.

All of these packing materials—plastics, rubber, leather—are most commonly found in molded or machined "V"s, "U"s and "O" rings.

Impregnants and lubricants are vital to packing service, and constitute a good percentage by weight of some types of braided packing. Impregnants include: tallow, lard oil, fish oil, soap, castor oil, paraffin, lubricating oil, silicones, fluorocarbons, graphite and mica, their selection again depending on the packing application.

Fibrous Packing Construction

Packing constructed of fibrous materials is conventionally in twisted or braided form. Twisted packing does not have the strength of braided packing, and is primarily suitable for valve stems. It can be easily untwisted to obtain the requisite size.

The three most commonly used types of braided packing are:

1. **Square braid.** Its loosely locked braids are produced by one pass through the braiding machine. Its advantage—assuming thorough internal lubrication—is that its strands can adjust to uneven rod motion.

2. **Braid-over-braid.** Construction is a series of braided tubes, one over the other. A dense packing, it is used where stem or rod is in good condition for higher pressure jobs on valve stems, or where there is slow relative motion. Since it resists extrusion, it is particularly useful in reciprocating service.

3. **Lattice Braid** (Garlock Trademark). Every braiding strand passes diagonally through the body of the packing. This type of braid combines flexibility and firmness in a completely unified structure, with each strand contributing to the

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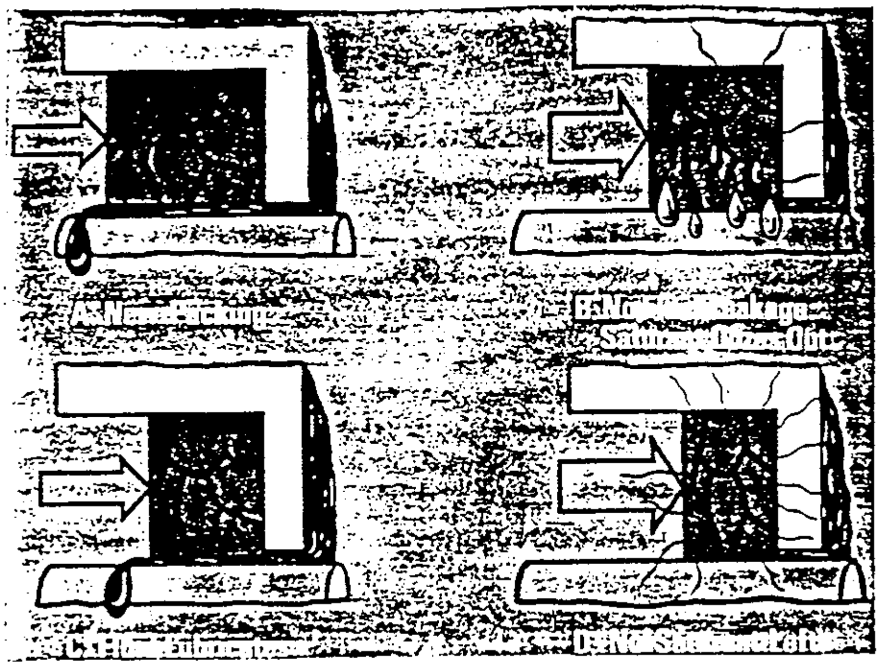


FIGURE 1. ILLUSTRATING THE HAZARDS OF SUCCESSIVE OVERTIGHTENING OF COMPRESSION PACKINGS.

packing's overall strength. Unlike other types of braid, wear will not loosen the strands of lattice braid packing.

Cloth woven from basic asbestos fibers may be reinforced with various kinds of wire such as brass, Monel, etc., or impregnated with rubber or other compounds to act as a binder and reduce porosity. The cloth is either wrapped around itself, or accordion-folded, or laminated with rubber and cemented with a binder. These types of construction render such packings highly suitable for reciprocating motion applications involving higher pressures, slow speeds, or heavy duty service. They are used infrequently for very slow rotary service, as end rings in combination with another type of packing for sealing.

Metal packings are of spiral-wrapped, folded, crumpled or braided construction. They are lubricated between layers to form lubrication reservoirs, thus simulating a lubricated metallic bearing while serving as a seal. Generally used for higher speeds, they often prove to be the only feasible packing for high-temperature applications. They may also be used as bull rings with other types of packing to prevent extrusion.

Shredded fibers (asbestos), plastics (TFE) and metals are combined with graphite and a binder to make shredded packing. Also called "plastic" packing because of its softness and ease of compression, it can be obtained in bulk, coils or die-formed rings. Excellent for sealing gases with little leakage, it requires end rings to prevent extrusion.

There are four broad functional classes of dynamic seals: compression, automatic, floating and mechanical.

Compression Packing

Compression or jam-type packings are "soft-packings" that are installed in the stuffing box and adjusted periodically by taking up a gland. Compression types include twisted, braided, laminated cloth, shredded and metal foils. In a typical compression packing installation, the fluid is "throttled" to an average leakage rate of 10 or 12 drops per minute, flowing through the slight clearance between the moving shaft and the packing to act as a lubricant (sketch "A," Figure 1). The lubricant in the packing itself takes over during possible periods of dry operation, and acts as a safety valve in the event the packing is over-tightened and the fluid flow is cut off.

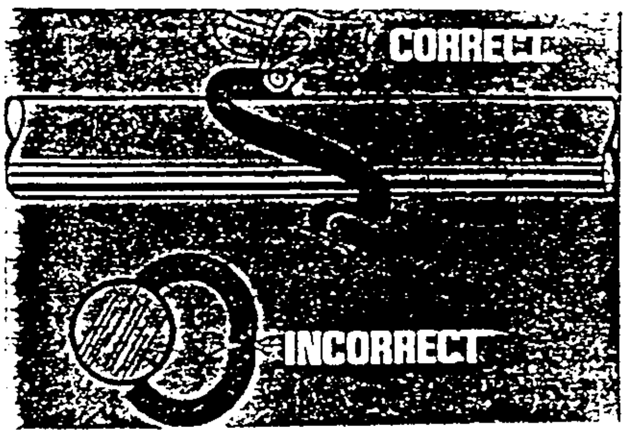
The hazards of successive over-tightening of the gland are sketched in Figure 1. Over-tightening will eliminate the leakage, but the packing in turn will run dry on the shaft, building up friction heat. This heat will melt the lubricant in the packing, and temporarily prevent the packing from burning up and the shaft or rod from scoring (sketch "B," Figure 1). This lubricant loss reduces the packing's volume, and as leakage from the casing again resumes (sketch "C", Figure 1) further tightening may be necessary. If the gland is again tightened to eliminate *all* fluid leakage, the cycle is repeated until (as shown in sketch "D", Figure 1) there is no saturant left in the packing and its volume cannot be further reduced. The ultimate result: burned up packing, scored shaft.

The "moral": avoid over-tightening. IF ALL PERSONNEL WITH WRENCHES WOULD ADJUST PACKING PROPERLY ITS LIFE COULD BE MORE THAN DOUBLED.

Impregnated packings cannot provide sufficient lubricant where high operating temperatures are involved or where conditions create high frictional heat. In such cases, external lubrication is supplied through the use of a lantern ring, usually located near the middle of the stuffing box.

Lantern rings, by which a "sealing liquid" is injected into the packing at a pressure higher than that of the fluid being contained, are also required for all packings against gases which, because of low viscosity are not adequate lubricants and also leak

FIGURE 2. CORRECT METHOD OF INSTALLING DIE-FORMED PACKING RINGS.



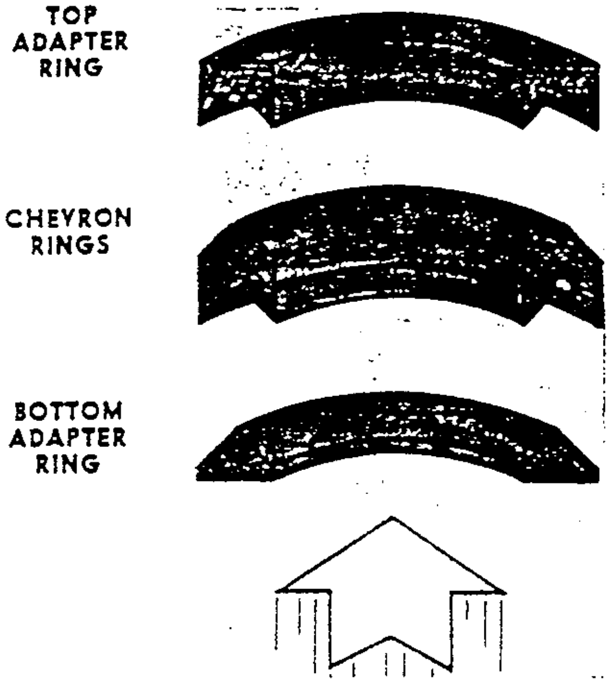


FIGURE 3. HOW DIFFERENT SECTIONS OF V RINGS SHOULD BE ASSEMBLED.

excessively; for liquids of low viscosity or high volatility under conditions of high speed or high pressure; for liquids containing large amounts of dissolved or suspended matter; and for fluids of any kind that are poisonous, corrosive, or too valuable to lose.

Maintenance pointers for compression packing include:

- Cut rings when packing is wrapped around shaft to insure parallel ends.
- When installing foil wrapped packings, inside edges should face in direction of shaft rotation.
- When die-formed rings are installed, they should be opened sideways (Figure 2) to prevent breakage at opposite side from gap.
- Use split-bushing to seat each ring individually.
- Stagger the ring joints so that fluids will not have a straight path to leak past the packing.
- Keep spare coils of packing in stock for all key equipment.
- Clean stuffing box thoroughly after removing old packaging. Avoid scratching shaft.
- OVER TIGHTENING IS THE GREATEST SINGLE CAUSE OF PACKING FAILURE.

Automatic Packing

Automatic packing is so called because it responds automatically to fluid pressure to establish a seal. The flexible packing lips fluctuate with changing pressures . . . tightening with increasing pressures, yielding with diminishing pressures. They are ideally suited for reciprocating rods, pistons and rams. Included in this classification are "V" rings, flange cup and "U" packings and "O" rings, generally supplied in molded or machined forms.

An excellent example of automatic packing is Chevron (Garlock Trademark) packing, an improved form of "V" ring named from its functional shape. The hinge in the design is the factor which gives these rings their greater pressure-compensating and friction-relieving characteristics.

As with compression types, the stuffing box should be thoroughly cleaned before replacing automatic type packing. The use of multiple nested rings—Chevron rings, for example—makes cut-open sets practical and thereby minimizes downtime during servicing.

The open side of the "V" rings always points toward the pressure (Figure 3), so the male adapter is put into the stuffing box first with the flat surface seated on the bottom of the box. If split rather than endless rings are used, joints should be staggered just as in the case of soft compression packing. Here again, excessive gland pressure will drastically—and uneconomically—curtail the operating life of the packing.

Floating Packing

Like automatic packings, floating metal types of packing also depend on internal pressure to achieve and maintain a seal. For use as rod packing wherever gas or air is compressed or expanded, they are designated floating type because their segmented rings are free-floating in their case, can move laterally or "float" with a shifting rod. The segmented rings are held together by garter springs so they bear on the rod until fluid pressure of the gas provides the seal. Annular surface of these rings is a ten micro-inches or less, and they are flat within light band readings. They are housed together in grooves in a metal packing case of either split-case or annular solid-cup design.

The sealing theory of floating type packings is that on the compression stroke, the gas or air is forced along the rod to the packing groove. This presses the packing rings tightly together and against the sealing face of the groove (BB). Rod packing sections consist of two single segmented rings: a radial cut ring on the pressure side, doweled to a tangentially cut sealing ring.

The pressure passes along the radial cut, then envelops the outside of the rings, forcing them in tighter to the rod. On the discharge stroke of the compressor, the pressure in the cylinder becomes less than the pressure in the packing case, thus allowing the air or gas to escape back into the cylinder. The ring segments are so constructed as to automatically close-in uniformly to the rod to compensate for wear.

Mechanical Seals

Mechanical seals are designed for precise rotary shaft sealing, at pressures up to 1200 p.s.i., temperatures of minus 60°F. to 500°F., and face velocities up to 5000 f.p.m., depending on style and application. Normal mechanical seal construction consists of a smooth rotating face sealing against a smooth stationary face at right angles to the shaft. Sealing faces are precision lapped; there is no need for initial break-in, periodic repacking or adjustment. The spring loaded and flexibly mounted design affords continual and automatic compensation for shaft run-out, axial and play, vibration and wear.

They are recommended where leakage requirements are extremely low as in the case where fluids are of a hazardous, corrosive or costly nature; and are problem solvers for high-speed, high-temperature or high-pressure applications.

They are a virtually leakless seal and consequently, if a mechanical seal drips steadily, maintenance personnel should:

- Check compression of gland

TABLE I—TYPICAL TEMPERATURE AND PRESSURE LIMITATIONS

Gasketing Material	Maximum Temperature X Pressure	Maximum Temperature °F.
Rubber	15,000	225
Vegetable Fiber	40,000	225
Cloth-Inserted Rubber	125,000	225
All TFE	150,000	500
Compressed Asbestos	250,000	750
Spiral-Wound:		
Stainless Steel/TFE	over 250,000	500
Stainless Steel/Asbestos	over 250,000	850-1200 varies with alloys
Stainless Steel/Magnesium-lithium ceramic	over 250,000	1200-1900 varies with alloys

gasket.

- Look for deflected faces caused by improper gland bolting.
- Check for installation damage to shaft packing.
- Check for excessive shaft vibration caused by misalignment, impeller imbalance, cavitation or defective bearings.

Static Sealing

Static seals—gaskets—perform a simple function: that of making a pressure-tight joint between two rigid elements, usually flanges. There are three principal forces involved in the make-up of a joint that affect the functioning of a gasket:

1. **Compressive Load.** The compressive load is the force available for initial gasket compression and is usually applied by bolting. The force must be sufficient to squeeze the gasket into all voids in the flange face—that is, the gasket material must "flow" into hills and valleys and surface imperfections of joint faces to mate satisfactorily and achieve a tight seal with no leakage pathways. The compressive load must also compensate for the hydrostatic end force to be encountered and maintain a residual stress on the gasket sufficient to prevent leakage.

2. **Hydrostatic End Force.** When internal pressure is applied to the assembly, the hydrostatic end force tends to force the flanges apart and thus reduces the load on the gasket. The difference between the initially applied force and the hydrostatic end force is the residual gasket load.

3. **Pressure at the joint** tends to bypass or blow-out the gasket material. The strength of the gasket material and the residual gasket load must be sufficient to contain internal pressure.

The ratio of residual gasket load (compressive or bolt load minus hydrostatic end load) on the gasket area to internal pressure is referred to as the "m" factor. This "m" factor is actually a safety factor: the factor by which the residual compressive force in p.s.i. on the gasket at operating conditions is greater than the pressure to be contained. Garlock design engineers, for example, recommend a minimum "m" factor of three for spiral wound gaskets.

Typical temperature and pressure limitations for various gasket materials are given in Table I.

Rubber, both natural and synthetic, is used most widely against cool aqueous liquids and gases at relatively low pressures. Pressure range can be extended through the use of a reinforcing fabric or wire insert, the resultant gasketing material being known as cloth-inserted sheet. In extreme temperature conditions, but at low pressures, some of the specialized synthetics such as Viton (DuPont Trademark) or silicone may be used.

Vegetable fiber is a light-service, economical gasket material more suitable for fluids such as oils than for water or gases.

Homogeneous TFE offers the ultimate in chemical resistance, yielding only to molten alkali metals and certain fluorine compounds at elevated temperatures. However, it cold-flows rather readily, and TFE gaskets should, therefore, be kept as thin as possible or confined. TFE envelope gaskets provide a thin material with a variable core density and thickness to adjust for flange conditions and pressure requirements. They are ideal for glass or glass-lined piping and other requirements where a high degree of resiliency is required because of flange waviness and low bolt loads. A patented etched TFE envelope gasket has been developed to create more friction between the gasket and flange faces. Envelope gasket styles will handle pressures up to 300 p.s.i.

Of the semi-metallic gaskets, the most versatile and widely used is the spiral-wound gasket. Garlock Guardian (Garlock trademark) spiral-wound gaskets, for example, are made from a continuous strip of preformed metal, wound spirally from the inside to the outside with a soft filler such as asbestos or TFE between each ply. Variations in the number of metal plies, and changes in filler, in filler thickness and in wind-up tension permit spiral-wound gaskets to be used over a broad range of bolting conditions and sealing requirements.

The success or failure of any gasket depends in large measure on the condition of the flange itself. Seating surfaces should be flat—free from waviness or warpage. A surface finish in the range of 125 RMS is recommended for hazardous service. For general service, satisfactory performance can be achieved with almost any commercial flange surface.

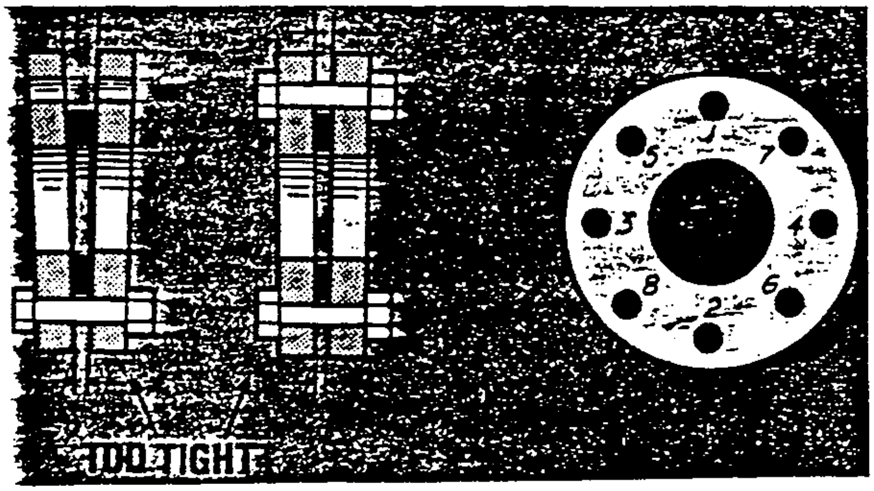


FIGURE 4. CORRECT BOLT TIGHTENING SEQUENCE OF GASKETS.

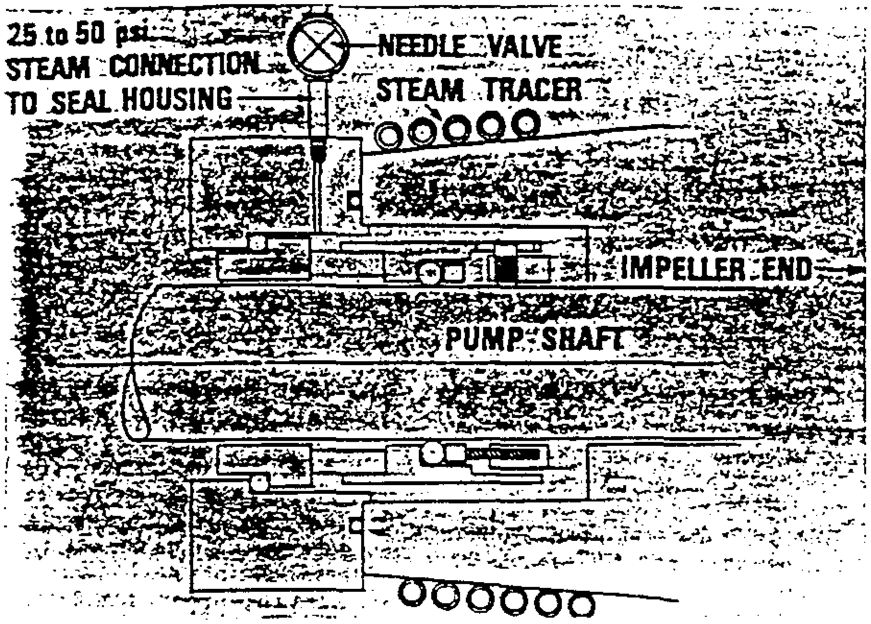


FIGURE 5. HEATING ARRANGEMENTS FOR BLACK LIQUOR PUMP MECHANICAL SEAL

up to the range of 250 RMS.

Concentric or even phonographic grooves are acceptable if proper seating loads are provided. A surface made by a planer, however, should never be used because lines machined into the surface by the planer provide straight-line leakage paths.

Additional pointers on proper gasketing are:

- Tighten flange bolts in proper sequence, going back and forth between opposite sides of the flange (Figure 4).
- Since hydrostatic end pressure is exerted against exposed portions of flange faces as well as the internal diameter of the pipe, gasket inside diameter should conform closely with ID of flange
- Bolt holes in gasket should be larger than bolts
- If flanges are wide apart, metal spacer should be used, with gaskets on each side.

Woodroom Applications

This general background information of packings and gaskets can now be related specifically to the pulp and paper industry, which involves rugged and demanding applications.

Barking drums, chippers and other equipment in the wood room are subject to heavy thrust loads. While this has a greater effect on bearings than on seals, the bearings can be better protected by using a double opposed lip seal rather than a single seal.

This recommendation—well worth the extra cost—keeps spray water and chips from working into the bearings.

Gaskets in Chemical Pulping

Of the various pulping operations, both the sulphite and kraft processes involve strong hot chemical solutions for the digestion of wood chips. Circulating systems for acid towers, digesters, recovery towers, coolers, and their equipment and accessories require chemical and heat-resistant packings, as do the hot and corrosive white, black and green liquors involved in the alkaline system.

These demands are best met by either a pure all-TFE braid, or blue asbestos with TFE impregnation, or mechanical seals. Both the pure TFE braid and the TFE-impregnated asbestos braid, because of TFE's high coefficient of thermal expansion, require *extreme care in adjusting* at start-up to avoid the possibility of almost immediate seizure.

In black liquor pumps, the temperature of the liquor should be normally kept at above 170°F. Below this temperature the liquor becomes extremely viscous and tends to tear packing apart or to destroy a mechanical seal. If packing is used, a steam tracer coil around the box will keep the liquor temperature from falling below the prescribed level. With a mechanical seal on black liquor pumps (Figure 5) a steam flush is ideal. A one-quarter inch line with a needle valve is brought from any convenient 50 p.s.i. steam line to the flush connection on the mechanical seal housing. The needle valve is opened slightly to allow a trickle of steam to the stuffing box, thus maintaining sufficient temperature to keep the black liquor around the seal in a liquid state. A steam tracer around the outside of the box can also be used. Upon shutdown, the drain-cock on the volute is opened, the needle valve is opened wide and the stuffing box is blown clear of fluid, to prevent solidification around seal and resultant damage at start-up.

Two special gasketing applications should be noted:

1. TFE envelope gaskets are recommended for goose-neck connections over solid TFE or blue asbestos.

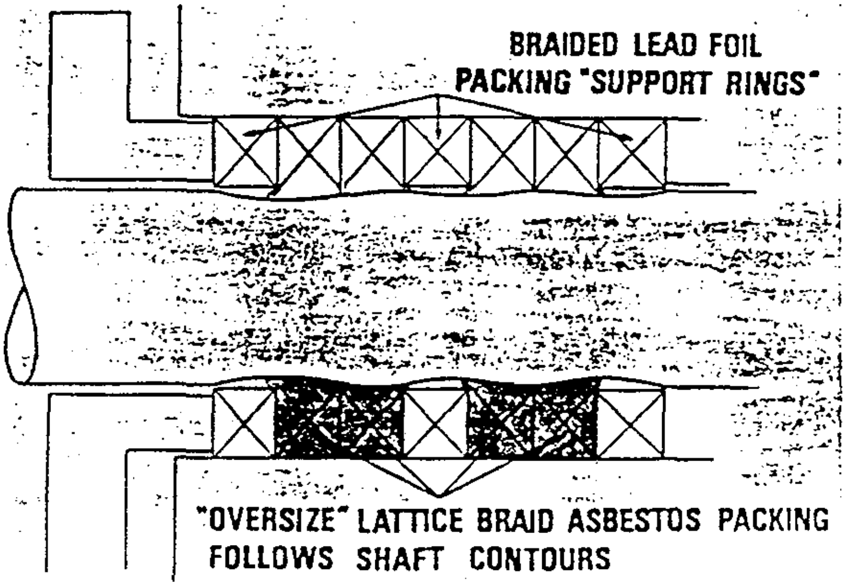


FIGURE 6. PACKING WORN SHAFT ON AGITATOR OR ROBERTS GRINDER.

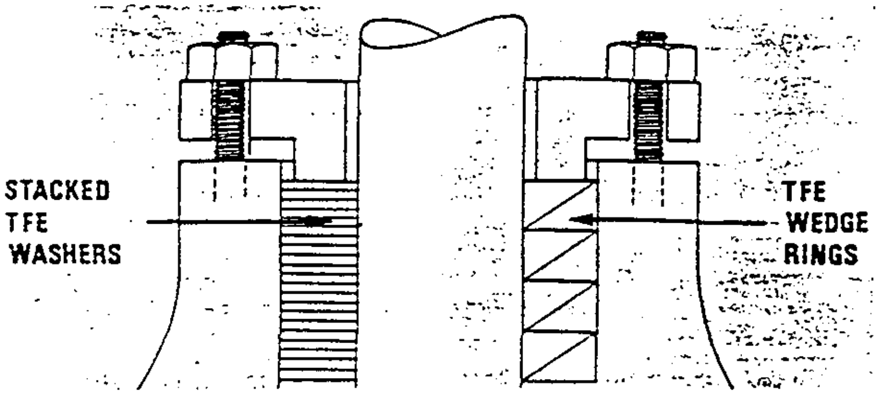


FIGURE 7. CHLORINE AND HYPOCHLORITE VALVE PACKING.

With proper care, they can be reused.

2. Plain woven asbestos gaskets —the same as ordinary boiler gaskets—are recommended for digester head covers. More efficient than pulp or rubber gaskets, they can be reused many times.

Mechanical Pulp Service

In groundwood pulping, wood particles and water, rather than corrosive fluids, must be contended with. In pocket type grinders, Chevron packings on the rod and leather cups on the pistons have proven universally satisfactory.

With its large shafts expensive to replace, the Roberts grinder is representative of the tough packing demands encountered in pulp and paper making. The stuffing box is subjected to an abrasive condition, and consequently requires packing which will compensate for considerable wear of the shaft. Here, the answer is a combination of a very soft packing that can be made to conform to the worn shaft, supported by a firm bearing-type packing, such as braided lead foil (Figure 6). This arrangement performs satisfactorily until shaft wear exceeds ¼ inch.

Washing and Bleaching

In bleaching and washing operations, pump applications generally pose no serious packing problems. The outlet seal on the deckers and washers is best provided by multiple-nested packing rings of the automatic type, such as Chevron. Lubrication of rings with vaseline assists the installation and helps insure that although the rings are narrow in relation to diameter, they are not twisted. Rings should be seated true and square.

For chlorine and hypochlorite valve packing, several versions of TFE packings, such as square rings, wedge rings and "V" rings, have been found partially satisfactory. A packing consisting of stacked TFE washers cut from ⅛ inch sheet, however, has proven much more universally successful (Figure 7).

In stock refining equipment a primary requirement is to keep the pulp out of the packing. This is done most effectively by means of a seal ring or lantern fed with clean water at a slightly higher pressure than pumpage.

Problem of Packing Adjustment

Proper packing adjustment is of extreme importance and, particularly in the pulp and paper industry, is often made difficult by the rather high pressures and large throat clearances encountered. Excessive tightening in such cases causes extrusion of and actual loss of packing into the media. Bull rings offer an effective and relatively simple solution to this problem (Figure 8). One of the best of the variety of firm packing materials from which they can be made is white hydraulic duck and rubber packing. The ring must be made 1/16 inch less cross-section than the packing. For example, with ⅞ inch round soft braided packing, *bull rings should be made from 13/16* inch hydraulic packing. Reason for this size differential is that at high surface speeds, the bull ring should not be in tight contact with shaft, or it will burn and weaken. The sole function of the bull ring is to reduce the clearance at the throat and gland.

In many such installations, the use of these bull rings has increased packing life three- or four-fold. Nor is the use of bull rings limited to jordans and modern refiners. They are equally applicable to any equipment having large throat clearances. Older equipment such as fan pumps, particularly if the packing life is short, should be checked, since bull rings can often result in much improved service.

IN FACT, EXCESSIVE CLEARANCE AT THROAT AND GLAND AND WORN SHAFTS ARE THE PRINCIPAL CAUSES OF PACKING FAILURE THROUGHOUT ALL AREAS OF PULP AND PAPER MAKING.

Whip or deflection can drastically reduce the efficiency and life of packings. This can be caused by uneven

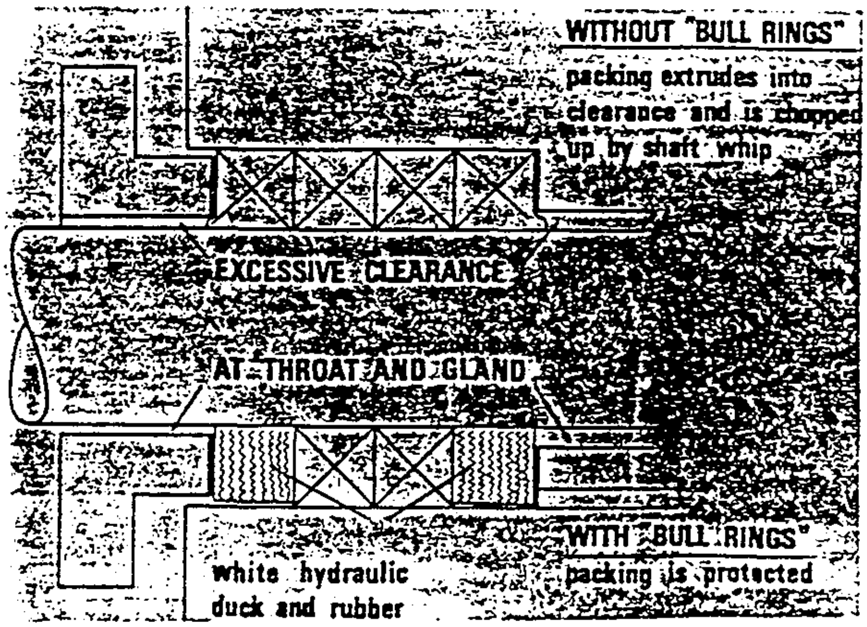


FIGURE 8. USE OF BULL RINGS SOLVES PROBLEM OF PACKING LOSS INTO MEDIA.

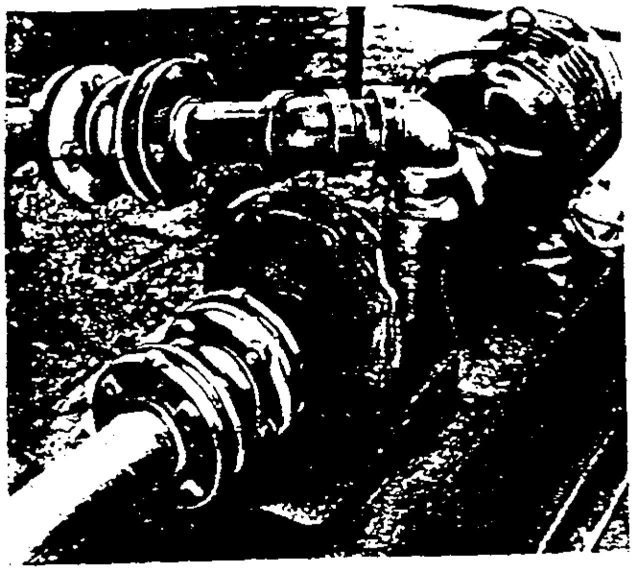


FIGURE 9. USE OF SPOOL-TYPE RUBBER EXPANSION JOINT PROVIDES PIPE-LINE INSURANCE.

loading, which may be corrected by replacing worn bushings or bearings; or by bent shafts, which should be replaced.

Pumping Abrasive Materials

In pumps handling abrasive slurries such as clay, titanium dioxide or lime slurries in the recovery operation, a water seal should be used for maximum life and efficiency. A double mechanical seal is often the most suitable in such applications. Rosin pumps may require a steam tracer to keep the material fluid and prevent tearing the packing apart.

If excessive leakage is encountered with agitator shafts of stock chests, it is often due to over-tightening which causes shaft wear and a resultant unsatisfactory seal. Here again, a water seal, properly installed and adjusted, is the best solution.

Super calenders and embossing rolls in converting operations require high-temperature oil seals of Viton rubber.

Rubber Expansion Joints

One final item which has universal application throughout the mill and power plant is the spool type rubber expansion joint (Figure 9). They represent "pipe-line insurance," especially on transite pipe. Where pumps must be changed frequently, expansion joints readily pay for themselves by just the time saved in removing one pump and replacing it with a spare. They reduce vibration, relieve torsional strain and compensate for misalignment. In one instance, for example, torsional strain in a long river intake line cracked the body of a 36 inch gate valve. A 36 inch rubber expansion joint—many times less the cost of the gate valve—corrected this situation.

To sum up, the savings realized through proper selection, installation and maintenance of packing and gaskets can more than offset the cost of a paper plant's entire annual packing purchases.

APPLICATIONS AND GENERAL RECOMMENDATIONS

Application	Packing Recommendation		Gasket Recommendation	
	Preferred	Acceptable	Preferred	Acceptable
Sulphite Acid and Waste Liquors	Special TFE fiber yarn, lattice braid	Mechanical seal or African blue asbestos impregnated with TFE, lattice braid	TFE envelope	African blue asbestos compressed sheet, with SBR* rubber binder
Kraft Green Liquor White Liquor Black Liquor	Special TFE fiber yarn, lattice braid	Mechanical seal or African blue asbestos impregnated with TFE, lattice braid	TFE envelope	African blue asbestos compressed sheet, with SBR* rubber binder
Chlorine, SO_2 (Valves)	TFE Washers	African blue asbestos impregnated with TFE, lattice braid as end rings with plastallic centers rings of TFE powder, synthetic binder, ungraphited	TFE	White asbestos compressed sheet, with SBR* rubber binder
Fresh Water White Water	Long fiber white asbestos yarn, white lubrication, surface treated with TFE, regular square braid	Long fiber white asbestos yarn, lubricated but ungraphited	White asbestos compressed sheet, with SBR* rubber or** binder	SBR* rubber sheet
Condensate & Steam (Power House)	Long fiber white asbestos yarn lubricated and graphited, lattice braid	Long fiber white asbestos yarn, lubricated and graphited, regular square braid	White asbestos compressed sheet, with SBR* rubber or binder	
Wet Strength Solution Dyes and Alum	Long fiber white asbestos yarn, white lubrication, surface treated with TFE, regular square braid	Long fiber white asbestos yarn, lubricated but ungraphited	White asbestos compressed sheet, with SBR rubber binder	SBR* rubber sheet
Clay Pumps	Long fiber white asbestos yarn, white lubrication, surface treated with TFE, regular square braid	Double mechanical seal or long fiber white asbestos yarn, lubricated but ungraphited	White asbestos compressed sheet, with SBR rubber binder	SBR* rubber sheet

*Styrene Butadiene
**Depends on Flanges