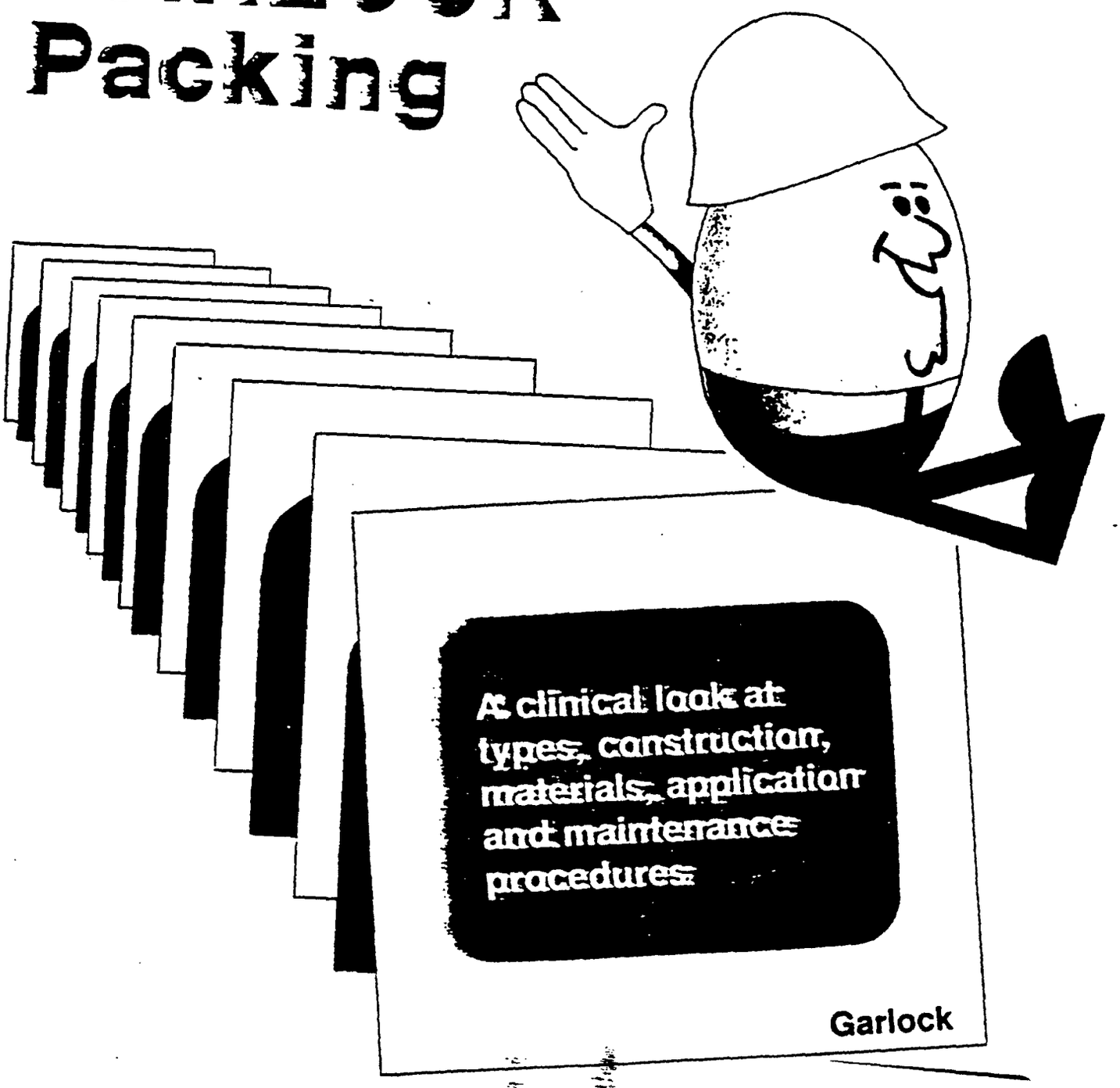
What's New in GARLOCK Packing

PLAINTIFF'S EXHIBIT
G-362



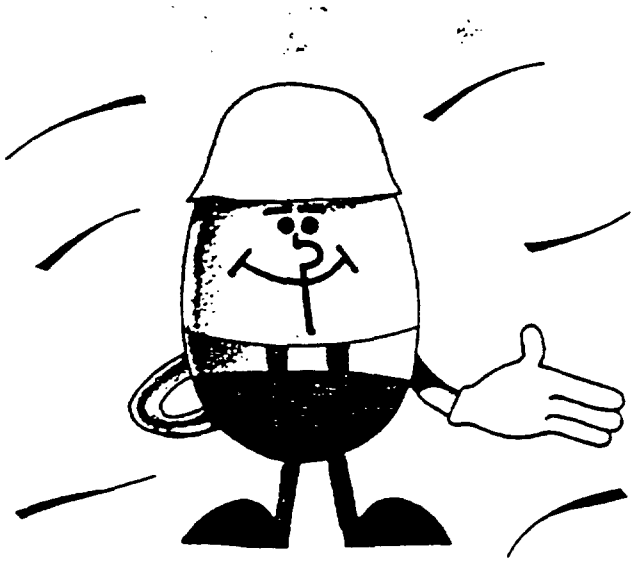
Welcome to the world of compression packing!

GARLOCK is interested in having you - - our valued customer - - understand the types of packing available to you and how to best use them.

Our *"What's New in Garlock Packing"* program has been designed to provide the answers you'll need to solve a wide variety of equipment maintenance problems. You'll find the booklet that accompanies the audio-visual presentation a handy tool to refresh your memory about the use of compression packing. Please refer to it as frequently as necessary to solve your packing problems.

This booklet and the *"GARLOCK Industrial Products Catalog"* will provide you with all the information you need for selecting the best packing suited to your requirements. Premature packing failures should be a thing of the past.

Realizing, however, that not every unique problem can be covered in our packing program, please feel free to call on us with your particular application. Contact your GARLOCK field service representative or the Inside Sales Department of our Sodus facility.



©Copyright 1978. GARLOCK Inc

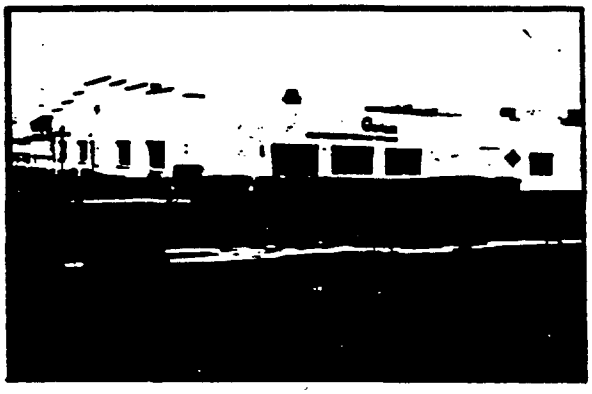
SLIDE #1



SLIDE #1

Welcome to the GARLOCK Packing Clinic. Your company realizes the need for this sort of educational meeting on compression packing, and we are very pleased to have this opportunity to share our knowledge and experience with you. GARLOCK main plant and general offices are located in Palmyra, New York.

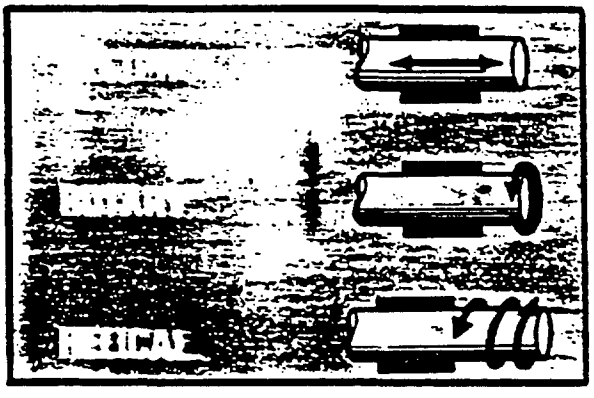
SLIDE #2



SLIDE #2

and our Compression Packing facility has moved to newer and more efficient quarters in Sodus, New York. We want you to know where we're located and where our products are produced. These plants sit on more than 100 acres and represent an investment of several million dollars in facilities to produce packings, gaskets, and seals. GARLOCK also has other plants worldwide to produce and distribute their complete line of products. GARLOCK has been the leader in the packing industry for nearly a century. The products have changed dramatically since O.J. Garlock cut his first set of packings from rubber hose in 1887 and GARLOCK is still the frontrunner in research and development of new products for all types of industries.

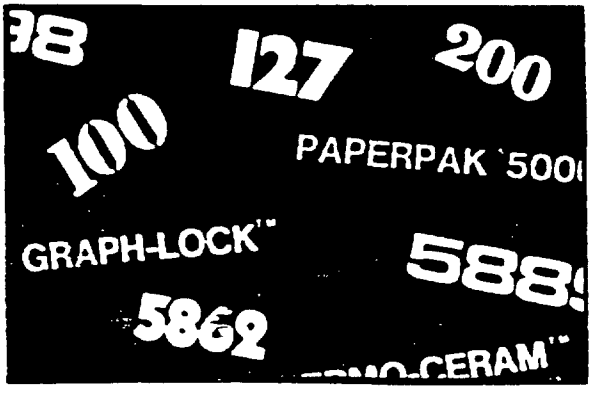
SLIDE #3



SLIDE #3

In this discussion we will be talking about packings as dynamic sealing materials. Dynamic packings seal moving parts. There are three kinds of motion that usually must be sealed: reciprocating motion as in reciprocating pumps; rotary motion as in centrifugal pumps; and helical motion as is found in valves.

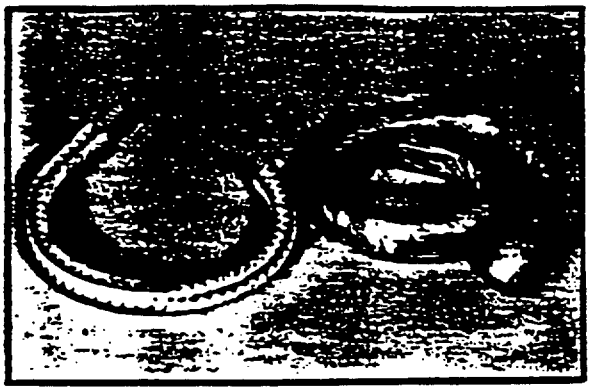
SLIDE #4



SLIDE #4

Dynamic packings are used to retain all types of fluids under different amounts of pressure, including vacuum, at varying temperatures. To seal this great variety of fluids, hundreds of materials and lubricants have been developed, although as you know, a handful of them will handle the vast majority of applications. Let's now look at some of the more popular materials and constructions of compression packings.

SLIDE #5



SLIDE #5

Metal is usually found in compression packings in foil form, although some metal is used in braided and shredded forms. You'll find metals used as end rings, as well as pressure or thermal barriers in high pressure or high temperature service. The commonly used metals in metallic packing such as you see here are lead, copper and aluminum.

Metal packings are commonly found in a twisted core construction. Sometimes you may see a folded, crumpled, or braided metal packing. Some metals have less friction against moving surfaces than fibers. The crumpled and folded types are lubricated between the layers to form reservoirs for lubrication. Metallic packings are generally used at

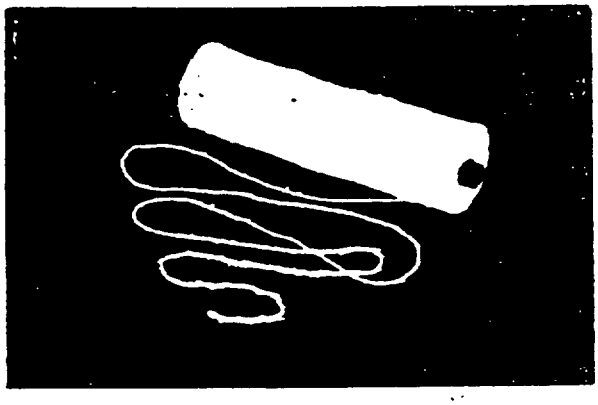
SLIDE #6



SLIDE #6

higher speeds, and also as end or bull rings with other types of packing to prevent extrusion.

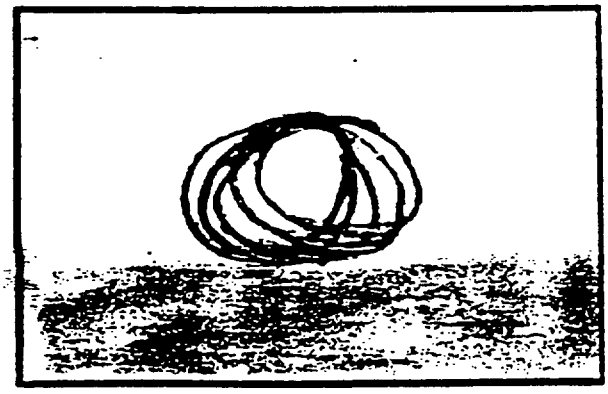
SLIDE #7



SLIDE #7

Asbestos, a mineral fiber, is widely used because of its strength, temperature resistance, and versatility. White asbestos, because of its short fiber length, must be intermixed with rayon fibers to facilitate braiding. The presence of these rayon fibers limits the use of white asbestos packings to handling alkalines, neutral or weak acid solutions. Blue asbestos fibers are longer and don't require the aid of rayon so packings from this family can be used on equipment handling strong mineral acids.

SLIDE #8

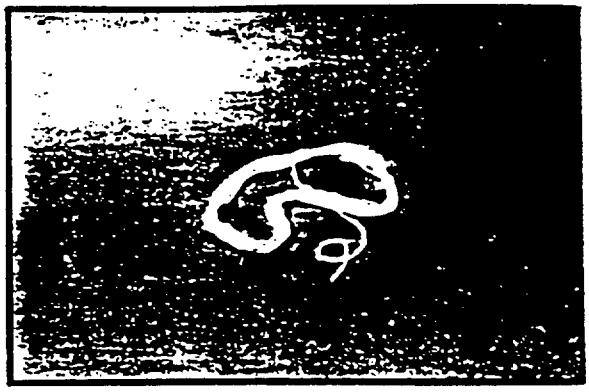


SLIDE #8

Vegetable fibers of flax, ramie, jute, and cotton

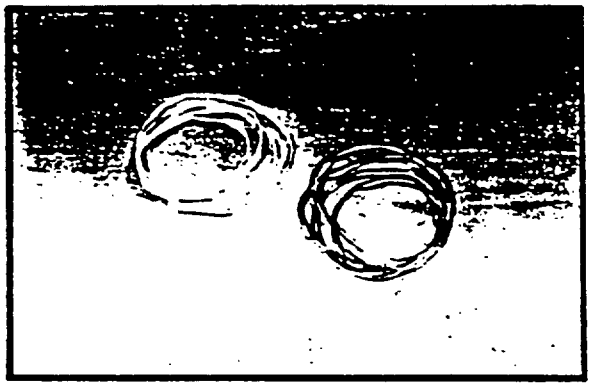
SLIDE #9

are also used to manufacture compression packings. They have a temperature limitation of 220° F and are primarily cold water and cold oil packings. Vegetable fiber packings are excellent for these applications because the fibers actually get stronger as they get wetter.



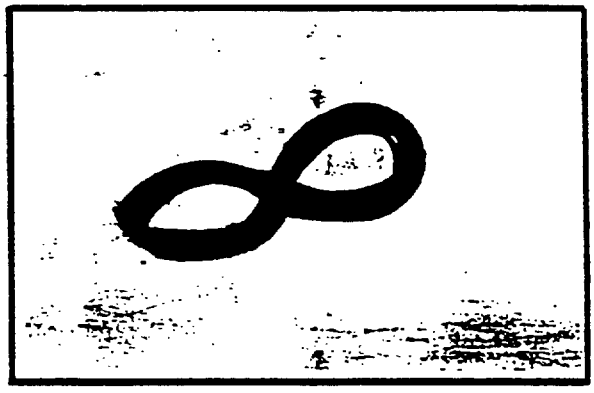
SLIDE #10

Synthetic fibers came on the market a few years ago and have had quite an impact in the packing industry. The best known of these fibers, of course, is TEFLON*. TEFLON has a low coefficient of friction, can handle fluids in a pH range of 1 — 14, and temperatures up to 500° F. There is a new synthetic fiber on the market known as KEVLAR*. This new product contains no asbestos is extremely durable, and can handle temperatures up to 550° F, and a pH range of 4 through 10.



SLIDE #11

Through updated technology and GARLOCK engineering come the most exciting, cost-saving packings made from carbon and graphitic fibers. Even though these products cost more on a pound basis, they actually save industry thousands of maintenance dollars because of fewer repacks, fewer adjustments, less product loss, and more feet per pound for your packing dollar. Carbon/graphite products can be used everywhere in every type of industry. They are chemically inert, handle pH ranges from 1 — 14, temperatures to 650° F (1200° F in steam); they have great thermal conductivity characteristics, and no problems with thermal expansion. These packings are truly the "problem solvers" for today's industries which use exotic chemicals, higher temperatures, and faster shaft speeds.



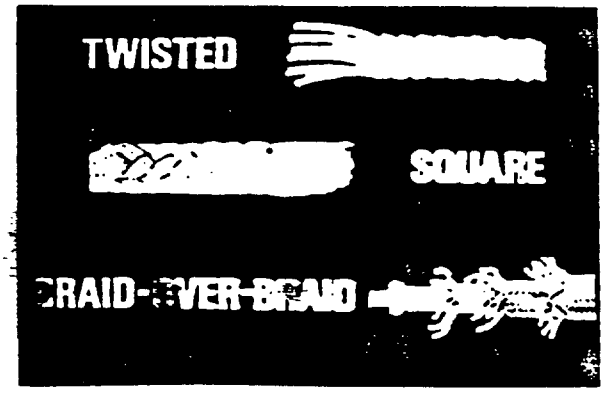
SLIDE #12

Now let's look at how these materials are constructed and actually manufactured into packing. Let's investigate the different shapes of packings and what advantages these different constructions offer you in actual performance.

Twisted packing is the first construction we will discuss. Twisted does not have the strength of braided packing; therefore, it is mainly suitable for valve stems. You'll find it useful primarily because it can be untwisted to create smaller sizes that you may need.

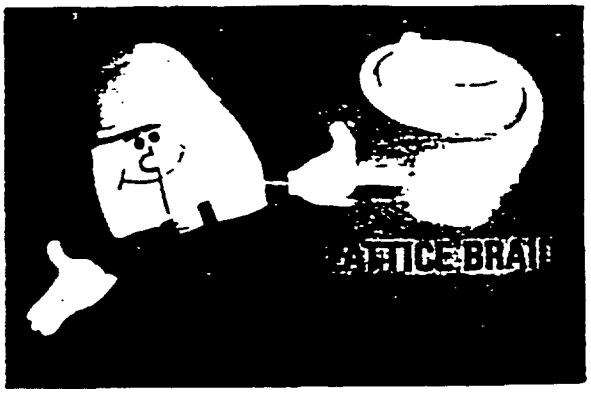
There are three types of popular braid. Simple square braid is produced by one trip through the braiding machine. The braids are not firmly locked in square braid construction. The advantage is that its strands can adjust to uneven rod motion on older equipment.

Braid-over-braid is a round packing, made up of a series of braided tubes, one braided over the other. It's a dense packing and is used for higher pressure jobs on rods or valve stems or wherever there is relatively slow motion. It resists extrusion, which makes it particularly useful in reciprocating service. It can also be used as a gasketing material on oven doors, crucibles, or any tongue-and-groove application.



*Registered Tradernark duPont Company

SLIDE #13



SLIDE #13

LATTICE BRAID® combines flexibility and firmness. Each braided strand passes diagonally through the body of the packing forming a completely unified structure. It is naturally shaped square in cross section and every strand contributes to its strength. The important feature is that wear does not loosen the strands. Whereas another packing would be seriously damaged, LATTICE BRAID maintains its unified structure.

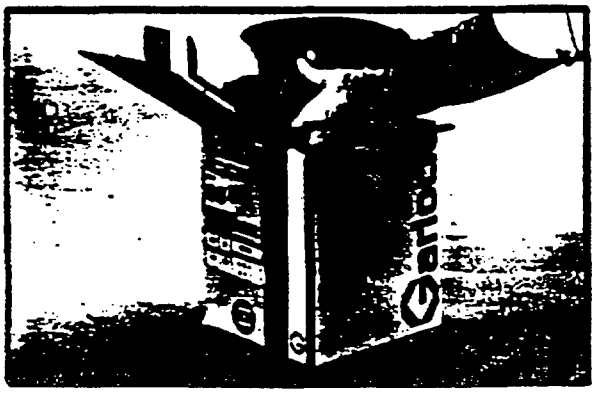
SLIDE #14



SLIDE #14

To the braided product, impregnants and lubricants are added to fill voids and provide additional lubrication. Though impregnants and lubricants do not help construct the form or shape of a piece of packing, they are vital to packing service and actually constitute a fair percentage of most kinds of braided packing. Impregnants include: tallow, lard oil, fish oil, soap, castor oil, paraffin, lubricating oil, silicones, teflons, grapfite, mica, and many others, depending on service requirements. One of the main reasons for good packing performance lies in matching the impregnant or lubricant to the particular application.

SLIDE #15



SLIDE #15

We now have our finished product ready to be installed. Compression or jam-type packings are "soft-packings" that are installed in the stuffing box and adjusted from time to time by taking up a gland. The packing constructions that are included among compression types are twisted, braided, laminated cloth, shredded, and the metal foils. They are found, as you know, on rotary, helical, and reciprocating applications.

Now that we've touched on the high spots of packing materials, how they are put together, and the ways they are used in dynamic sealing, we come to a very important stage — their installation and proper maintenance.

SLIDE #16



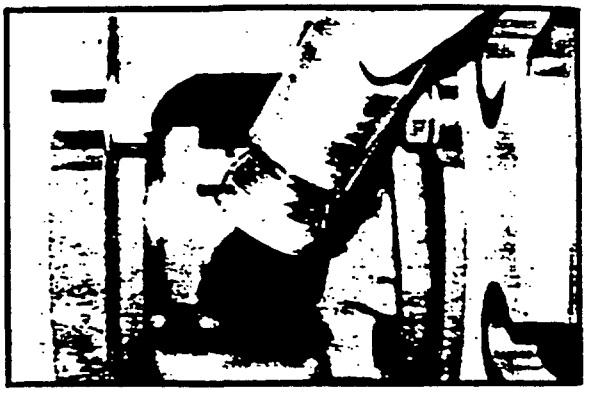
SLIDE #16

Your job of working with packings is indeed an art, because yours is the tough and elusive problem of throttling leakage between a moving and a stationary part. Packing does not stop leaks. Packing controls leakage by throttling. The key word is throttling, which means there must be some leakage.

SLIDE #17

Packings themselves must not run dry. If they do, it creates heat, wear, and destruction of the packing, along with scoring of the shaft. You can literally make packings work very well...or fail completely.

SLIDE #17



SLIDE #18

Before we get to the actual installation, let's discuss the theory of how compression packings work.

With all types of materials and all kinds of packing, the key to successful maintenance is keeping leakage to a point where it merely lubricates and cools the packing, without resulting in a serious loss of the fluid being sealed. An average leakage rate is 10 to 12 drops per minute for conventional type packings, and considerably less for the carbon and graphite types. Packing that is saturated with a lubricant acts as a safety valve in the event that packing is over-tightened and fluid flow is actually cut off.

SLIDE #18



SLIDE #19

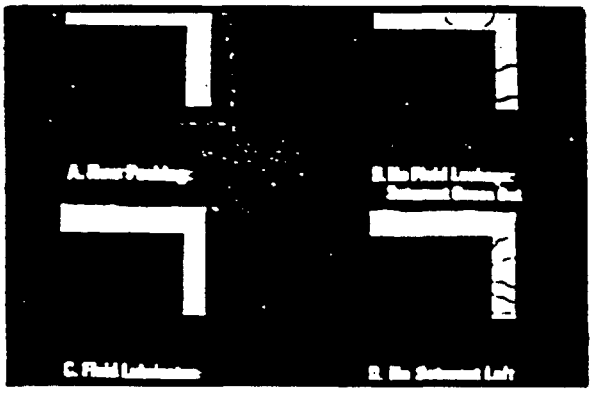
In typical packing installations, you would snug up the packing by tightening the gland. In operation, the fluid flows through the tiny clearance between the moving parts and the packing and acts as the lubricant, as shown in Sketch A.

Now see what happens if you over-tighten the gland. The leakage will be reduced or eliminated, but this in turn will cause the packing to run dry and create heat from friction on the shaft. This heat will melt the impregnant in the packing as in Sketch B, and creates a flow that will supply the vital lubricant necessary to keep the packing from burning up, and the shaft or rod from scoring. However, the impregnant that has melted out of the packing has reduced the packing's volume. Soon, all has cooled down and leakage starts again, as you'll note in C. So again we adjust.

If this cycle is repeated several times, tightening the gland just enough to stop fluid leakage, you will eventually compress the packing to the point where no impregnant or internal lubricant remains. At this point—Sketch D—there's a cloud of smoke...and burned packing and scored shaft. You can see the moral of this story: Never tighten the gland to eliminate all fluid leakage from a rotating shaft or reciprocating rod.

Packings lubricated with grease and oils have this built-in safety factor but must be repacked more often because of the volume loss.

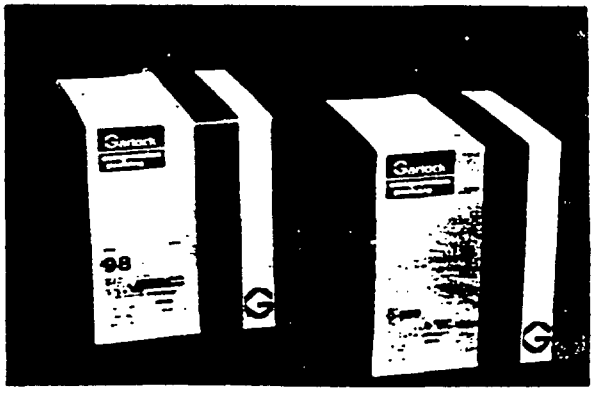
SLIDE #19



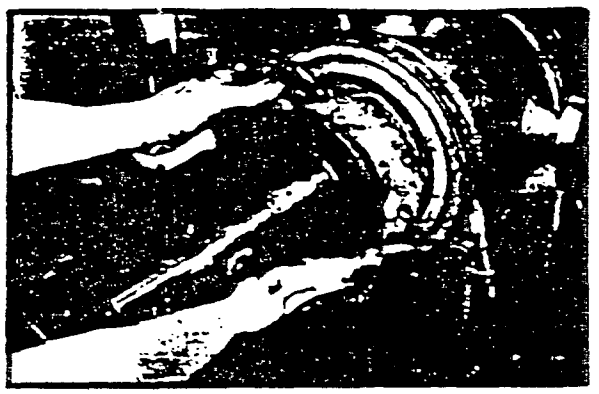
SLIDE #20

The newer carbon and graphitic packings require closer attention during installation and break-in period, but after that they are maintenance and trouble free because there are no lubricants or impregnants to leak out—the moral to this story: lower maintenance costs.

SLIDE #20



SLIDE #21

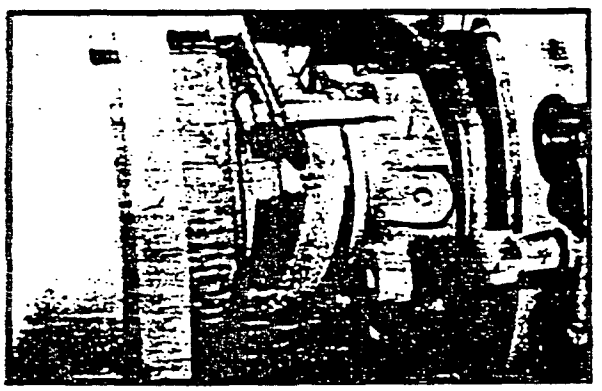


SLIDE #21

When you do have a packing failure—whatever the cause—you have a nasty job on your hands. Packing a pump may sound like a simple procedure; however, nearly 60% of an average plant's packing problems come from improper installation or maintenance, rather than the packing itself.

Let's go through a soft packing installation now, step by step, and get a feel for the important ideas to keep in mind.

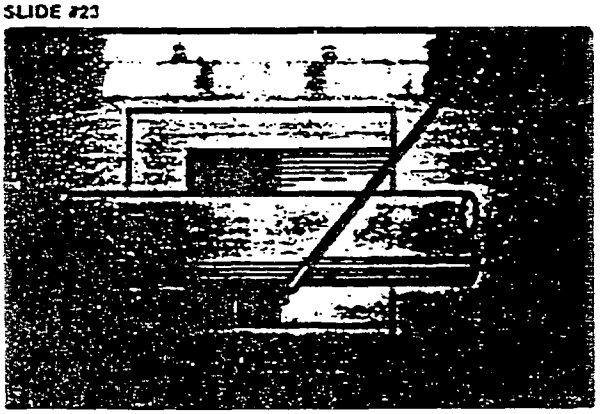
SLIDE #22



SLIDE #22

First, remove all the old packing. Modern stuffing boxes are designed to hold just enough packing to do the job. It is, therefore, important that each ring be replaced with new packing. Merely adding a ring will only result in quicker shaft and sleeve wear. The bottom rings in a packing installation seal against clearance space at the bottom of the stuffing box. They help keep impurities, as found in slurry service, away from the work-horse rings located next to the packing gland. When these impurities get under the packing set, they normally cause early packing failure and severe shaft damage. In field packing replacement, conditions are most often found to be uncomfortable. Frequent excuses include—it is too hot or too cold, you can be cramped for space, and you may not feel that you have enough time to do a proper installation job. Remember, a good repack the first time with a quality packing will eliminate the chore of having to do it again right away.

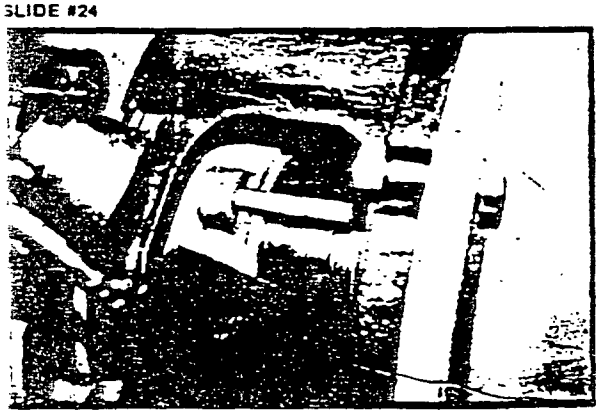
SLIDE #23



SLIDE #23

When removing the old packing, remember to aim your packing hook and tools away from the shaft to avoid damage. A nick or gouge in the shaft will rapidly tear up the new packing.

SLIDE #24



SLIDE #24

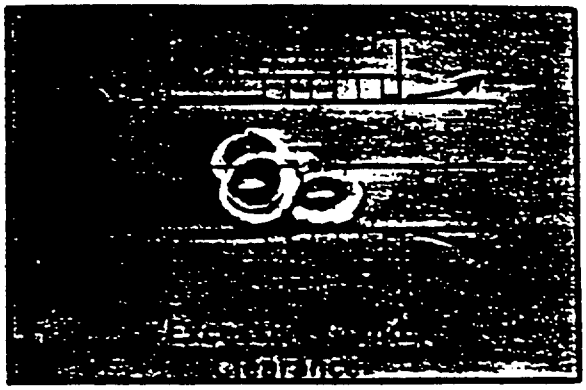
You are now at a very important phase in packing replacement —inspection. The equipment must be in good condition if you are to expect long packing life. Examine the shaft for excessive wear. Use a mirror and flashlight to check the shaft for cuts and gouges. Many times the causes of packing failures are not readily apparent. However, careful examination of the used packing will often indicate the factors causing this failure. The following slides show some examples of how certain clues can pinpoint the reason for the failure:

SLIDE #25

1. If one or more rings are missing from the set, look for excessive shaft clearance allowing extrusion of rings into the system. As a result of this condition, packing may get trapped in other equipment or contaminate the fluid being handled.

2. If packings tend to sheet-out or extrude between rod or shaft and gland follower, look for too great a clearance between rod or shaft and gland followers. Use of anti-extrusion ring may be necessary if the pressure is high or if clearances cannot be reduced.

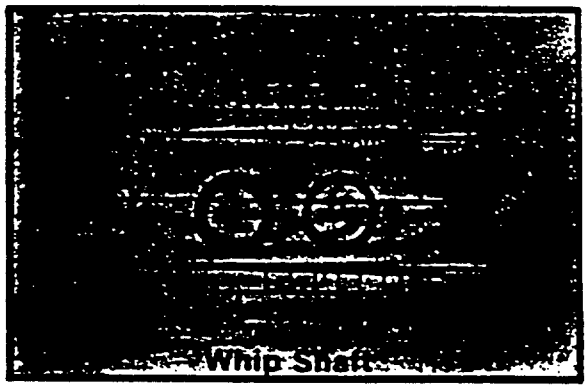
SLIDE #25



SLIDE #26

3. If packing radial thickness appears other than nominal in one or more places, look for an undersize shaft, badly worn bearings, causing shaft whip or rod or plunger wobble.

SLIDE #26



SLIDE #27

4. If packing radial thickness directly beneath the rod, shaft or plunger is excessively reduced or early leakage occurs at top of rod or shaft, look for misalignment of center lines of shaft or rod and stuffing box bore.

5. If outside diameter of packing is worn, look for loose ring or rings rotating within shaft due to insufficient gland load.

SLIDE #27



SLIDE #28

6. If one or more rings has "bulges" in the faces, look for adjacent rings cut too short, causing packing under pressure to be forced into the spaces at the joints.

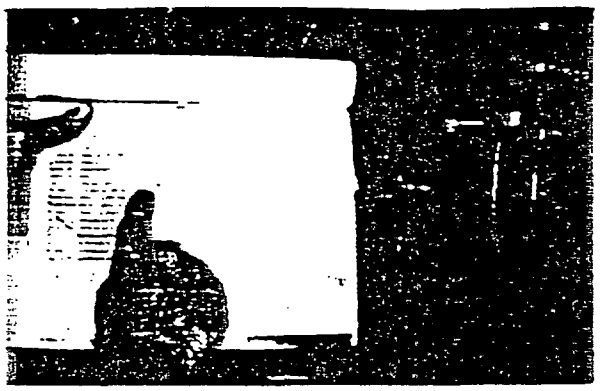
7. If bottom rings are in fair condition yet rings next to gland followers are prematurely deformed, look for improperly installed packings and use of excessive gland pressure.

When you are sure your equipment is in good condition, you are ready to install new packing.

SLIDE #28



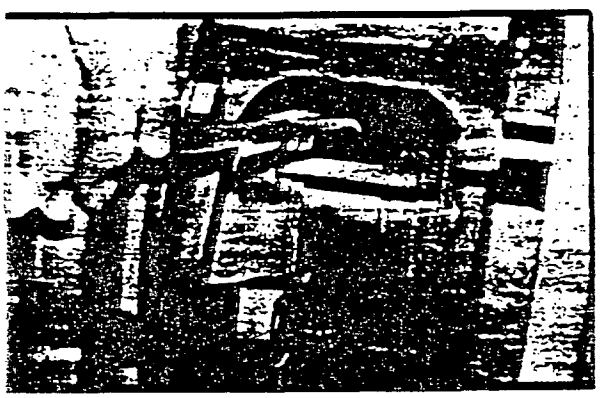
SLIDE #29



SLIDE #29

Using the correct size and type packing is very important. A packing survey will list all equipment using packings and the proper size to use. It will also show how many rings of packing go on each side of the lantern ring. If you don't now have a packing survey, GARLOCK will be happy to conduct one and assemble a report for you at no cost.

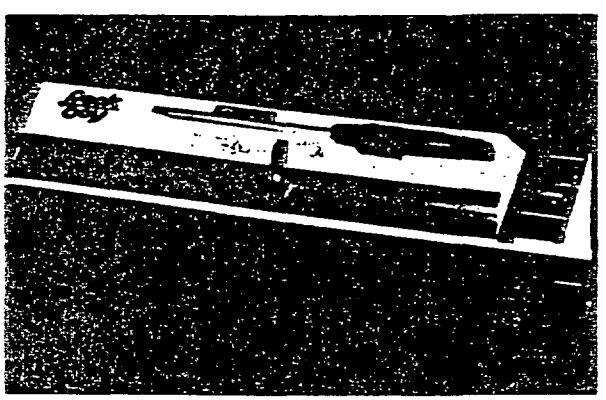
SLIDE #30



SLIDE #30

Without a packing survey, you will need to measure the shaft and stuffing box to obtain the proper size. Subtract the shaft diameter from the stuffing box diameter and divide by two. This is your packing size.

SLIDE #31



SLIDE #31

You will have to cut rings to the proper size. A packing cutter such as you see here will give you a ring that will be a precise fit, which is very important to controlling leakage.

SLIDE #32



SLIDE #32

Simply lay the correct packing on the scale and cut. The result will be a perfectly cut ring.

SLIDE #33

If you don't have a packing cutter, wrap the packing around a rod or sleeve the same size as the shaft, then mark and cut.

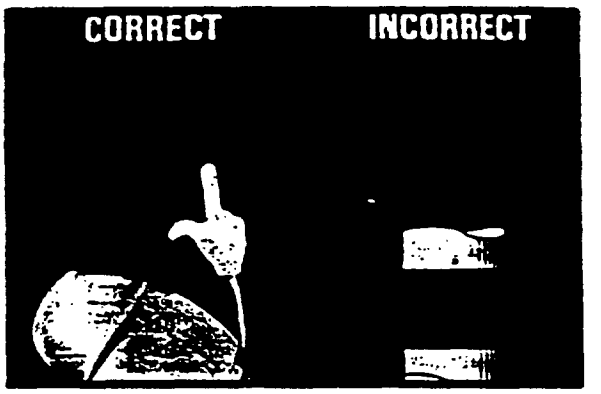
SLIDE #33



SLIDE #34

Avoid cutting the packing lying flat. You will probably wind up with a vee shaped gap as shown here. Cutting flat is acceptable if you have already measured a good fitting ring and can use it as a guide for cutting the rest of the set.

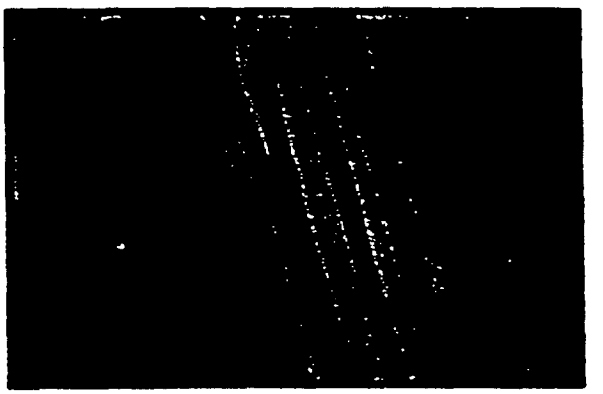
SLIDE #34



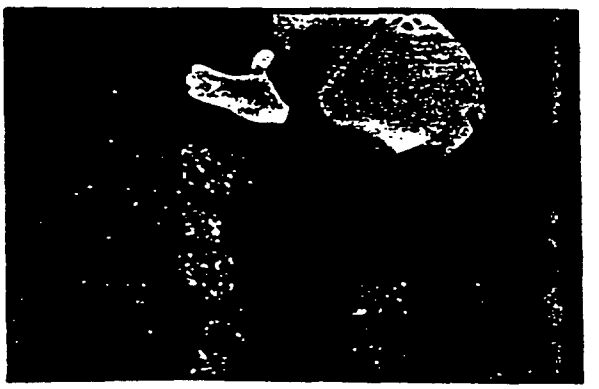
SLIDE #35

These packing rings were taken out of a set which we found when called to examine a premature packing failure. Notice the bulge on the ring second from the left. The ring next to it was cut approximately one inch too short. The packing leaked tremendously on installation and the mechanic really tightened the gland to cut down on leakage as you can see by the first two rings on the left which are burned and fused together. This also shows you that in a packing set the rings next to the gland apply approximately 70% of the mechanical pressure to the shaft and are the first to burn. The ring on the right is from the bottom of the set and is practically new. To make a long story short, no amount of tightening will make an improperly cut set of packing work—it will only lead to shaft and pump damage.

SLIDE #35



SLIDE #36

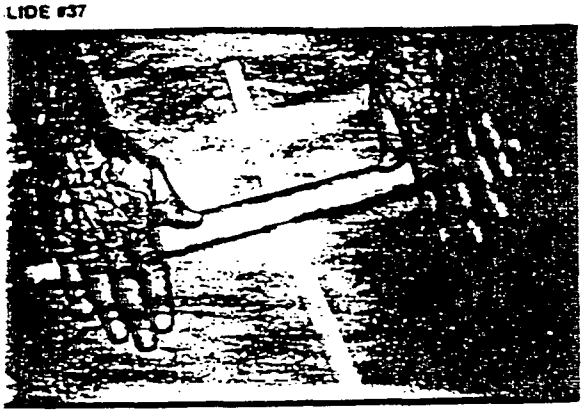


SLIDE #36

Now that we have the proper size packing cut to the proper ring size, we are ready for installation—or are we?

Packing often comes from the factory slightly oversized in order to provide a snug fit. If the packing will not go into the box, do not hammer it flat; this breaks down the fibers and ruins the packing structure.

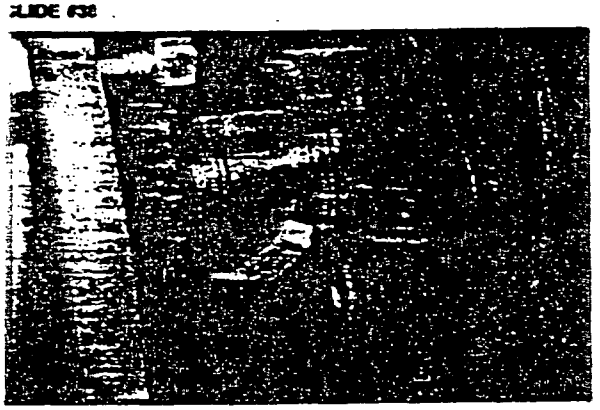
LIDE #37



SLIDE #37

Carry a short length of pipe in your tool box and roll the packing flat--it is quicker and better than hammering. Notice we are using a protective piece of paper under the packing to keep the packing clean so that abrasives do not get on the packing and damage the shaft or sleeve.

LIDE #38



SLIDE #38

Now that the packing fits precisely, install the first ring into the stuffing box. It helps to stick an end slightly into the box and twist gently to insert the outer edge of the packing ring into the stuffing box.

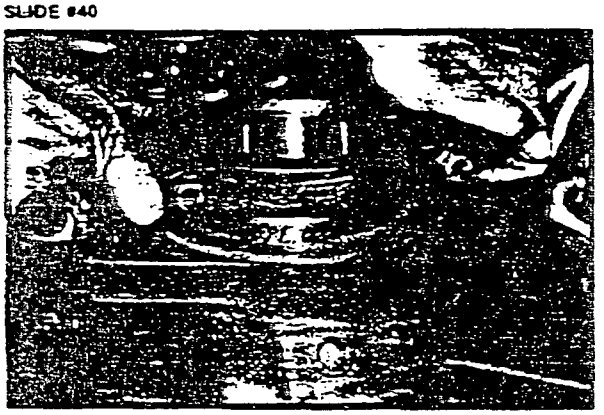
SLIDE #39



SLIDE #39

Remember to stagger the joints of the rings 90° to avoid direct paths of leakage.

SLIDE #40



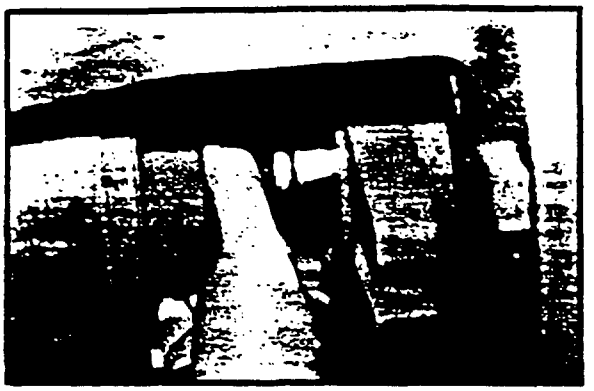
SLIDE #40

Seat each ring individually by inserting the packing gland into the stuffing box.

SLIDE #41

After seating each ring, rotate the shaft 360° by hand. This helps to seat the packing and to distribute lubricant which is critical on initial start-up.

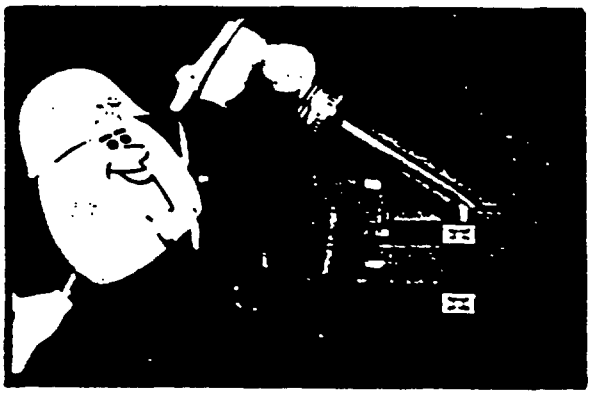
SLIDE #41



SLIDE #42

Impregnated packings cannot contain enough lubricant to give satisfactory service under extremely high temperatures or where conditions create high frictional heat. External lubrication must be supplied. External lubrication is also required when you're sealing fluids or gases that are not satisfactory lubricants, or when an acid or other toxic substance is involved and cannot leak into the atmosphere. But — something must leak or you don't have a good packing installation.

SLIDE #42



SLIDE #43

In such cases, you'll be involved with equipment that provides a lantern ring near the middle of the stuffing box, and external lubrication is supplied here. Anything from a simple grease-cup fitting to a separate pumping system may be used. Continuous lubrication is better than intermittent, so if you have equipment with grease-cup fitted lantern rings, it is important to lubricate them frequently.

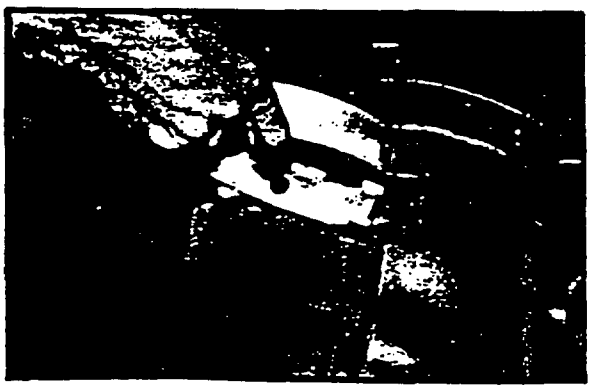
SLIDE #43



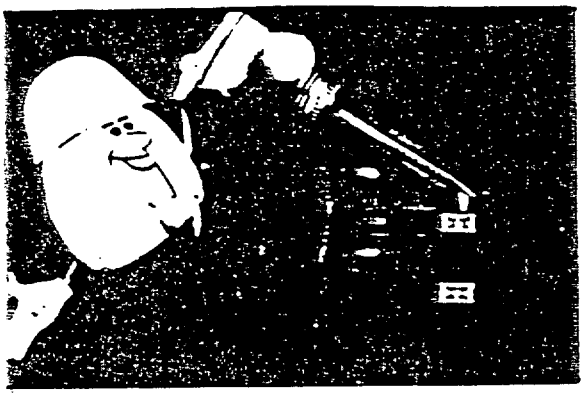
SLIDE #44

The lantern ring is often split, as you see here, to make installation easier.

SLIDE #44



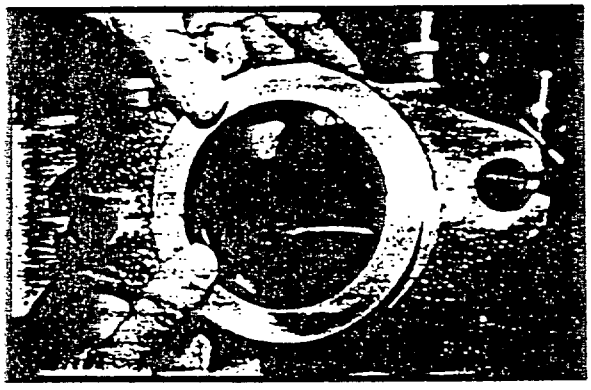
SLIDE #45



SLIDE #45

When inserting the lantern ring, make absolutely sure that it is under the lubrication opening. Check your survey for the proper number of rings to install behind the lantern ring. If the space is large enough, you can use your hand to feel the lubrication opening in the stuffing box. Be sure to allow enough clearance to move the ring back into the stuffing box 1/8th of an inch. You are now ready to insert the remaining rings into the stuffing box. Remember to seat each ring individually.

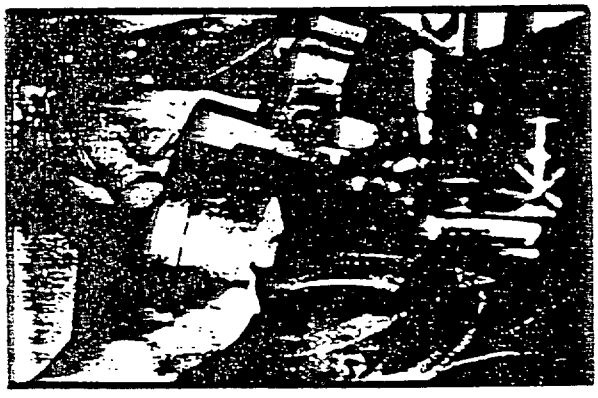
SLIDE #46



SLIDE #46

The packing will be held in the stuffing box by a packing gland as is seen here.

SLIDE #47



SLIDE #47

The gland can also be split to provide easy installation and removal.

SLIDE #48



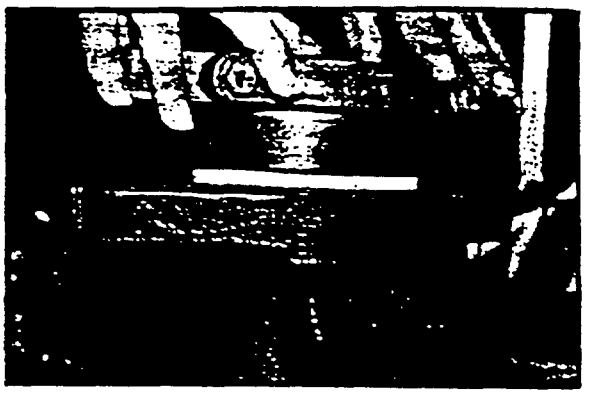
SLIDE #48

The gland fits into the stuffing box as you see here. Pressure can be adjusted on the packing by tightening the nuts on the bolts which pass through the holes you see in the gland.

SLIDE #49

On a proper installation, the gland will sit squarely on the packing. Your set will then be seated properly as shown.

SLIDE #49

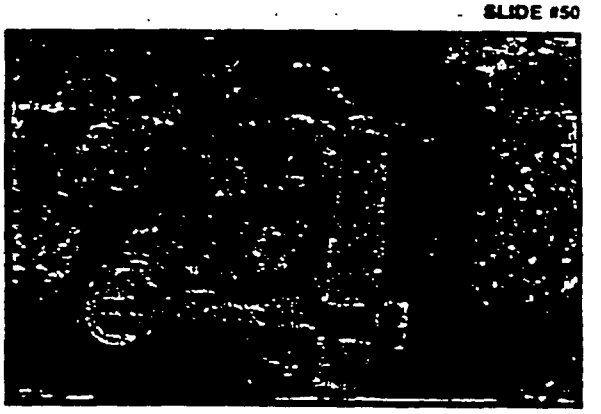


SLIDE #50

An improperly seated set invites trouble. As you can see, the packing will leak and the gland will become cocked.

The packing is extruding around the tilted edge of the gland. This is a common occurence and can lead to shaft damage, bearing failure, and many other expensive problems.

SLIDE #50



SLIDE #51

With our packing installation complete, we are now ready for start up. The first few seconds of operation are critical. This is the time that the fluid being pumped has not completely penetrated the packing in order to provide sufficient lubrication. It is at this point when you are most likely to burn the packing. With conventional type packings, snug the gland up with a wrench and then back the nuts off until they are finger tight. When working with teflon, carbon, ang graphite products, only snug the gland up finger tight. Leave the wrench in your pocket. Turn the shaft by hand to make sure it isn't binding. Turn on all valves and make sure flushing connections are flowing adequately. Hit the start-up button and run the pump for about 4 or 5 seconds only. Then leave the pump off for a few seconds to allow the fluid to penetrate the set. Restart the equipment and allow it to leak until the packing seats itself, which is usually when stuffing box temperatures begin to level off. Then adjust the gland nuts one flat at a time for conventional packings and one quarter of a flat for carbon and graphite packings, until you reach the desired leakage rate. It may take a day or two before you can make the final adjustments, but longer packing life makes it worth the effort.

SLIDE #51

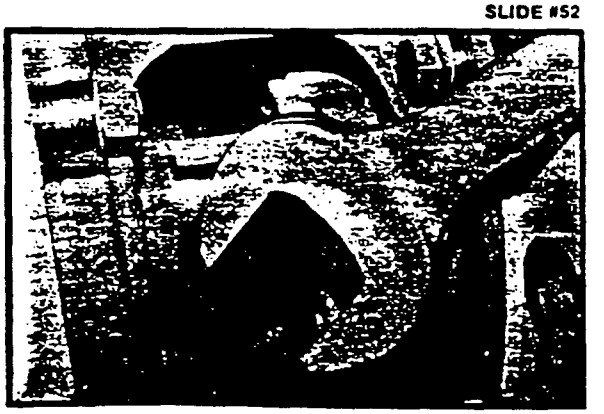


SLIDE #52

The wrench is the greatest enemy of most compression packings. Overtightening is the greatest cause of premature packing failure and equipment damage. Try to remember this simple tip – adjust packing –do not tighten it.

Don't try to solve a leakage problem by tightening down on the packing. Replace the packing or repair the equipment and you can save thousands of dollars anually in unscheduled downtime and equipment damage.

SLIDE #52



SLIDE #53



SLIDE #53

Try to keep plenty of the right size and type packing on hand and avoid substituting a packing which may not be right for the job.

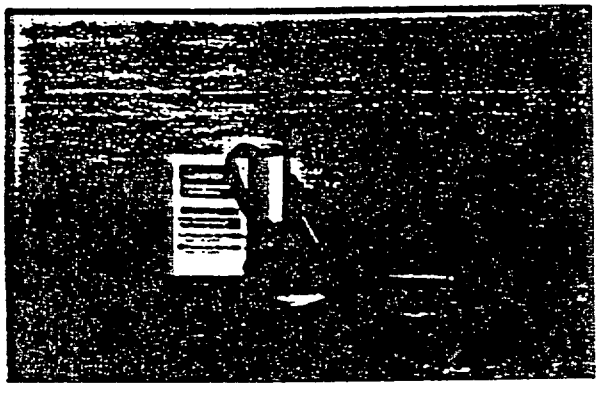
SLIDE #54



SLIDE #54

Store your packing in a clean area to avoid picking up dirt and abrasives that are damaging to packing and equipment.

SLIDE #55



SLIDE #55

We have not covered one new type of packing material that requires a slightly different method of packing. It's called pure graphitic tape. This type of packing is rapidly coming into use because of its chemical and heat resistance which gives it very long life especially in valve stems. There are no binders or fillers to wash out and cause volume loss so this means there are fewer adjustments, fewer repacks, fewer aggravations, and lower maintenance costs.

SLIDE #56



SLIDE #56

First, loosen the packing nuts, remove the old packing, and clean the stuffing box.

SLIDE #57

Wrap sufficient tape around the stem to fill the stuffing box diameter. The exact lengths can be determined by the chart supplied with each package of tape.

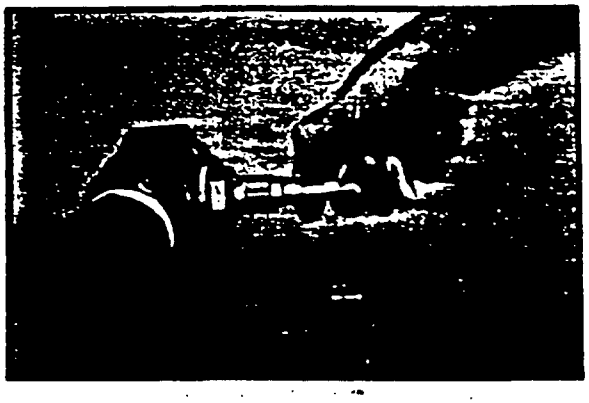
SLIDE #57



SLIDE #58

Next, insert the wrapped ring into the stuffing box and tighten down sufficiently on the follower to compress the wrapped ring to 1/2 its original thickness.

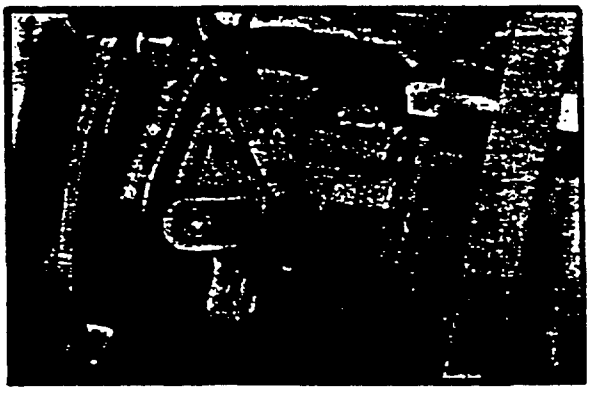
SLIDE #58



SLIDE #59

This same procedure can be used in packing pumps or

SLIDE #59



SLIDE #60

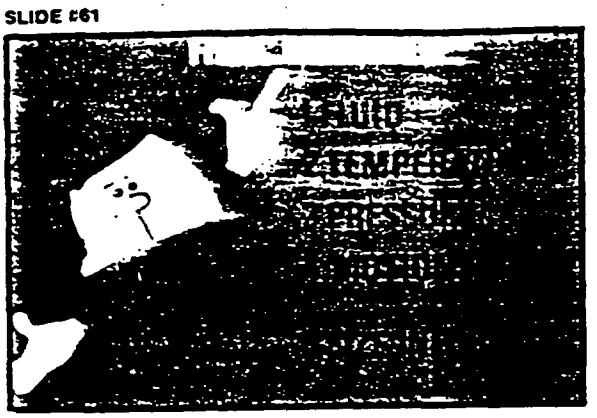
you may use preformed ring sets consisting of graphitic tape with braided graphitic end rings.

In the stuffing box, your formed ring will be endless with no leakage paths and will be a precise fit. This is important in high pressure applications where small leakage paths can start a serious leak.

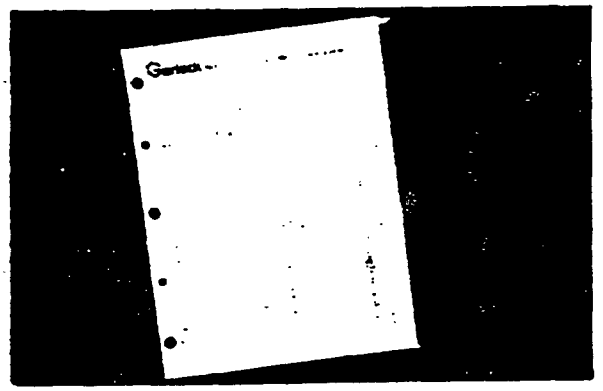
SLIDE #60



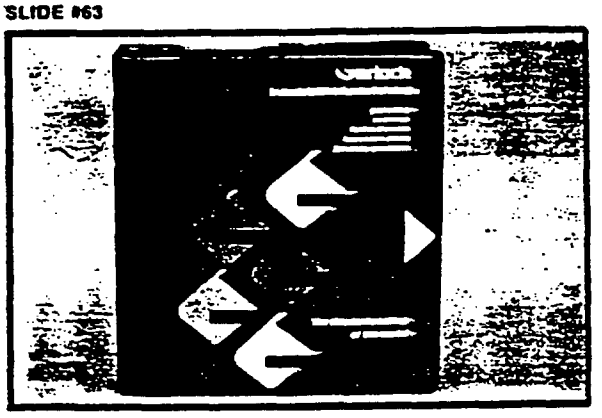
SLIDE #61



SLIDE #62



SLIDE #63



SLIDE #61

Be sure to remember these important tips:

All through this presentation we've used terms such as "highlight" or "tips" or "pointers". Even though we don't have time to cover this very complex and involved subject in detailed fashion, there are some very important ideas we'd like to leave with you. The five words you see here — fluid, temperature, pressure, motion and size — have been mentioned throughout this talk.

We repeat them now because they are the five factors you must know before you can specify a packing.

FLUID — You have to know if you are dealing with an alkaline, an acid, or if it is a highly corrosive solution.

TEMPERATURE — The packing you use has to be able to handle the stuffing box temperatures.

PRESSURE — If you have high pressure service, you obviously must work with different packing than with lower pressure.

MOTION — The revolutions per minute or strokes per minute of a rod or shaft also tell you what you should or should not use as packing.

SIZE — Knowing the right size packing is basic, but important, because just one wrong dimension can give you a packing that won't work.

Know your inside diameter, outside diameter, and stuffing box depth and do away with guesswork and maintenance headaches.

SLIDE #62

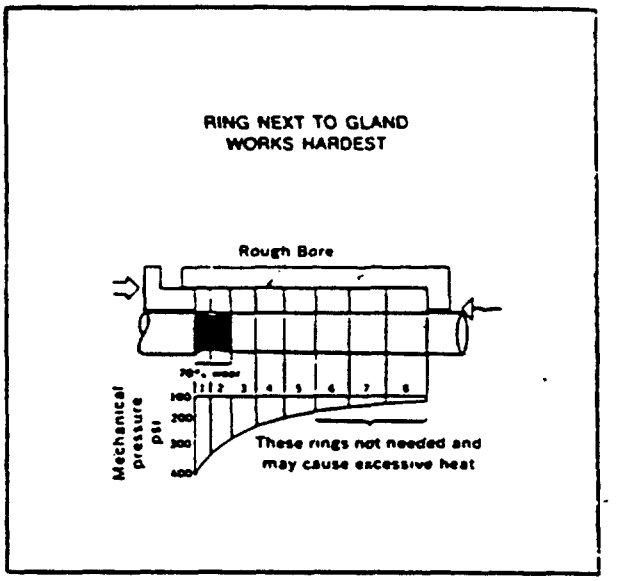
After this very important information is known, you can then consult the GARLOCK packing recommendation chart in the *"GARLOCK Industrial Products Catalog"*.

SLIDE #63

At GARLOCK, packing is our business. We supply packing to hundreds of plants like yours every day. We've seen packing problems of every imaginable type and have worked together with our customers to solve even the most difficult situations. For assistance with a particular packing installation, call our Inside Sales Department in Sodus, New York.

Compression packing maintenance tips

1. Always try to have a spare set of packing in stock, particularly for key pieces of equipment. But don't overstock. Store in a cool, clean place.
2. If a long stuffing box creates excessive heat, use a spacer in the bottom of the box to reduce the number of rings in the set. *(See sketch.)*
3. In typical compression packing installation, most of the sealing in the stuffing box is done by the ring next to the gland. Note where the wear usually occurs in the drawing at right. Be sure to compress the packing ring by ring to assure maximum sealing efficiency.
4. Clean the stuffing box thoroughly after removing old packing. Also thoroughly clean and polish the rod or shaft.
5. Over-tightening is the greatest single cause of packing failure.
6. Lubricate packing rings with GARLOCK LUBALL® packing lubricant prior to assembly.
7. When a packing set fails unexpectedly or after unusually short service life, *save it for the manufacturer to examine.* It can tell a lot about operating conditions and about possible causes of failure.



All slides, tapes and accompanying illustrations are the property of GARLOCK INC and may not be used or duplicated without the expressed consent of GARLOCK INC.

Colt Industries

Garlock Inc

Mechanical Packing Division
Compression Packing
300 Alling Drive
Sodus, New York 14551 315/483-6961
Garlock Packing International Division:
Palmyra, New York 14522
Garlock of Canada Ltd., Toronto, Ontario M8Z 2H3

PRINTED IN U.S.A.

GPS-Rev. 6/78-5M