

# The A B C 's on How to Maintain and Troubleshoot Packing for Hydraulic Elevators

By Wallace T. Wheeler

The intention of this article is to educate and familiarize the reader with essential information that is required when repacking a hydraulic elevator unit. The Texacone



"Packing Pete"

Company has been supplying the elevator industry with hydraulic seal sets for over fifty years. During this time, we have compiled a collection of information that can be vital in determining the correct replacement seal set for a specific application and root out the cause for sealing performance issues.

The science of dynamic seal design can be quite involved, but for the purposes of this article, we'll omit the detailed engineering principles behind the seal profile geometry and material selection, and instead focused on a more practical "hands-on" approach that can save time and money if done systematically.

## Background

The never-ending demand for more environmental-friendly and efficient machines has required many changes. The goal is for them to do more work at a lower operating cost, while requiring less maintenance and providing greater safety. Specifically for the hydraulic elevator industry, there has been an increase in the use of holeless units also

including: above ground tandem, cantilevered, roped hydro's and telescopic.

Environmental code changes have led to more strict requirements of PVC liners for the in-ground cylinders.

These changes explain the need for higher performance standards from the system components because of:

- **Lower speeds** - roped and telescopic units have dramatically reduced operating and leveling speeds.
- **Higher temperatures** - PVC lined and above ground holeless cylinders no longer have direct contact with the ground and are surrounded by an insulating blanket of air. Generated heat will not dissipate as efficiently as before. Smaller machine room space allowances also increase overall system temperature.

Because of these recent industry trends, the demand for improved sealing components has greatly increased in the past decade and will probably continue in the future.

## Basics

The mechanics of a hydraulic system are relatively simple: a cylinder is filled with fluid and under pressure the fluid forces the plunger out of the cylinder.

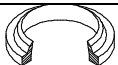







The seal forms a barrier to block the passage of the fluid generating system pressure. Hydraulic equipment has been



around for a very long time. In fact, the term "stuffing box" goes back to the early days when whatever was readily available was literally stuffed into the cavity to help restrict the leakage.

Typically, the words, "packing" and "seals" are used interchangeably which can lead to some confusion. Technically, "packing" refers to the entire set of components, which will always include one or several types of "seals". Also included in the "packing" set may be a wiper, spacers and bearings. See "Packing Set Components" for the specifics on individual component functions. "Packing" can also refer to an older compression style of packing that is still widely used today.

### PACKING SET COMPONENTS

| COMPONENT       |   | FUNCTION  |
|-----------------|---|---|
| Wiper           |    | Excludes foreign debris off of plunger                        |
| Seal            |    | Prevent passage of fluid                                      |
| Spacer          |    | Fills deep box cavities                                       |
| Lantern         |    | Placed between 2 seals allowing oil return system to function |
| Lantern Bearing |   | Combines functions of lantern and bearing                     |
| Wear Ring       |  | Precision guides plunger                                      |
| Bearing         |  | Guides plunger through box to protect sealing lips            |
| O Ring          |  | Static seal between 2 machined pieces                         |

### Documentation Collection

Even before going to the field site or ordering parts, it is vital to gather as much information as possible about the unit that is to be repacked. The **critical information** that must be collected includes:

- Plunger size
- Manufacturer of unit
- Configuration of the installation

Additional information that could prove to be helpful includes date of unit installation, any modifications done to this unit since installation, previous history of performance problems, type of seals previously installed

and date of last repack. In order to minimize elevator down time and the technician's travel time, it is best to purchase the seal components before traveling to the site. Having the above information will greatly aid in the selection of the correct seal set for that specific manufacturer.

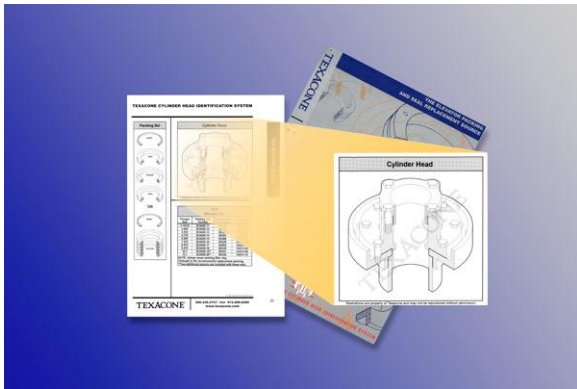
Once on the job site, it is best to confirm as much information as possible **BEFORE taking the unit offline**. This will avoid costly down time should the on-hand seal set be incorrect and new parts need to be reordered.

Plunger Size: The plunger diameter should be measured with a caliper or tape and should be



done in several locations from top to bottom. We recommend using a diameter tape (PI tape) to eliminate the need for any calculations. Note any variations in readings. Pay special attention to areas at the plunger ends and around joints, as these are common areas for dimensional variances. It is important to note that the correct machined dimension of a 5" plunger, for example, can vary as much as .060 inch depending on the manufacturer. We recommend that you use a seal specifically engineered for that manufacturer, not a standard seal.

**Manufacturer of Unit:** Compare the cylinder head with any available drawings or prints to confirm the manufacturer and model of the hydraulic cylinder. Note that often the OEM manufacturer of the different system components can vary. We make this step easier by providing 3-D pictures in our catalog and field handbook.



If still unsure, a common practice used is to send several digital photos of the cylinder head for verification.



**Configuration:** Finally, confirm the configuration of the installation. Seal selection is often dictated by type. For example, roped hydros typically require a single seal and have a higher potential for "stiction" (a term coined to mean a sticking friction felt when motion starts). This would be good application for a low friction seal such as Texacone's 900 SUPREME GREEN urethane seal. Another example would be 2-seal holed units. It is important to maintain the integrity of the OEM set design requirements by having 2 seals in the packing set while not causing undue friction. This is an application suited for a "Reduced-Friction" packing set where the oil return system can still be maintained.

## Unit Inspection

Once the information has been confirmed, the hydraulic cylinder should be monitored for operational conditions before taken offline. Potential problems to look for that can be seal related are:

- Leakage
- Ride performance
- Condition of oil
- Plunger Condition

**NOTE:** It is important to observe the position or condition when the above problems manifest themselves. As an example, does the problem occur at the second landing while the car is in the down direction and as the plunger's joint passes through the packing box.

**Leakage:** Determine where the leakage originates. Does it appear uniformly or erratically at a specific position? Does the oil squirt out or does the plunger have a heavy film of oil when traveling upward. Also inspect the box for external leaks that may be coming from a gasket or an "O"-ring failure.

**Ride Performance:** Observe where the problems occur. Is there bumping just as the plunger begins to move from rest and in which direction? Does the problem occur primarily at the top floors or bottom floors or both? Note the severity of the problem.

Next, try a diagnostic procedure that we use to determine the source of excessive friction. While the unit is online, smear a thin coat of Jack's Green Slime or equivalent lubricant on a significant portion of the plunger. Now run the unit and observe any changes. If the ride performance issue is eliminated, the friction source is likely originating from the seal. If the issue changes only marginally or not at all, then most likely the source is either the guide rings in the packing box or even an external source such as the rail guide system or the hydraulic valve.

**Condition of oil:** Inspect the hydraulic oil for signs of degradation such as discoloration, strong odors or contamination. Usually, a visual test is adequate to detect any problems with the oil that could affect the seal. For example, milky oil is evidence of water contamination while a significantly dark color is indication of degradation. Note that increased system temperatures accelerate degradation and can further decrease the lubricity that is critical in achieving optimal ride performance. If the oil has indications of degradation or contamination, it should be replaced, as this will significantly affect seal performance and longevity.

**Plunger Condition:** Finally before removing the packing components, thoroughly inspect the entire length of the plunger for scores or pits, bad joints, poor grind patterns, and discoloration.

## Packing Set Inspection

Now remove the packing set components from the cylinder head. Consult manufacturer's manual for the proper procedure and observe all safety procedures. When removing the components, mark their position relative to the plunger. This will aid later when determining the exact position of a defect on the plunger, if necessary. Remove the components carefully trying to preserve any wear marks or indications of failure. Refer to the "Seal Trouble-Shooting Guide" to quickly determine the probable cause of failure base on the visible condition of the seal component.

### SEAL TROUBLESHOOTING GUIDE

| VISIBLE SEAL CONDITION               | PROBABLE CAUSE  | POSSIBLE CURE  |
|--------------------------------------|---|--|
| Hardening of Seal /Brittle           | <ul style="list-style-type: none"> <li>Excessive fluid temperature</li> <li>Deterioration of fluid</li> </ul>                   | <ul style="list-style-type: none"> <li>Add coolers</li> <li>Use high-temp seal compound</li> <li>Renew fluid, use additives</li> </ul>   |
| Abnormal wear on lip on dynamic side | <ul style="list-style-type: none"> <li><b>Misalignment</b></li> <li>Worn wear ring</li> <li>Guide shoe misadjustment</li> </ul> | <ul style="list-style-type: none"> <li>Realign</li> <li>Install renewal parts</li> <li>Replace or adjust guide shoes</li> </ul>  |
| Rapid wear - even light scratches    | <ul style="list-style-type: none"> <li>Plunger or bore finish too rough</li> </ul>  | <ul style="list-style-type: none"> <li>Refinish plunger with <b>Sanding Sleeve</b></li> </ul>  |
| Heavy deep scratches on dynamic side | <ul style="list-style-type: none"> <li>Scars on plunger or bore</li> <li>Foreign material in fluid, metal chips</li> </ul>      | <ul style="list-style-type: none"> <li>Refinish plunger with <b>Sanding Sleeve</b></li> <li>Heavy scores use <b>Sure Fill Repair Kit</b></li> <li>Flush system completely</li> </ul>                                 |
| Extruded material on dynamic side    | <ul style="list-style-type: none"> <li>Gap between plunger and box too wide.</li> </ul>   | <ul style="list-style-type: none"> <li>Use back up ring</li> <li>Check alignment</li> </ul>  |
| Cut on seal                          | <ul style="list-style-type: none"> <li>Improper installation</li> <li>Sharp edges on machine box or plunger</li> </ul>          | <ul style="list-style-type: none"> <li>Use <b>Packing Replacement Kit</b></li> <li>Use liberal amount of <b>Jack's Green Slime</b> on parts and plunger or box</li> <li>Chamfer lead in on box or plunger</li> </ul> |

Be careful not to use any sharp metal objects like a screwdriver that can damage the plunger or stuffing box. Kits are available that contain special tools that allow easy packing removal without damaging the other hydraulic components. Also determine if there are any missing components in the packing box.

Examine all of the components from the packing box. Note any findings of the individual component such as:

- Deep scores or scratches
- Uniformity of the wear on sealing lip or wear surface
- Deformations of the components
- Hardening or discoloration of materials
- Cracks or missing portions of components

## Methods for Corrective Action

If needed, use the "Cause and Effect" chart, determine if there is a possible solution to help bring damaged equipment back to acceptable working condition.

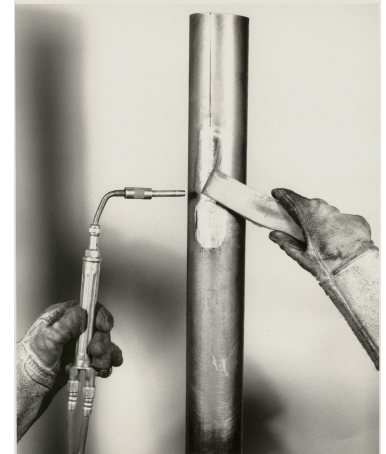
- Plunger Scores and Scratches: Raised scored areas must be dressed down flush to the plunger surface. Shallow scratches can be sanded down with sandpaper to minimize seal damage. Wrapping an old pair of nylon stockings or panty hose around the plunger is an excellent way to detect small burrs on the plunger when



U.S. Pat. #4,198,789

refinishing a plunger. It is important to maintain a true diameter without creating flat spots. We recommend using a Sanding Sleeve or other concentric sanding device that can uniformly refinish the entire plunger.

Deep scores should be filled to eliminate excessive seal leakage. Epoxy type fillers are generally temporary and should be avoided, as the oil pressure will pop out the repair over time. We recommend using the Sure-Fill repair kit that employs a solder-based filler that is permanent and will last the life of the plunger. The only other alternative for a deep scoring is to replace the plunger.



- Poor Plunger Finish: In the elevator industry, a plunger should not either be too smooth or too rough. If after several years of service, the plunger becomes glazed or polished to point of being very smooth, it must be refinished. Highly polished surfaces can cause ride performance problems due to the inability of the surface to carry any lubricating oil through the seal. Typically a very dry plunger is the result.

Rough plungers will usually carry an excessive amount of lubricating oil as well as dramatically decreasing seal service life. In either case, the plunger should be refinished to bring it back to the manufacturer's specs. Texacone's Sanding Sleeve will work perfectly in both of these situations to renew the plunger's surface finish to O.E.M. specs.

- Dimensional Variations: Plunger dimensions are the most common variation and can be

from over/under grinding, tapered grinding or from excessive grinding on a repair spot such as a joint. Sometimes a plunger is "hour-glassed" meaning that the plunger has several low spots over its length. Often, the Sure Fill Repair Kit can be utilized to fill a low spot to bring it to the original plunger dimension.

Packing box dimensions are harder to measure but fortunately do not typically have dimensional problems. The box will have to be removed to take accurate readings. Once again, there is dimensional information available for most manufacturers. It is rare, but if a box is out of spec, it may have to be replaced.

- Under/Over-sized Plungers: If a plunger is suspected of being an incorrect dimension over the entire length, take several measurements with a diameter tape. There is dimensional information available for most OEM's and it can be determined if the plunger is out of tolerance. There are special seals available that can be used in most cases.

- Mismatched Plunger Joint: If a joint has a mismatch between two sections, it must be redressed so that there is a smooth transition from one section to another. Texacone's Sanding Sleeve can be used to smooth the joint while the Sure-Fill Repair Kit is used to fill low spots around the joint particularly if there is any grinding involved.

- Cylinder Misalignment: Incorrect alignment can cause both leakage and friction. In order to obtain optimal seal performance, alignment must be within spec. All kinds of "spider bobs" have been used to help accomplish this. We recommend using an aligning system that will quickly and accurately align cylinders consistently. Selecting a seal that has a wider sealing

range can also be a solution to this problem. Check with Texacone for recommendations.

- Temperature extremes: Very low temperatures can cause abnormal leakage while high temperatures (above 140° F) can cause seal friction and short seal life. Note that the temperature measured in the oil tank is typically lower than the temperature measured near the seal where there is dynamic movement. Oil heaters and coolers should be employed to maintain temperatures. Specific seal materials can also be chosen to handle these extremes such as Viton, Hydrogenated Nitrile or the newer premium grades of urethanes like what is found in the Texacone 900 series seal, which performs up to 300° F.

- Oil Degradation / Contamination: Replacement is often the most effective way to correct contaminated or deteriorated oil. When replacing the oil, use a filter element with a minimum rating of 10 microns. Also be sure that the entire system is filtered including the cylinder. In addition to replacement, it is also important to determine the root cause of the deterioration whether from temperature extremes or from foreign debris induction. To help improve the existing oil, additives are available for example to add lubricity to the oil to help reduce ride performance problems. Be sure that these additives are completely compatible with **ALL** of the sealing components in the system including the valve system.

- Incorrect Parts: After the sealing set components are removed from the stuffing box, compare them to the new replacement set. Be sure that you have all of the components necessary to replace the entire set. Also confirm that the part numbers and given dimensions match the unit's requirements. Consult Texacone's catalog and field handbook for a list of all of the correct parts and seal set part numbers that are necessary for specific North American units.

| CAUSE                        | EFFECT  |          | SOLUTION              |
|------------------------------|---------|----------|-----------------------|
|                              | LEAKAGE | FRICTION |                       |
| Plunger Scores and Scratches | √       |          | Sand; Fill            |
| Poor Plunger Finish          |         | √        | Refinish              |
| Dimensional Variations       | √       | √        | Fill low spots        |
| Under/Over-sized Plungers    |         |          | Special seal          |
| Mismatched Plunger Joint     | √       | √        | Smooth; Fill          |
| Cylinder Misalignment        | √       | √        | Realign               |
| Low Temperatue               | √       |          | Heaters               |
| High Temperature             |         | √        | Coolers; Special seal |
| Oil Degredation              |         | √        | Additive; Replace     |
| Oil Contamination            | √       |          | Filter; Replace       |
| Incorrect Parts              | √       | √        | Use Complete Set      |

## Repacking:

If the cylinder unit is in good repair and set up according to spec, it is now time to install the packing set. The packing box must be very clean and completely void of any burrs. Remove any sharp edges on the box that may damage the seal components upon installation. Clean all grooves and bores thoroughly before installing new seals and components. In the case of split wear bands grooves, this is very critical as any debris in the grooves will decrease clearances and cause ride performance problems. Also inspect the top of plunger for a lead-in chamfer. This chamfer must be present in order not to damage the seal when placed over the plunger.

There are two types of packing sets available for hydraulic cylinders. The compression type (Vee or Chevron) must be compressed by a

gland for proper operation. The floating type should not be compressed and should have a minimum of a 1/32" space in the box for floating. Floating sets that are compressed can result in either excessive leakage or friction.

Confirm that the type of packing set that you have matches that type required for the unit. Also confirm that when the set components are installed, that there is ample compression or space depending on which is required by the set type. Occasionally, in the case of compression packing sets, shims are required to provide enough compression for sealing. It is important to install the component pieces in the correct sequence as packaged or as shown in the catalog. For example, there should always be a lantern between 2 seals.

Other notes and tips concerning repacking are:

- When repacking a hydraulic unit, always order a complete seal set. Until out in the field when the seal components have been removed and inspected, it is uncertain to know which parts are in need of replacement.
- When installing a new seal set, always use a premium lubricant like Jack's green slime that is provided with all packing sets. This will help prevent damage to the components upon installation as well as provide break-in lubrication for the seal.
- When installing new set components, never use sharp objects that can damage the components or the machined surfaces. Use the proper tools like found in packing replacement/installation kits.
- Always save seal set components on units that have seal performance issues. Texacone can lab test the components to help determine the cause of a chronic sealing problem.

- Be sure to document the information about the installed seal set for future repacks. Use the supplied label that is attached to Texacone packaging that provides all of the necessary information to insure that you will receive the correct seal set for the next time a repack is needed.

We hope that this overview has and will be helpful to you in the future. While there are a myriad of exceptions to the above, we tried to keep the article simple and straightforward. Feel free to copy the "Repack Checklist" and use it as a guide during your next repack. Also if desired, please contact us for more information about this article or any other packing and seal related questions.

*Wallace T. Wheeler is a degreed engineer from Southern Methodist University. He has been involved in seal research, design and manufacturing for the Texacone Company since 1984.*

# HYDRAULIC ELEVATOR REPACK CHECKLIST

Date: \_\_\_\_\_ Job: \_\_\_\_\_ Technician: \_\_\_\_\_

## Documentation Collection:

- Plunger size** \_\_\_\_\_
- Manufacturer of Cylinder** \_\_\_\_\_
- Configuration (Roped, telescopic, etc...)** \_\_\_\_\_
- Date of Installation \_\_\_\_\_
- Modifications \_\_\_\_\_
- Previous Performance Problems \_\_\_\_\_
- Type of Packing Previously Installed \_\_\_\_\_
- Date of last repack \_\_\_\_\_

## Unit Inspection:

- Leakage \_\_\_\_\_
- Ride Performance \_\_\_\_\_
- Condition of Oil (color, contamination) \_\_\_\_\_
- Plunger Condition \_\_\_\_\_

## Packing Set Inspection:

- Deep heavy wear marks \_\_\_\_\_
- Uniformity of wear marks \_\_\_\_\_
- Deformation, Hardening, Cracks \_\_\_\_\_

## Repack:

- Remove sharp edges, burrs
- Clean grooves
- Check lead-in Chamfers
- Install complete set
- Use lubricant
- Save used components for analysis
- Document for next repack



"Packing Pete"

# TEXACONE