



PENBERTHY SERIES U FLAT GLASS GAGES
 INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

Before installation these instructions must be read fully and understood

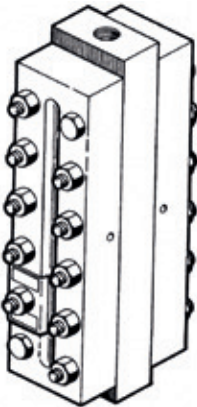


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Product warranty

Emerson warrants its Penberthy products as designed and manufactured to be free of defects in the material and workmanship for a period of one year after the date of installation or eighteen months after the date of manufacture, whichever is earliest. Emerson will, at its option, replace or repair any products which fail during the warranty period due to defective material or workmanship.

Prior to submitting any claim for warranty service, the owner must submit proof of purchase to Emerson and obtain written authorization to return the product. Thereafter, the product shall be returned to Emerson with freight paid.

This warranty shall not apply if the product has been disassembled, tampered with, repaired or otherwise altered outside of Emerson's factory, or if it has been subject to misuse, neglect or accident.

The responsibility of Emerson hereunder is limited to repairing or replacing the product at its expense. Emerson shall not be liable for loss, damage or expenses related directly or indirectly to the installation or use of its products, or from any other cause or for consequential damages. It is expressly understood that Emerson is not responsible for damage or injury caused to other products, buildings, personnel or property, by reason of the installation or use of its products.

This is Emerson's sole warranty and in lieu of all other warranties, expressed or implied which are hereby excluded, including in particular all warranties of merchantability or fitness for a particular purpose.

This document and the warranty contained herein may not be modified and no other warranty, expressed or implied, shall be made by or on behalf of Emerson unless made in writing and signed by the company's general manager or director of engineering.

1 ABOUT THE MANUAL

This manual has been prepared as an aid and guide for personnel involved in installation or maintenance. All instructions must be read and understood thoroughly before attempting any installation, operation or maintenance.

SAFETY INSTRUCTIONS

Emerson does not have any control over the manner in which its gage is handled, installed or used and Emerson cannot and does not warrant or guarantee that a gage is suitable for or compatible with the user's specific application.

WARNING

Contained fluids may be pressurized and can exit vessel connections unexpectedly due to apparatus or material failure. Safety glasses should be worn when installing a liquid level gage. Failure to follow instructions could result in serious physical injury or property damage.

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2 INTRODUCTION

Penberthy liquid level gages are used to allow direct visualization of liquid level in vessels. By peering through the glass, it is possible to monitor color, clarity and level of a gas/liquid interface. Gages are available in varying lengths and configurations (end connect, side connect, multiple sections, NPT or flange connections, etc.). Visual indication can be enhanced by using illuminators (accessory). The design of Penberthy Series U liquid level gages is such that the gage covers are bolted directly to the liquid chamber with solid metal-to-metal contact. All clamping forces are withstood by the steel components of the gage, thereby relieving stress concentrations on the gage glass.

2.1 System description

Penberthy gages comprise six basic components. Each component may vary slightly, depending on the desired physical and mechanical properties for the gage. Use the exploded parts view in Section 11 as additional reference material.

Chamber: provides a pressure retaining metallic channel for the liquid to enter and be viewed. Slot(s) are machined into the chamber to provide direct visualization of the process fluid.

Gaskets: seal the gap and prevent leakage between the chamber and the glass. Gaskets are available in a variety of materials for compatibility with the media in the gage.

Glass: allows for visual observation of the process fluid in the chamber.

Cushion: acts as a protective buffer between the glass and the cover.

Cover: protects the glass assembly from external hits and provides a flat, rigid surface that is used to compress the gage assembly evenly.

Bolting: compresses the chamber between the covers.

3 AVAILABLE MODELS

Penberthy ultra high pressure (Series U) liquid level gages are designed for applications other than steam/water, requiring a pressure rating higher than that of Penberthy Series H liquid level gages.

3.1 Design ratings at maximum and minimum operating temperatures

TABLE 1

Gasket material	Glass size	Model TU transparent
		Wetted parts material steel or stainless steel w/B7 bolting
Buna-N (NBR) w/302 STS retainer (standard)	1, 3, 4, 5, 7	6000 psig (41370 kPa) at -20°F (-29°C) to 250°F (121°C)
FKM (Viton®) w/302 STS retainer	1, 3, 4, 5, 7	6000 psig (41370 kPa) at -20°F (-29°C) to 400°F (204°C)
PTFE (Teflon®) (special chamber required)	1, 3, 4, 5, 7	6000 psig (41370 kPa) at -20°F (-29°C) to 500°F (260°C)

NOTE

Lower temperatures are possible with metallic material variation. [e.g., 316 stainless construction, PTFE (Teflon®) gaskets/cushions usable to -325°F (-198°C)].

To determine the maximum allowable working pressure for a specific temperature within the design limits stated in the table, the user should refer to applicable technical data sheets or, when provided, the specifically stated design limits on a product proposal.

WARNING

NEVER exceed these design ratings or application data. Exceeding design ratings or application data may result in mechanical failure of gage components resulting in death, serious personal injury and property damage.

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4 INSPECTION

On receipt of a liquid level gage, check all components carefully for damage incurred in shipping. If damage is evident or suspected, do not attempt installation. Notify the carrier immediately and request a damage inspection. Penberthy standard 1 section TU gage consists of: (1) chamber, (2) gaskets, (2) borosilicate flat glass, (2) rubber bands, (2) cushions, (2) covers, (1) washer, (1) nameplate and (6-12) bolting sets, depending on the size.

4.1 Glass inspection

The self stick caution tape was applied at the factory to protect the glass during shipping, handling and installation. Do not remove the tape from the glass until all installation procedures have been completed, except during receiving inspection to inspect glass for shipping damage momentarily. Glass that is not protected will be vulnerable to dust, grit, tools and any other objects which may scratch, chip or break the glass.

WARNING

DO NOT use glass that is chipped or even slightly scratched. Glass surface defects weaken the glass, which may result in glass breakage and fluid loss under pressure resulting in serious personal injury and property damage.

4.2 User's rating inspection

The user should confirm that:

1. The Series U liquid level gage model and assembly number stamped on the nameplate conform to the description on the user's purchase order.
2. The operating conditions described in the purchase order agree with the actual operating conditions at the installation site.
3. The actual operating conditions at the installation site are within the application data shown on the relevant technical data sheet or product proposal referred to above.
4. The materials of construction of the liquid level gage are compatible with both the contained media and surrounding atmosphere in the specific application.

SAFETY INSTRUCTIONS

If the size, model or performance data of the liquid level gage as received do not conform with any of the criteria above, do not proceed with installation. Contact an authorized Penberthy distributor for assistance. The incorrect gage can result in unacceptable performance and potential damage to the gage.

5 INSTALLATION

Installation should only be undertaken by qualified, experienced personnel who are familiar with equipment of this type. They should have read and understood all of the instructions in this manual. The user should refer to applicable technical data sheets or the product proposal to obtain dimensional information for the specific size and model of liquid level gage.

All liquid level gage installations should be provided with gagecock sets equipped with a ball check shut-off. Gagecock sets are designed to isolate the gages from the pressure vessel when it becomes necessary to drain or service the gages. The ball check shut-off is designed to retard leakage of the contained fluid in the event of gage glass breakage. Ball checks are available for both positive and negative vessel pressures.

The number of different types of gage and gagecock installations is too great to adequately detail in an installation manual. Therefore, it is the user's responsibility to assure that the knowledgeable installation personnel plan and carry out the installation in a safe manner. The following procedures are some of the installation guidelines that should be employed:

5.1 Piping strain

The gage should be mounted and connected so that it does not support any piping weight. Piping not properly supported, independent of the gage, may subject the gage to stresses that can cause leaks or glass breakage. Support brackets are available as an accessory.

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5.2 Differential thermal expansion

High mechanical loads may be imposed on a gage by expanding and contracting pipes due to hot or cold service. Such mechanical loads on the gage must be minimized by the use of expansion loops in the system. Failure to allow for expansion or contraction can result in leaks or glass breakage.

5.3 Mirror viewing

For added safety, a system of indirect viewing by means of mirrors should be installed to protect personnel from the hazards of possible gage failure.

5.4 Nut retorquing

Nut retorque is vital to the operation of a liquid level gage because gaskets take permanent set under initial bolt loading at assembly. Tightening of nuts before installation to values specified in Table 2 is necessary to insure pressure retaining capabilities of a liquid level gage to specific design ratings. The user must refer to the liquid level gage model and assembly number and to the purchase order or tag to determine materials of construction.

SAFETY INSTRUCTIONS

Before placing liquid level gage into initial operation, torque values must be verified. From factory testing to installation, gasketing may take 'set' reducing closure force. Retorquing before operation reduces the chance of leakage or gasket 'blow out'.

Using a torque wrench, tighten cap screws and nuts in 5 ft·lb (7 Nm) increments following the 'Z' pattern sequence in Figure 1, until the torque values shown in Table 2 for the specific liquid level gage are reached. For multiple section gages, torque the center section(s) and progressively work toward the ends of the gage. If bolting, gasketing or glass on any repaired section of a multi-section gage is disturbed, all sections must be checked for integrity and retorqued as necessary.

WARNING

Failure to comply with the proper torquing sequence or force value can lead to leakage, gasket blow-out or glass breakage resulting in gage failure, serious personal injury or property damage.

Note: depending on gage size there may be less bolting than shown in Figure 1. Start at the center and follow 'Z' pattern outward to the limit of bolting on a specific gage.

6 OPERATION

Before initializing liquid level gage operation, check that all installation procedures have been completed. Use only qualified, experienced personnel who are familiar with liquid level gage equipment and thoroughly understand the implications of the tables and all the instructions. Check to determine that all connections are pressure tight. Assure that nuts have been retorqued to their proper values as specified in Table 2. Remove self stick caution tape from the glass and inspect to be sure that glass is clean and free of any damage such as cracks, scratches, pits and chips.

6.1 Hydrostatic test

DANGER

Liquid level gage installations should be brought into service slowly to avoid excessive shock or stress on the glass. Rapid pressurization or sudden changes in temperature may cause glass breakage. To avoid excessive thermal shock or mechanical stress on glass, the connecting gagecocks should be opened slightly and the gage temperature and pressure allowed to equalize slowly. If the gagecocks are equipped with ball checks, the gagecocks must be opened all the way after the pressure and temperature have equalized to permit operation of the automatic ball checks in the event of failure. Failure to follow the recommended operating procedures can result in death, severe personal injury and/or property damage.

Take all precautions necessary to handle the possibility of leakage during the test. Hydrostatically pressure test all installations to at least 100 psig (690 kPa) but less than the design pressure and correct any leakage before proceeding.

FIGURE 1
Nut tightening sequence

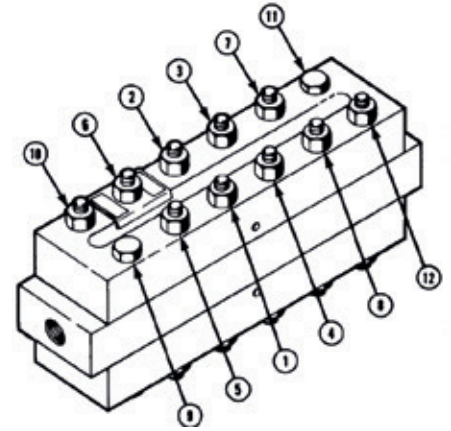


TABLE 2 - BOLT TORQUE VALUES

Gasket material	ft·lb (Nm)
NBR (Buna-N) w/302 STS retainer (standard)	60 to 65 (81 to 88)
FKM (Viton®) w/302 STS retainer (optional)	
PTFE (Teflon®) (optional)	

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7 MAINTENANCE

WARNING

Use only qualified, experienced personnel who are familiar with liquid level gage equipment and thoroughly understand the implications of the tables and all the instructions. DO NOT proceed with any maintenance unless the liquid level gage has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature and has been drained or purged of all fluids. Failure to follow instructions can cause serious personal injury and property damage.

The rate at which components degrade is dependent upon a variety of conditions. Pressure, temperature and process media all influence the rate at which gage components deteriorate. Higher temperatures can accelerate the deterioration of gaskets, cushions, glass and metals. Acids and similar chemicals can break down the integrity of almost any material. Concentration of chemicals can accelerate the corrosion rate. Emerson cannot create a blanket maintenance schedule for every application.

The end user is the most familiar with the process media and conditions and must be responsible for creating a maintenance schedule. The user must create maintenance schedules, safety manuals and inspection details for each liquid level gage. Realistic maintenance schedules can only be determined with full knowledge of the services and application situations involved. These will be based upon the user's own operating experience with their specific application. If bolting, gasketing or glass on any section of a multi-section gage is disturbed, all sections must be checked for integrity and retorqued or repaired as necessary.

On all installations the following items should be evaluated regularly by the user for purposes of maintenance:

1. Glass, for cleanliness and signs of damage or wear.
2. Gage, for signs of leakage around gaskets or at connections.
3. Gage, for signs of internal or external corrosion.

7.1 Maintenance procedures

Glass should be given regular and careful attention. Keep glass clean using a commercial glass cleaner and a soft cloth. Inspect the surface of the glass for any clouding, etching or scratching or physical damage such as bruises, checks or corrosion. Glass that is damaged is weakened and may break under pressure.

Shining a light at approximately a 45° angle will aid in detecting some of these conditions. Typically, damaged areas will glisten more brightly than the surrounding glass because the light is reflected.

Detection of any damage, problem areas or surface wear is sufficient evidence to take the liquid level gage out of service. DO NOT proceed with operation of the liquid level gage until the glass has been replaced with a glass replacement kit following the disassembly - reassembly instructions in Section 8.

Gasket leaks must be repaired immediately. DO NOT proceed with operation of a liquid level gage until gaskets have been replaced by following Section 8 disassembly-reassembly instructions.

Connection leaks at a flanged or threaded connection should be corrected by tightening the bolting at the connection or by taking the liquid level gage out of service and wrapping the connection threads with PTFE tape on all male pipe threads.

Corrosion may occur if the user has selected an improper material for the liquid level gage application. It is the responsibility of the user to choose a material of construction compatible with both the contained fluid and the surrounding environment. If internal or external corrosion is present, an investigation must be performed immediately by the user. It may be necessary to contact an authorized Penberthy distributor to better determine the origin of the corrosion.

7.2 Troubleshooting

Problem: Glass becomes etched prematurely or clouded in service.

Cause: Fluid being handled is not compatible with the glass.

Solution: Check application to determine actual operating conditions and contact an authorized Penberthy distributor on how to proceed.

Problem: Glass breaks in service continually despite careful attention to maintenance procedures.

Cause: Thermal shock, hydraulic shock, mechanical loads, exceeding design ratings or a combination of these.

Solution: Check entire system to determine possible sources of loads. Check application to determine actual operating conditions and contact an authorized Penberthy distributor on how to proceed.

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8 REMOVAL - DISASSEMBLY - REASSEMBLY

WARNING

Use only qualified, experienced personnel who are familiar with liquid level gage equipment and thoroughly understand the implications of the tables and all the instructions. DO NOT proceed with any maintenance unless the liquid level gage has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature and has been drained or purged of all fluids. Failure to follow instructions can cause serious personal injury and property damage.

8.1 Disassembly

Secure a workbench longer than the liquid level gage, and sufficiently wide to lay out parts as they are removed.

1. Hold gage firmly; loosen cap screws and nuts starting at both ends of each section and then proceed from both ends to the center of each section as shown in Figure 2. **Note:** if maintenance is to be performed on one (1) side of the gage only, the cap screws on the opposite side of the gage do not need to be removed. If these screws are removed, then all glass, gaskets and cushions on both sides of the gage must be destroyed, disposed of and replaced.

2. Nut loosening sequence

- Remove nuts, cap screws, washer and nameplate.
- Tap covers with rubber hammer as needed to loosen and remove.
- Remove cushions, glass and gaskets.
- Tap liquid chamber or remaining covers as necessary with rubber hammer to break loose and remove remaining components.
- Remove, destroy and dispose of all glass, cushions and gaskets. Under no circumstances should these components be re-used or installed on a gage.

Note: if size of gage is smaller than shown, follow spiraling sequence from the ends until all bolting is loosened.

WARNING

Once used, cushions and gaskets are deformed permanently by compression and, if re-used, may cause leaks and high stress points resulting in glass breakage. Glass may contain hidden damage and internal stresses caused by previous usage. If re-used, the glass may break under pressure causing severe personal injury or property damage.

8.2 Inspection of glass seating surfaces

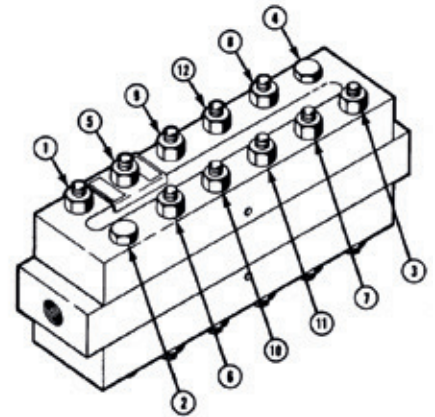
Clean the glass seating surfaces on the liquid chamber and cover with a soft metal scraper (preferably brass) to remove all burrs, rust and remnants of the previous gaskets and cushions. Exercise extreme care to avoid gouging or scarring gasket and cushion seating surfaces. Use a known flat piece of metal the same approximate length as the glass or a new piece of glass and a thickness gage to check flatness of each glass seating surface on liquid chamber and under cover. Surfaces on the liquid chamber must be flat within 0.001 inch (0.03 mm) and on the cover must be flat within 0.002 inch (0.05 mm). If any one surface is found to be beyond the tolerances described above, the entire gage must be disposed of and replaced.

WARNING

Flatness of glass seating surfaces outside the tolerances specified above is an indication of the gage having been overstressed through repeated exposure to mechanical, thermal or hydraulic shock during its previous service. Operation of a liquid level gage which has been overstressed will result in abnormal stresses on the glass which may cause glass to break with resulting sudden release of pressure, leakage of contained fluid, serious personal injury or property damage.

Glass seating surfaces should NOT be machined to achieve seating tolerance. The chamber and cover are designed for a critical thickness to achieve the pressure/temperature ratings. Machining glass seating surfaces may result in non-compliance to the necessary critical thickness due to material removal.

FIGURE 2
Nut loosening sequence



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8.3 Reassembly

If all glass seating surfaces are found to be within the tolerances described in the previous section, proceed to obtain new glass, gaskets and cushions, and proceed to reassemble as follows (refer to exploded parts view in Section 11 if needed):

1. Clean threads on cap screws, studs and nuts to remove all paint, rust and scale. Apply a light coat of oil to the threads.
2. Lay chamber flat on bench with gasket slots facing up. Lay out covers along the bench, side by side, with the liquid chamber. Use chamber to space covers and line them up with vision slots.
3. Install gasket in place on liquid chamber. When using a gasket with a retainer, the gasket should be installed with the retainer side away from the chamber.

WARNING

Separate installation instructions are supplied with replacement glass. All instructions supplied with the glass must be followed, as there are precautions to be taken when handling gage glass. Among the precautions is avoidance of bumping or sliding glass against any surface and inspection of individual pieces. Failure to follow any of the replacement gage glass installation instructions could result in glass breakage with resulting sudden release of pressure, severe personal injury or property damage.

4. Install rubber band around glass, then place glass centered on gasket.
5. Install cushion centered on glass.
6. Install cover in place being careful to maintain components alignment inside.
7. Secure the cover to the liquid chamber with the corner cap screws. The cap screws should only be snugged down enough to maintain the cover positioning.
8. If the gage is a multiple section, complete the gasket, glass, cushion and cover assembly for the remaining sections per instructions 3 through 7 above.
9. Rotate the liquid chamber 180° on the bench so as to expose the glass pocket on the opposite side of the liquid chamber.
10. Install the gasket, glass, cushion and cover for each section per instructions 3 through 7 above.
11. Turn the gage on its side on the bench. Install the nuts on one end of the studs and insert studs into all remaining holes in the covers for each section.

12. Install nameplate, washer and nuts to studs on the opposite side of the gage. Tighten nuts with fingers. Using a torque wrench, tighten cap screws and nuts in 5 ft-lb (7 Nm) increments, following the sequence in Figure 1 until the torque values shown in Table 2 are reached.

Note: depending on gage size there may be less bolting than shown in Figure 1. Start at the center and follow 'Z' pattern outward to the limit of bolting on a specific gage. Refer to Section 5 for installation and Section 6 for operation of liquid level gage when returning to service.

9 DISPOSAL AT END OF USEFUL LIFE

Penberthy gages are used in a variety of fluid applications. By following the appropriate federal and industry regulations, the user must determine the extent of preparation and treatment the gage must incur before its disposal. A Material Safety Data Sheet (MSDS) may be required before disposal services accept certain components. Metal, glass and polymers should be recycled whenever possible. Refer to order and applicable technical data sheets for materials of construction.

10 TELEPHONE ASSISTANCE

If you are having difficulty with your liquid level gage, contact your local Penberthy distributor. You may also contact the factory direct at (956) 430-2500 and ask for an applications engineer. So that we may assist you more effectively, please have as much of the following information available as possible when you call:

- Model #
- Name of the company from whom you purchased the liquid level gage
- Invoice # and date
- Process conditions (pressure, flow rates, tank shape, etc)
- A brief description of the problem
- Trouble shooting procedures that failed

If attempts to solve your problem fail, you may request to return your gage to the factory for intensive testing. You must obtain a Return Authorization (R.A.) number from Emerson before returning anything. Failure to do so will result in the unit being returned to you without being tested, freight collect.

To obtain an R.A. number, the following information (in addition to that above) is needed:

- Reason for return
- Person to contact at your company
- 'Ship-to' address

There is a minimum charge for evaluation of non-warranty units. You will be contacted before any repairs are initiated should the cost exceed the minimum charge. If you return a unit under warranty, but it is not defective, the minimum charge will apply.

NOTE

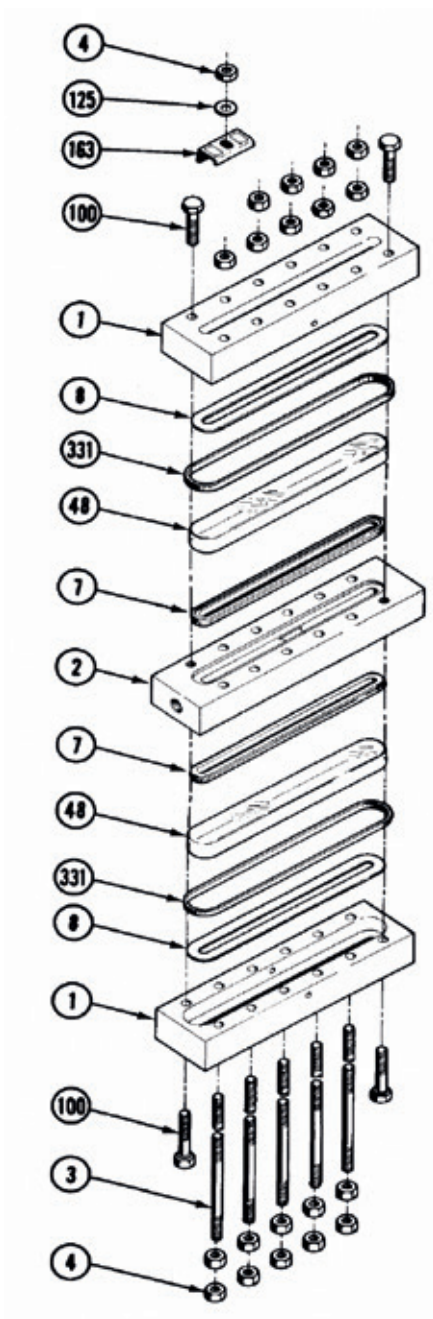
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11 EXPLODED PARTS DIAGRAM

FIGURE 3
U Transparent



PARTS LIST

Item	Description
1	Cover
2	Chamber
3	Stud
4	Nut
7	Gasket
8	Cushion
48	Glass
100	Screw
125	Washer
163	Nameplate
331	Band

RECOMMENDED SPARE PARTS

Item	Description	Min. qty.
3	Stud	2 per sect.
4	Nut	2 per sect.
48	Glass	1
100	Screw	1 per sect.
7	Gasket	2
8	Cushion	2

NOTE

Size 7 shown - actual gage may be shorter and require fewer bolting components.