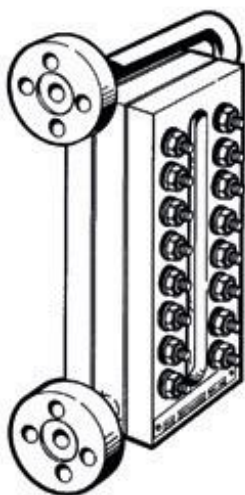


PENBERTHY SERIES TSL AND TSM STEAM WATER GAGES

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

Before installation, these instructions must be carefully read and understood.



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This is Penberthy'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 or 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 Penberthy unless made in writing and signed by the company's general manager or director of engineering.

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Product warranty

Penberthy products are 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. Penberthy 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 Penberthy and obtain written authorization to return the product. Thereafter, the product shall be returned to Penberthy, with freight paid.

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

The responsibility of Penberthy hereunder is limited to repairing or replacing the product at its expense. Penberthy 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 Penberthy 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.

PENBERTHY®

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PENBERTHY SERIES TSL AND TSM STEAM WATER GAGES

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

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

Penberthy does not have any control over the manner in which its gage is handled, installed or used. Penberthy cannot and will 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.

2 INTRODUCTION

Penberthy steam/water gages are used to allow direct visualization of liquid level in vessels, typically boiler drums. By peering through the glass, it is possible to monitor the level of the boiler water or condensate. Gages are available in varying lengths and configurations (end connect with stuffing box nipples and flanged side connect). Visual indication can be enhanced by using an illuminator (accessory).

2.1 System description

Penberthy Series TSL and TSM gages comprise eight basic components. Each component may vary slightly, depending on the desired physical and mechanical properties for the gage. Use the exploded parts views 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 liquid level.

Gaskets: seal the gap and prevent leakage between the chamber and the glass. Gaskets are available in graphite with 316 STS insert (as standard).

Mica shields: used to protect the glass from direct exposure to steam. Mica shields prolong the life of glass in steam/water use.

Glass: allows for visual observation of the process fluid in the chamber. Glass is only available in the transparent style because shields are used.

Cushion: acts as a protective buffer between the glass and the cover. For proper sealing, cushions must be as hard or harder than the gasket material.

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

Belleville washers: conical washers used to distribute bolt compression uniformly over the length of the cover and allow thermal expansion without increasing bolting stress.

Bolting: compresses the components between the covers and chamber.

3 AVAILABLE MODELS

Penberthy series TSL, TSL-F and TSM-F liquid level gages are designed specifically for steam/water and heat transfer fluid applications. These gages are designed to be applied where the gage experiences dynamic thermal cycling.

PENBERTHY SERIES TSL AND TSM STEAM WATER GAGES

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

3.1 Design ratings at maximum operating pressures

TABLE 1

Gage model	Maximum pressure at saturation
TSL and TSL-F	650 psig [4480 kPa] at 497°F (258°C)
TSM and TSM-F	1500 psig [10340 kPa] at 596°F (313°C)

NOTE

Temperature ratings follow saturated steam curve.

The maximum pressure and temperature ratings may deviate from the table above if the materials of construction are other than carbon steel. The rating will follow the saturated steam curve.

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.

DANGER

Excessive mechanical and thermal stress can cause failure in the gage's structural integrity. Under no circumstances should these design ratings or application data exceeded. Exceeding design ratings or application data may result in mechanical failure of gage components resulting in death, serious personal injury and property damage.

4 INSPECTION

On receipt of a steam/water 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. A standard 1 section TSL and TSL-F gage consists of: (1) chamber, (2) gaskets, (2) Mica shields, (2) borosilicate flat glass, (2) rubber bands, (2) cushions, (2) covers, (24-28) nuts and Belleville washers, (1) nameplate and (12-14) studs, depending on size.

A standard 1 section TSM and TSM-F gage consists of: (1) chamber, (2) gaskets, (2) Mica shields, (2) borosilicate flat glass, (2) rubber bands, (2) cushions, (2) covers, (24-32) nuts, (72-96) Belleville washers, (1) nameplate and (12-16) studs, depending on 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 momentarily for shipping damage. 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 or property damage.

4.2 User rating inspection

The user should confirm that:

1. The steam/water liquid level gage model and assembly number stamped on the nameplate conforms 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 previously.
4. The materials of construction of the gage are compatible with both the contained media and the surrounding atmosphere in the specific application.

SAFETY INSTRUCTIONS

If the size, model or performance data of the liquid level gage as received does 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.

PENBERTHY SERIES TSL AND TSM STEAM WATER GAGES

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

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 relevant technical data sheets or product proposal to obtain dimensional information for the specific size and model steam/water gage.

All liquid level gage installations should be provided with isolation gagecocks. Gagecock sets are designed to isolate the gages from the pressure vessel when it becomes necessary to drain or service the gages. ASME guidelines suggest OS&Y gagecocks with ball checks omitted or gagecocks with vertically rising ball check in the lower gagecock and a leaky seat upper gagecock. The ball check shut-off is designed to retard leakage of the contained fluid in the event of gage glass breakage.

The number of different types of steam/water gage and gagecock installations is too great to detail adequately in an installation manual. Therefore, it is the user's responsibility to ensure that 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 supported properly, independent of the gage, may subject the gage to stresses that can cause leaks or glass breakage. Support brackets are available as an accessory.

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 Weight and vibration

Gages over 100 pounds (45 kg) in weight or 4 feet (1.4 meters) in length should be supported with brackets: 1) to avoid imposing high mechanical loads on the connecting gagecocks and piping and 2) to prevent damage from vibration. Improper supporting of gages can cause leaks or glass breakage.

5.4 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.

5.5 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 ensure 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 a 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 chance of leakage or gasket 'blow out'.

Do not hot torque these gages!

FIGURE 1
Nut tightening sequence

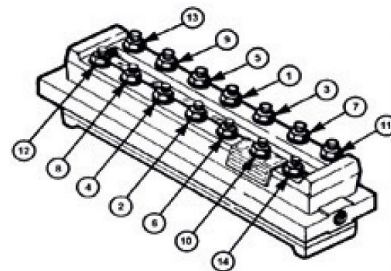


TABLE 2 - BOLT TORQUE VALUES

Gage models and gasket material	ft·lb (Nm)
TSL and TSL-F w/Grafoil® (standard)	20 to 25 (27 to 34)
TSL and TSL-F w/non-asbestos (optional)	
TSM and TSM-F w/Grafoil® (standard)	25 to 30 (34 to 41)
TSM and TSM-F w/non-asbestos (optional)	

NOTE

Grafoil® is a registered trademark of GrafTech.

PENBERTHY SERIES TSL AND TSM STEAM WATER GAGES

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

5.6 Belleville washers

Belleville washers are used to reduce or eliminate the need to retorque nuts. This is especially important for gages subject to pressure and/or thermal cycling. The conical washers allow for material expansion and contraction while maintaining axial bolt loading and, therefore, compression on the gasket. Model TSL and TSL-F gages require 1 washer per nut; model TSM and TSM-F gages require 3 washers per nut. Washers should be assembled with cupped side facing the gage cover.

Refer to Figure 2 for proper washer assembly.

Note: the following procedure is to be done on only one side of the gage.

Using a torque wrench, tighten nuts in 5 ft.lb (7Nm) increments following the 'Z' pattern sequence in Figure 1, until the torque values shown in Table 2 for the specific steam/water gage are reached.

If bolting, gasketing or glass on any 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 for glass breakage resulting in gage failure, serious personal injury or property damage.

Do not hot torque these gages!

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 understand the implications of the tables and all the instructions thoroughly. Check to determine that all connections are pressure tight. Ensure 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 gage. 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.

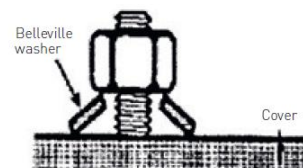
Take all precautions necessary to handle the possibility of leakage during the test. Hydrostatically pressure test all installations to at least 100 psig (690 kPa) but less than the design pressure and correct any leakage before proceeding.

7 MAINTENANCE

DANGER

Use only qualified, experienced personnel who are familiar with liquid level gage equipment and thoroughly understand the implications of 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.

FIGURE 2
Belleville washer position



PENBERTHY SERIES TSL AND TSM STEAM WATER GAGES

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

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. Shields, for signs of clouding, wear or deterioration.
3. Gage, for signs of leakage around gaskets or at connections.
4. 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.

Shields showing any signs of clouding, wear or deterioration are an indication that the gage glass has been exposed, or could soon be exposed to the contained fluid. Take liquid level gage out of service immediately.

DO NOT proceed with operation of the liquid level gage until shields and glass have been replaced by 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 and 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 or shields.

Solutions: Replace the glass and install shields which will not be affected by contained fluid.

Problem: Glass breaks repeatedly in service 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.

PENBERTHY SERIES TSL AND TSM STEAM WATER GAGES

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

8 REMOVAL – DISASSEMBLY – REASSEMBLY

WARNING

Unexpected bursts of pressurized fluid may occur. Use only qualified, experienced personnel who are familiar with steam/water gage equipment and thoroughly understand the implications of the tables and all the instructions thoroughly. DO NOT proceed with any maintenance unless the steam/water 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 do so 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. Lay gage on bench.
2. Hold gage firmly; loosen nuts starting at both ends of each section and then proceeding from both ends to the center of each section as shown in Figure 3.
3. Nut loosening sequence.
 1. Remove nuts, Belleville washers and nameplate
 2. Tap covers with rubber hammer as needed to loosen and remove.
 3. For Belleville washer assemblies: to remove covers, studs may need to be removed by laying the assembly on its side and knocking the studs through the cover with a hammer and punch.
 4. Remove cushions, glass, shields and gaskets.
 5. Tap liquid chamber or remaining covers as necessary with rubber hammer to break loose and remove remaining components.
 6. Remove, destroy and dispose of all glass, cushions, gaskets and shields. 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, gaskets and shields 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

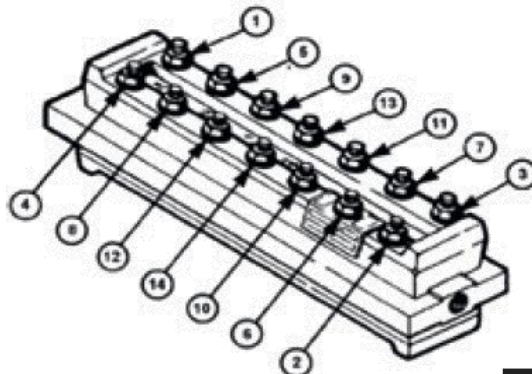
Clean the glass seating surfaces on the liquid chamber and cover with a small metal scraper (preferably brass) to remove all burrs, rust and remnants of the previous gaskets and cushions. Exercise extreme care to avoid gouging or scarring gasket and cushion seating surfaces. Use a known flat piece of 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. Surface must be flat within 0.002 inch (0.05mm). If any one surface is found to be beyond a tolerance of 0.002 inch (0.05mm), the entire gage must be cut out from the tank or vessel, disposed of and replaced. Gasket seating surface must have a final surface finish of 63 to 250 AARH.

WARNING

Flatness of glass seating surfaces outside 0.002 inch (0.05mm) tolerance specified 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. If surface finish is not in the 63-250 AARH range, the gasket may extrude under pressure 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 3
Nut loosening sequence



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8.3 Reassembly

If all glass seating surfaces are found to be within the 0.002 inch (0.05 mm) tolerance and gasket seating surface has a finish of 63-250 AARH described in the previous section, proceed to obtain new glass, gaskets, cushions and shields and proceed to reassemble as follows (refer to exploded parts views in Section 11 if needed):

1. Clean threads on studs and nuts to remove all paint, rust and scale. Apply a light coat of oil to the threads.
2. Thread nuts on stud, place one (TSL and TSL-F) or three (TSM and TSM-F) Belleville washers under nut with pointed end toward the nut (see Figure 2), insert stud through each cover and lay out covers along bench, side by side, with liquid chambers. Use chambers to space covers and line them up with vision slots.
3. Install one cushion inside each cover.

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 a rubber band around each piece of glass, then place glass centered inside each cover.
5. Install shields and gasket on glass being careful to keep components centered.
6. Install covers in place on either side of the chamber being careful to maintain components' alignment inside.
7. Install nameplate and appropriate number of Belleville washers (one TSL and TSL-F, three TSM and TSM-F) under each nut with pointed end towards the nut (see Figure 2). Tighten nuts with fingers.

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.

Note: the following procedure is to be done on only one side of the gage.

8. Using a torque wrench, tighten nuts in 5 ft.lb (7 Nm) increments, following the sequence in Figure 1, until the torque values shown in Table 2 are reached.

Do not hot torque these gages!

Refer to Section 5 for installation and Section 6 for operation of the 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 Applications Engineer. You may also contact the factory direct at (440) 572-1500 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 your 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 Penberthy 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 the 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.

PENBERTHY SERIES TSL AND TSM STEAM WATER GAGES
INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

11 EXPLODED PARTS DIAGRAM

FIGURE 4
TSL transparent

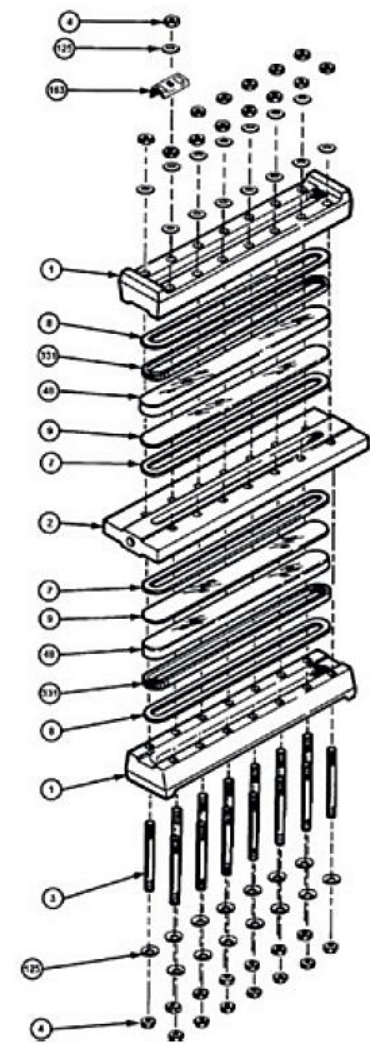
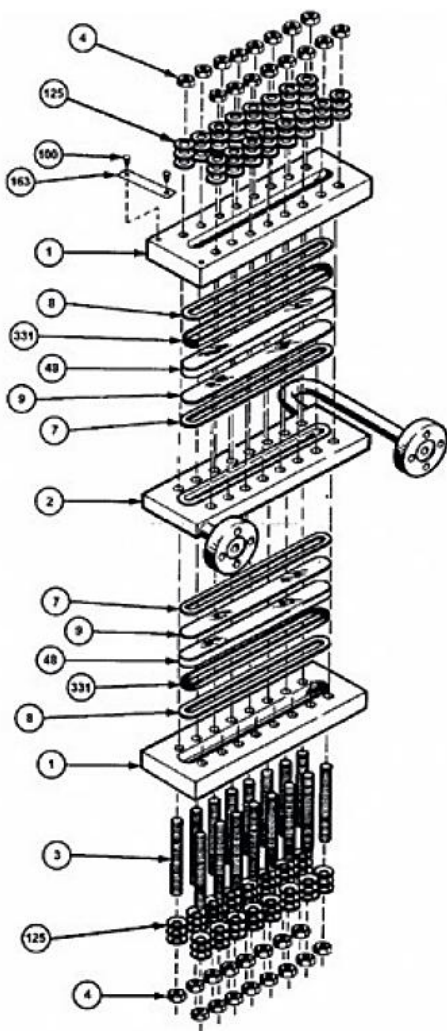


FIGURE 5
TSM transparent



PARTS LIST

Item	Description
1	Cover
2	Chamber
3	Stud
4	Nut
7	Gasket
8	Cushion
9	Shield
38	Plug
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	2
7	Gasket	2
8	Cushion	2
9	Shield	2



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