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Date: 26 Aug 99

PenTech FAQ # 3 by Gary G. Sanders, Vice President - Engineering

Refurbishing Glass Liquid Level Gages:

Introduction:

To ensure a troublefree and extended useable life for a glass liquid level gage, maintenance is required. The intervals for maintenance must be determined by the operations personnel involved since it depends upon type and severity of service conditions (e.g., frequency and extent of thermal and pressure excursions, corrosiveness of the process, etc.). Operational maintenance is delineated in the product I.O.M. (Installation, Operation and Maintenance manual) which is shipped with each product. Note: If an I.O.M. cannot be located - a request through your local distributor should produce one. There is some very preliminary conceptual thinking about the feasibility of posting all Penberthy I.O.M.'s on the Penberthy web site located at www.penberthy-online.com

Next Level:

Penberthy does NOT recommend the remachining of gage glass parts. From a safety or warranty standpoint, it can never be justified. From an economic standpoint, it is almost always more cost effective to replace gage glass than to attempt field re-machining. However, Penberthy does recognize that field refurbishment of gage glass occurs. The purpose of this FAQ is to establish some basic guidelines to help insure that the refurbishment effort will provide a satisfactory outcome.

The gasket surface of the liquid chamber of a liquid level gage is of paramount importance to the proper operation of the level gage. The surfaces should be even and held to a flatness tolerance equal to the flatness of the mating piece of glass, typically 0.002" [0.05 mm]. For transparent type chambers, i.e., glass mating surfaces on opposite faces, the ground surfaces must be parallel within 0.010" [0.25 mm]. No abrupt changes resulting in ridges or cavities in the glass seating area can be tolerated. Any such deviation may result in stress risers being telegraphed to the glass which will result in glass fracture. Some gages; e.g., steam/water types, have a raised face portion for the gasket/glass seat. If this surface is ground excessively the cover frame may bottom out on the chamber resulting in insufficient compression on the gasket and subsequent leakage.

Mark the cover(s) position and orientation. Disassemble bolting in reverse order from torquing to prevent cover warpage. Carefully remove old gasket residue with a soft (preferably brass) metal scraper being careful not to scratch the gasket surface. Lightly sand the surface with a sanding block. Check surface for flatness and parallelism. Visually inspect the surface for pitting and scratches.

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The gasket surfaces are on the thickest cross sectional portion of the chamber and provide the highest resistance to deformation, any material removed beyond minimum specifications will cause structural weakening. Due to overall gage design which uses compressive (by axial bolt load) loading on the chamber beam sections, removal of material across the beam width (by machining) is more detrimental to gage performance than a reasonable amount of beam thickness reduction due to corrosion (corrosion allowance should be limited to < 30 mils [0.75 mm]). The absolute minimum thicknesses are :

<u>Gage series</u>	<u>Glass type</u>	<u>Minimum allowable chamber cross section dimension</u>
L & M	Reflex	1.340" [34.04 mm]
	Transparent	1.335" [33.91 mm]
H	Reflex	1.528" [38.81 mm]
	Transparent	1.523" [38.68 mm]
LC	Reflex	2.698" [68.53 mm]
	Transparent	2.515" [63.88 mm]

These measurements must be made across the glass face(s) of the chamber section, if any point is below tolerance, the gage should be replaced. The chamber gasket surface should be a ground surface with a finish of > 63 A.A.R.H. to insure enough 'bite' to hold the gasket in place against the internal pressure. The lay of the finish must be in the direction of the length of the liquid chamber. Circular lay or lay perpendicular to the length of the part may result in numerous leakage paths. If a suitable seating surface cannot be obtained by these methods, discard the gage.

Re-machining the cushion area of the cover:

Except that this is not a ground surface, it has the same ramifications as re-machining the gasket surface on the liquid chamber. Unstoppable leakage is a possibility with insufficient compression on the gasket due to the cover bottoming out. Catastrophic failure due to imposed telegraphed stresses through the cushion gasket on the glass is a distinct possibility. Removal of excess material in the glass pocket also tends to weaken the cover and must be avoided. Covers are subjected to torsional forces by bolt loading and if weakened will apply compressively transmitted tensile loading onto the glass resulting in breakage. Remove old cushion residue using a soft (preferably brass) metal scraper. Check for flatness of cushion surface. If surface is not flat or has ridges or cavities, discard cover and replace.

Tie-bars in the vision slots:

Tie-bars are added to gage chambers with vision slots in excess 4.75" [12.07 mm]. This feature improves pressure retaining capability. A test program conducted by Penberthy engineering showed that the parallel sides of a liquid chamber over 4.75" long showed sufficient breathing upon rated pressure cycling to allow slip of the gasket resulting in leakage of the process media or gasket failure. Tie-bars effectively shorten the parallel side beams sufficiently to prevent the occurrence of excessive breathing. Re-machining the chambers weakens these tie-bars and the side beams - the gage glass should be derated from its original MAWP.

Reuse of components during re-build:

Chamber

If a chamber can meet all the aforementioned criteria for size, flatness, finish and parallelism - it may be reused.

Cover(s)

If the cushion surface in the glass pocket in covers can meet the flatness requirements and the cover size as stated above and show no signs of torsional bending or warpage, they may be reused.

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Bolting - if:

- 1) the bolting components have never been over-torqued or exposed to over-pressure situations, in other words, if use has always been maintained within the elastic range (below yield strength);
- 2) the parts are not pitted, grossly rusted, scaled or show other deformities; and
- 3) the parts are properly cleaned and lubricated; then, they may be reused.

Glass, Gasket(s), Cushion(s) and Shield(s) (if used)

Due to internal stress/strain changes occurring in these components during use, if a gage is ever disassembled, these components **must** be discarded and replaced regardless of their appearance.

Among plumbers, there is an adage that states 'old' plumbing, once opened will tend to leak until replaced. If a multiple section gage glass requires replacement of components of a single section, then all sections should be replaced. Otherwise, the neighboring sections (at least the gasketing seals) are subject to premature failure.

In service glass inspection

Glass cannot provide useful, reliable service if its surface finish is damaged. **ANY** surface imperfection (esp. on viewing surfaces) greatly reduces the capability of glass to withstand pressure and thermal stresses. For this reason, an in-service inspection schedule should be established. The periodicity of inspection must be determined by the service conditions. Refer to the appropriate I.O.M. for inspection procedures.

Final commentary:

We are reasonably certain that some people reading this FAQ will say "sour grapes" or whatever your particular version of that expression is. You are probably thinking that this is just a manufacturer's way of trying to sell more gage glass.

Our response - we'll wager that this is the first time you have seen or heard of a manufacturer willing to document guidelines for refurbishment. Yes, it is in our financial interest as a company to sell new gage glass but it is even more important to us that you maintain your process and our product in a manner that provides **SAFE** and satisfactory service to you - even if that means re-machining gage glass. We know that sooner or later replacement will become inevitable and **trust that you will think of Penberthy at that time.**