Subject: Use of Drain Tube Inserts In Purge Mist Oil Collection Bottles.

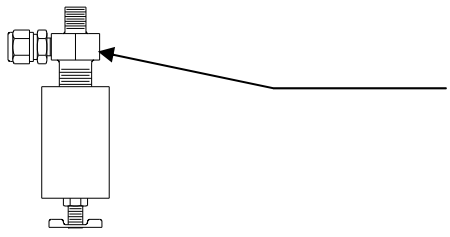
This PQSC Technical Bulletin is provided to clarify information that has been disseminated through LSC training regarding the use of the insert able drain tube into an oil sight bottle when used in purged turbine bearing housing applications. This PQSC TECH Bulletin describes the development and the use of the Drain Tube Insert (77700776) in Purge Mist Oil Collection Bottles (77600965).

Background:

A Quality Problem Report (QPR 210) was submitting in mid 1998 to address the problem of water contamination in a turbine bearing housing. The customer discovered that water was present in the bearing housing but did not show up in the sight bottles under bearing housings. The water intrusion resulted when a steam leak developed in the rotor housing seal. High pressure steam and condensed steam was blown down the shaft and into the bearing housing.

The problem was identified as the inability to detect free water contamination in the bearing housing before it collected to a level that resulted in a bearing failure. Fred Paben mentioned another company in California who was dealing with the same problem. That plant was purging bearing housings with nitrogen rather than oil mist, but was also having problems with liquid water intrusion in turbine bearing housings.

A design review was made of the application for purge mist bearing housings. A ¼ NPT bearing housing drain connection size is not uncommon, so the investigation focused on oil sight bottles with ¼ NPT bearing housing connections. During the pursuant work to resolve the QPR, a prototype machined nipple was designed to connect a sight bottle to a ¼ NPT bearing housing drain connection. As a part of the search and discovery for a solution to the problem, the use of the 77700776 Drain Tube was also considered. The nipple design was eventually incorporated into the LubriMist Product line as part of the 77600965 Vent Collection Assembly, however the drain tube was held as a separate item to be installed on an “as needed” basis.



Machined Nipple attaches the sight bottle to a ¼ NPT connection

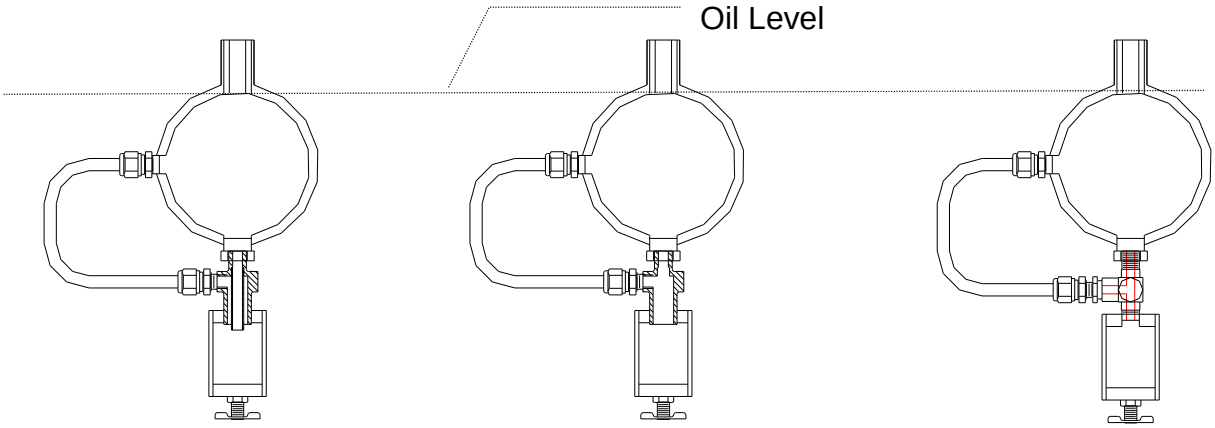
Set Up:

Three separate model bearing housings were constructed. The following describes how the sight bottles were evaluated.

- Bearing housing #1 used the prototype Vent Collection Assembly w/ the drop in tube
- Bearing housing #2 used the prototype Vent Collection Assembly w/o the drop in tube
- Bearing housing #3 used the Vent Collection Assembly (now obsolete). This construction used a ¼ inch pipe tee to connect the bottle to the bearing housing.

Testing And Evaluation:

The test apparatus was set up and the evaluations were conducted as follows. Note that the reader understands that where referred to as “prototype” in describing the 77600965 Vent Collection Assembly, the reference is made to the sight bottle shown in bearing housing #2 below and is the current design at the date of this PQSC TECH Bulletin.



Bearing Housing #1 Bearing Housing #2 Bearing Housing #3

Bearing Housing #	Bearing Housing Description
1	Oil sump where the oil sight bottle is equipped with prototype oil sight bottle nipple with an internal 3/8 inch OD tube.
2	Oil sump where the oil sight bottle is equipped with prototype oil sight bottle nipple only and without an internal 3/8 inch OD tube.
3	Oil sump equipped with the 77600965 oil vent collection assembly (old style with ¼ NPT tee fitting).

The first test configurations were with a 3/8 Tygon tube from the sight bottle to a side connection in the side of the "bearing housing". This line would be the same connection as we install to the constant level oiler or the oil level sight assembly.

The first step to evaluate the bottles was to fill the bearing housings and apparatus with oil. The oil level was filled to a point above the side connection:

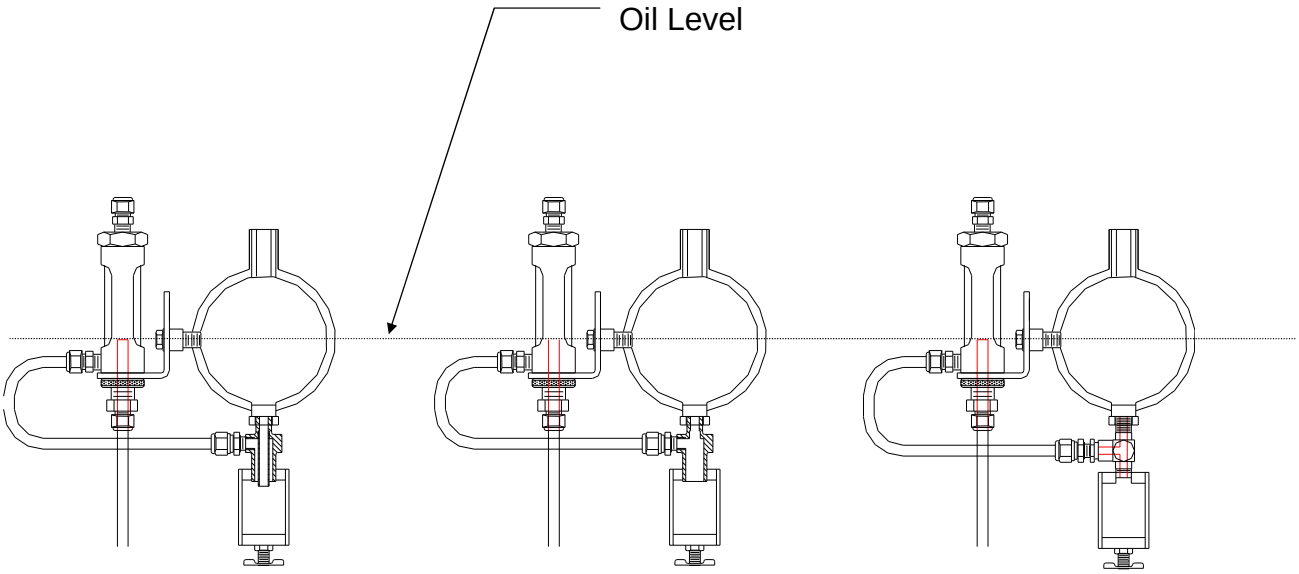
Bearing Housing #	Noted Observations
1	Oil readily filled the bearing housing, oil sight bottle and Tygon tube.
2	Oil readily filled the bearing housing, oil sight bottle and Tygon tube.
3	A small amount of oil drained into the bottom of the sight bottle of the 77600965. A volume of air became trapped in the top of the oil sight bottle. The sight bottle was approximately 1/3 oil and 2/3 trapped air. The Tygon tube filled with oil.

The second step was to add a small amount of water into the bearing housings.

Bearing Housing #	Noted Observations
1	After about 15 seconds, spherical water droplets, approximately 3/8 inch in diameter, were observed falling to the bottom of the sight bottle. The droplets accumulated at a constant rate until the water had collected in the bottle. The amount of water collected filled the sight bottle to about 75% water on the bottom, and 25% oil above the water. Additional water was not added
2	The apparatus for bearing housing number 2 performed the same as for number 1, except for the following. 1. The oil droplet size appeared to be larger, say about ½ inch in diameter. 2. Although the droplet size was larger, it seamed to take longer for the water to drain from the bearing housing and collect in the sight bottle. In neither did the time seem to be excessive, as both drained the water away in just a very few minutes.
3	The air remained trapped in the oil sight bottle. After a short period, the water was observed moving up the Tygon tube toward the bearing housing side connection. This did not occur in either bearing housing 1 or 2. After a period of time, the water was observed to be only in the Tygon tube and assumed to be into tee fitting of the 77600965 and bottom of the bearing housing. No water was ever observed to enter the bearing housing.

The above test sequence was conducted a second time with identical results.

A second test was set up using the same bearing housings and sight bottles but with the 77700217 Oil Level Sight Assembly. Oil mist was not applied during this test.



Bearing Housing #1 Bearing Housing #2 Bearing Housing #3

The oil levels in the bearing housings were set to the approximate centerline of the ¼ NPT side connections for the bearing housings. The bearing housings were filled with oil and allowed to drain until oil had stopped dripping from the over flow tube. Approximately 1 fluid ounce of water that was added to each bearing housing.

The results were basically identical as those of the first test. In bearing housing number 3, the water completely filled the Tygon tube and filled the bottom of the oil level sight assembly. This has to result in water being present in the bottom of the bearing housing to the same level. No water in number three ever entered the oil sight bottle. In bearing housings 1 and 2, water filled the oil sight bottle, draining it away from the bearing housing and was visible.

Findings:

From these evaluations, the following conclusions were made;

1. The prior design of the 77600965 Vent Collection Assembly was unsuitable for use in purge mist applications.

    a. As oil was poured into the bearing housing, the sight bottle became locked with an air pocket. The ¼ inch pipe tee in the sight bottle inlet had an ID small enough that was bridged by the viscous oil. Once the oil bridged the hole the addition of oil increased the head pressure over the bubble and the air became trapped. In order for oil to enter the sight bottle an equal volume of air has to escape, however the oil did not allow an air bubble to pass through the small ID of the pipe tee. Further, when water was introduced into the bearing housing, our testing indicated that the water was not detected in the oil sight bottle for the same reasons already described. This is the same experience identified by QPR 210.

    b. In pure mist applications, the liquid oil is introduced into the bearing housing slowly. This allows air to escape as the bottle gradually filled over time, avoiding the air lock. However no mechanism exists to ensure that water contamination is drained into the sight bottle. Once the bottle is filled with oil, water could presumably be washed past oil sight bottle inlet, through the overflow tube and into the oil collection container, and never be detected.

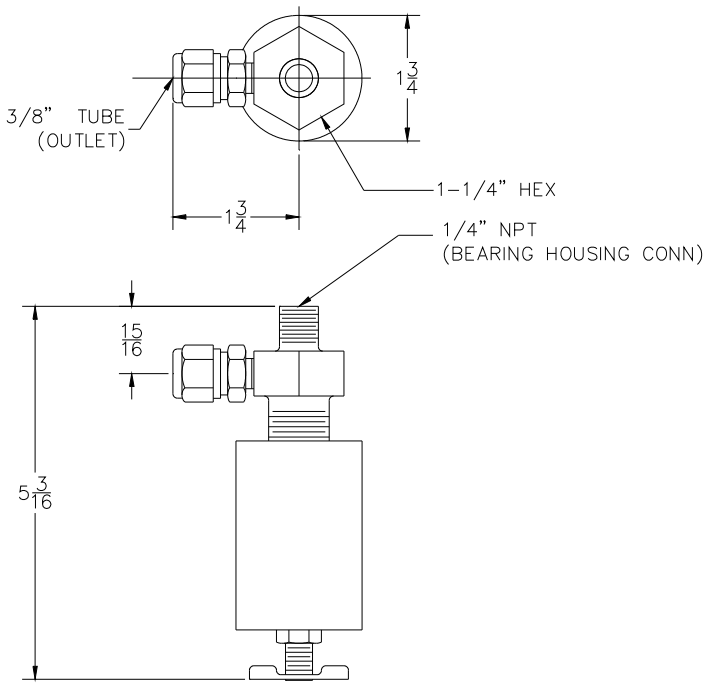
2. The tests indicated that both prototype oil sight bottle configurations (with and without the drain tube) were suitable for detecting liquid water contamination in bearing housings when used in conjunction with static oil sump bearing housings and for purge mist applications.

Conclusion:

The prototype used in bearing housing 2 performed well and allowed the water to collect in the bottom. It is suitable for use in pure mist and purge mist applications using existing purge mist.

The current (as of 7/17/03) design of the 77600965 Vent Collection Assembly does not utilize the 77700776 Drain Tube. The Vent Collection Assembly has been successfully installed over the past several years without the drain tube without negative feed back or customer complaints reporting the reoccurrence of the original problem of water contamination in turbine bearing housings.

It is the opinion of the PQSC that the 77700776 Drain Tube is not necessary and should not be used in the 77600965 Vent Collection Assembly for purge mist applications.



77600965 Vent Collection Assembly

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