THE GAMGRAM

No. 65 **PISTON DIFFERENTIAL GAUGES: FACTS AND MISUNDERSTANDINGS** **MAR. 2014**

To know how much contamination is in a filter, you watch the pressure drop, otherwise known of as "differential pressure" or DP. If the inlet pressure is only a little more than the outlet (for example 50 psi on the inlet and 47 psi on the outlet, or 3 psid, the d is differential), the filter elements have not yet removed very much dirt (if it is a filter separator) or dirt and water (if it is a monitor/water absorbing filter).

We want to avoid subjecting the elements to high differential pressure, because if they burst or collapse, you will be releasing contamination and bits of filter element downstream. This sort of failure can cause even a major airline plane to "not reach its destination" - and nearly did just that only a few years ago. In that event, the throttles on both engines froze, but the pilots managed to land safely.

For this reason, both the US ATA-103 and the International IATA JIG require monitor filters on hydrant carts to have an automatic differential pressure shutdown control. The ATA-103 also requires this on refueler trucks. At GTP we are proud to have pioneered the incorporating of a differential switch into a piston type direct reading differential pressure gauge.

There has been some concern recently with simple piston-in-glass-tube type differential pressure gauges, simply because it is "old technology" - but sometimes simple is a good thing.

To clear up some misconceptions on these gauges (we are not the only manufacturer) please consider these simple facts:

1. There are only 2 moving parts, a piston and a spring. There are only two things that can go wrong, the piston can stick or the spring can weaken. Many years ago, Shell Oil developed a simple test for both of these potential possibilities, adding a 3-way valve on the outlet. See the following link at the end of this paragraph. This test is accepted by all airlines, oil companies and militaries. This test causes the piston to move through full travel, which tests the gauge for freedom of movement and helps keep the glass clean. Note that this test only works in gauges with the piston on top of the spring.
   See also: http://www.gammontech.com/mainframe/manuals/pdf/GGTC2.pdf

2. You may feel that we left out a third thing that can go wrong with a piston gauge, the third important part of the gauge, the filter. There is a filter in any good piston gauge - to protect the piston from debris that may jam it up. But these filters never plug up on aircraft refueling equipment for two simple reasons; the filter is 10 micron and the system filters are 1-2 micron - and there is no real flow through this filter. Even if the filter did get dirty, it only slows the reaction time of the gauge, which would be obvious when you do the test in item 1 above. Some of our customers have policies to replace this filter every time the filters in the main filter vessel are changed, but privately we feel changing the element once every 10 years on into-plane fueling filters is fine.

3. You may ask how it is possible to check the accuracy of the gauge with this simple test. The answer is simple - a spring won't change without changing its length. If the spring can push the piston up to the zero, against gravity, the spring has not changed length and the accuracy has not changed.

4. There is one weakness in a piston gauge, someone could lose a scale and replace it with the wrong one. For example, a 0-30 psid scale on a 0-15 gauge. We guard against this by using lock tite on the screws and color-coding the springs, but even if this did happen, the greatest error is only 15 psid and the worse possible case would be a shutdown at 28 psid, well within the safety factor of the elements.

A subject under a lot of discussion these days is something called “corrected differential pressure”. This is perhaps one of the most misunderstood subjects in our industry. Basically, if you have a vessel in a system that normally can produce 600 gpm/2200 lpm but it is only flowing at half that rate when you happen to look at the gauge, the reading you get is pretty well useless, unless you correct it for the difference. The pressure drop at full flow rate will be more than twice that at half flow rate. To know what the differential would be at full flow rate, a “correction” can be done:

A. Manually with the filter manufacturer's chart.

B. Using a spreadsheet program from that manufacturer.

C. You can have this done automatically by adding a computer control system to your filter system. This control automatically compares the actual flow to the differential pressure at the time and corrects it.

But the question is - does correcting differential provide any additional safety benefit?

Remember - our goal in monitoring differential pressure is to not burst the elements and release contamination. We propose that a simple piston DP gauge with a switch accomplishes this inexpensively and is easy to test and check the calibration. So, what would corrected differential pressure do for us? Well, in our opinion, manually correcting the differential is fine, but the automatic controls only provide really useful data on the dirtier parts (fuel receipt) of an airport fuel system. Checking corrected DP in these filters may warn you of contaminated fuel or simply advise you earlier of an upcoming need to change elements. Software that notices not the level of contamination, but how quickly it is building up would be a useful Q.C. tool. On into-plane filtration it may advise you earlier than a DP gauge switch, but this does not make you any safer. We say this even though we do make a digital output version of our gauge.

Even though we make a digital output for our gauge, which can be used for this purpose on into plane filters, we believe these controls are most useful at the pipeline, ship, barge or airport entry stages, because this is where you would expect to see greater contamination and where you can learn the most. Such controls should include intelligently designed warnings.

The greatest advantage to the old, simple piston gauge is the simplicity. You can easily see that it is working correctly. You can easily test it and check the calibration. Adding a switch is simple. In addition, it won't “drift” on its reading as a pressure transducer may do, over time, and it is also easy to test the set point on the switch. But best of all, even if all the electronics fail, a trusted old piston gauge will still work reliably. In an emergency, someone can watch the gauge to be sure. Sometimes simple is good.