THE GAMGRAM

No. 26 AN EVEN NEWER LOOK AT PRESSURE DROP, CORRECTED AND UNCORRECTED

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One thing is certain in this universe, there is no such thing as a perpetual motion machine. In the real world, which means outside of politics, you cannot get anything done without expending energy.

This rule applies in fuel systems: when fuel flows, it takes energy to push fuel through any valve, meter, filter or pipe. This results in a drop in pressure.

A clean filter element in a vessel will have many open passageways for the fuel to take, so it is easy for the fuel to get through. This is why new filters show a low pressure drop indication on your Gammon Gauge (or other differential measuring device), it takes very little energy to push the fuel through.

As a filter removes dirt or as a monitor removes dirt or water (monitors trap water as a gel), some passageways are plugged. This means that more energy has to be used to push the fuel through the remaining passageways. If half of the holes plugged, the fuel has to move through the remaining holes at twice the velocity. We measure that lost energy as pressure drop.

Filter separators add a complication. Dirt causes pressure drop in the same way as in any other filter element, but water acts different than in a monitor. A coalescer element only collects tiny water drops and makes them into larger ones, and if no water is present, the pressure drop is low. If significant amounts of water are present, the pressure drop increases, but if the fuel becomes dry again, the pressure drop can go back down. The difference is not very large, but can observed on the DP gauge.

On the other hand is the “clay treater” vessel, often called a “clay filter”. These are most commonly found in pipeline terminals and ship unloading facilities, but some are located on airports. In reality, they are not filters at all; the “activated clay” (like activated carbon) is designed to remove chemical surfactant contamination, not dirt or water. Increased pressure drop happens only if there are a LOT of big dirt particles or large amounts of water, which blocks off flow in the clay.

PRESSURE DROP = DIFFERENTIAL PRESSURE = DP

So you don’t get an increase in the pressure drop (differential pressure or DP) between the inlet of a vessel and the outlet without something bad in the fuel, right?

Not true. Velocity is important. At zero flow, there is no pressure drop, even with virtually plugged filters. As the flow rate increases, DP increases, so an increase in the DP can take place simply because the flow rate is higher or decrease because flow rate is lower. For example, some aircraft can accept 850 gpm/3,200 lpm when the fuel tanks are empty, but this may decrease to just 150 gpm/560 lpm when you are flowing into the last small fuel tanks. The same is true in filling an above ground storage tank, the flow rate can vary as much as 50% or more from “head” pressure as the tank fills.

It is simple if you are at full system flow, you don’t need correction. But if you are flowing at a rate below 100% , you need to correct the indicated DP to what it would have been if the flow rate had been at 100%. Then you can keep a chart and see the trend. 100% is not the rated flow of any component, it is actual maximum flow you can achieve.

For manually correcting DP, there are charts, spreadsheet programs and electronics that can do this.

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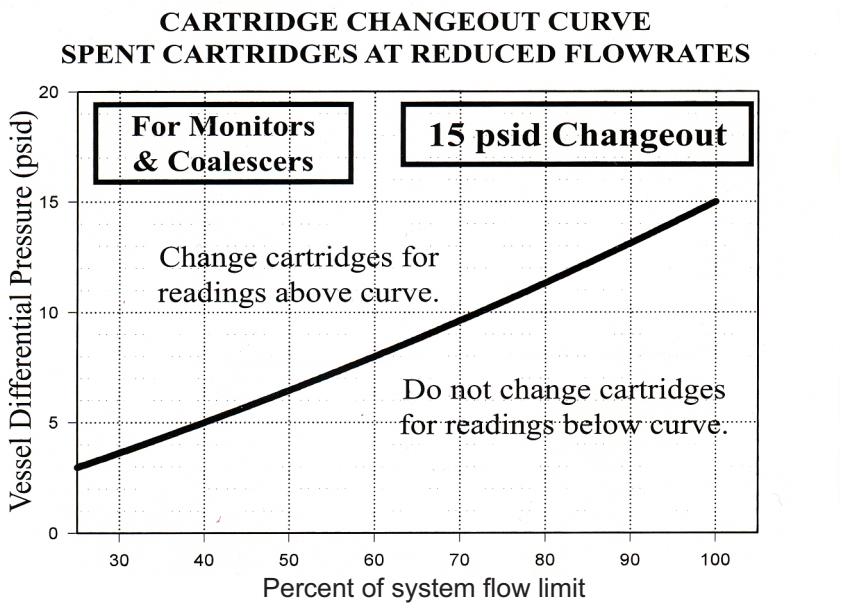
MEANINGFUL EVALUATION OF DIFFERENTIAL PRESSURE

There are different views on monitoring DP and an increase in corrected DP means different things in different places. A gradual increase is expected anywhere. A sudden increase can signal a serious problem, depending on your experience at this facility. A sudden drop in corrected DP is always serious, it means that a filter element has come loose or failed.

Some people watch DP to spot sudden contamination changes. Some watch DP to schedule the next element change. Some watch DP to make sure the system is shut down and elements changed before DP becomes too high, damaging the filter elements and allowing debris downstream.



We have four alternatives:

1. Simply put a shutdown switch onto the Gammon Gauge (or other differential pressure control) and stop flow if DP gets too high.
2. Add a low pressure switch to determine if the DP is too low, indicating a loose element.
3. Add a differential monitoring control that automatically corrects the DP and keeps a record. Such controls have alarms and shutdowns for high corrected DP, notice trends and sense a decrease in corrected DP that could mean an element has come loose.
4. We can manually calculate corrected DP, with a spreadsheet or by using a chart. The weakness is that you have no automatic shutoff if DP suddenly goes up.

Clearly #4 is no longer allowed on into plane monitors by either JIG or ATA-103.

There are arguments, we'd prefer to avoid, as to what is best. We make a DP transmitter that gives the Gammon Gauge an output that can be connected to an electronic DP correction control and we make switches that can be added to a Gammon Gauge to indicate low or high DP. We also make a High DP shutdown control.

On refueler trucks and on other types of filter vessels, it gets more complicated. Refueler vessels with monitors usually have a higher flow rate through the monitor than the meter shows, because of the pressure bypass control, so correcting DP is very difficult. Some refueler trucks have filter separators, which are not as vulnerable to bursting. Some (rare) have filter separators AND monitor elements, either in a separate vessel or inside of the separator elements.

On fuel farm and terminal filters, it depends on experience. If you never see high DP and the flow rate really doesn't vary, just keeping records and graphing DP may be enough. Any sudden increase, however, could mean much more than just some dirt, it may mean a mixture with other fuels, like diesel, where the mix is more of a problem than the dirt.

On clay, it means you have problems with water or gross dirt, and could also be more serious than you would think, due to mixed fuel. A low DP does NOT mean the clay is working.

REMEMBER: On any filter, a decrease in corrected DP can be as serious a problem and even a more serious problem than high corrected DP, it means you are very likely pumping unfiltered fuel!