THE GAMGRAM

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GETTING REPRESENTATIVE STORAGE TANK AND LOW POINT SAMPLES

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In GamGrams numbered 2, 3 and 5, we discuss obtaining representative filter sump samples. The same concerns apply to taking tank sump drain and low point pipe samples. In most cases, the worst of your water, dirt and microbial contamination will concentrate in low points. In this GamGram, we explore how to obtain and examine these samples. Getting a true, representative sample is important. This isn't as simple as it may appear.

An example:

A customer once called and said he took a sample from his tank and saw no contamination in a 5 gallon sample. But when he performed a "Bacon bomb" sample (in-tank sampler) there was quite a bit of water and dirt in the sample. How could that happen?

It turned out he had a vertical tank 100' (30 meters) in diameter and his drain line was 2" (50 mm) in diameter. He had taken a 2 gallon (8 liter) sample from his drain line.

In this case, his sample size was simply much too small. The drain pipe (50' x 2" - or 16 meters x 50 mm) itself held over 8 gallons/30 liters of liquid. To get a representative sample of what was in the tank sump, he needed to drain at least 10 gallons (37 liters)!

What happened in this case was that some water had entered the drain pipe, but it could never reach the bucket because as soon as he stopped draining, the water flowed back to the sump, water being heavier than fuel. This problem can take place in any tank, above ground or below, as well as any other samples taken from anywhere in your fuel system. You must drain enough fuel to get a representative sample.

So what volume of fuel must be removed to obtain a truly representative sample? There are two concerns:

1. Moving *enough* fuel to obtain a truly representative sample of what is really in your sump.
2. Moving that sample with enough velocity to get a true sample.

How is velocity important? Go back to the example above. If there were only a fairly small amount of contamination (water/dirt/microbes) in the sump, by taking a slow sample , heavier contamination may not be carried "up hill" faster than the fuel. Large diameter drain pipes can cause this and the only solution is higher velocity.

Open the valve fully, or as much as is possible without splashing and spilling fuel. Use a properly sized bucket/ container. A large container, such as a sump separator, may be needed.

We have seen "sump processor" devices mounted in pickup truck beds. They are typically locally fabricated. They may look like small "tanks", but do not call them "tanks". Storage tank regulations do not apply to them, if fuel is never stored in them. They are only for processing.

A sump processor has a large opening in the top (with a cover) for viewing the sample. A means of emptying them is included and most importantly, these are never left full.

They are specially designed to provide a way to receive fuel at velocity without splashing and still allow the operator to see the contamination that was removed. A properly sized hose is usually used to allow connection to drain lines. **Velocity is critical, so the hose must not be small in diameter.**

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The same problem applies to “low point drains” in hydrant systems. If the drain line is large, you need more velocity/flow rate to carry the water/dirt/microbes out.

In one case, the low point hydrant drain pipe was 2” (50 mm)in diameter and 12’ long (4 meters), but where the sample came out, it was reduced to 3/4” (20 mm) for convenience. They never got a good sample into a small 2 gallon (7.5 liter) bucket not only because the bucket was too small, but also because the velocity was too slow.

So how much of a sample do you need? You need to know the volume of fuel in the drain pipe. To allow you to avoid doing mathematics, we have prepared the chart below so you can easily calculate the amount of fuel you need to remove before you get a truly representative sample of the contamination (if any) in the sump.

Note: This chart is based on pipe INSIDE diameter. Interestingly, pipe and hose are usually referred to by inside diameter, while tubing is most commonly referred to by outside diameter.

PIPE/HOSE VOLUME

US MEASURE		METRIC MEASURE	
INCHES	**GALLON/FOOT**	**MILLIMETERS**	**LITERS/METER**
3/4	0.023	20	0.31
1	0.04	25	0.49
1 1/2	0.09	40	1.25
2	0.16	50	2
2 1/2	0.25	65	3.3
3	0.36	80	5
4	0.65	100	7.8

As you can see, the amount of fuel a pipe may hold can be more than you might think.

For example - a 2” pipe (50 mm) pipe holds about 1.6 times as much fuel as a 1-1/2” (40 mm) pipe, so you need to drain a larger volume, and at a higher flow rate, to achieve the same velocity.

Velocity? We recommend at least 6 feet per second (about 2 meters per second). That is easy to calculate using Howard Gammon’s formula. (Yes, he was the first one to figure this out 60 years ago, now a common engineering calculation, worldwide)

US measure: (Flow rate in gpm) divided by (pipe size in inches squared), multiplied by 0.4 = feet per second

(By “squared,” we mean multiplied by itself - example: 3 squared (3^2) is the same as 3 x 3 = 9)

Engineer’s version: gpm/p^2 x 0.4 =fps

Metric: Flow rate in lpm divided by (pipe size in mm, squared), multiplied by 22.6 = meters per second

Engineering version: lpm/p^2 x 22.6 = mps

So the calculation for a 3” pipe (80 mm) flowing at 300 gpm (~1135 lpm) would be:

- US: $\frac{300}{3^2} \times 0.4 = \frac{300}{9} \times 0.4 = 33.3 \times 0.4 = 13.3$ feet per second
- Metric: $\frac{1135}{80^2} \times 22.6 = \frac{1135}{6400} \times 22.6 \approx 0.177 \times 22.6 = 4$ meters per second