THE GAMGRAM

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SPARKS FROM JET FUEL

If you are already saying to yourself, "I'm not going to read this because I always ground everything," *YOU, FRIEND*, are the person we want to reach before you kill someone. Read the title again. Sparks *FROM* jet fuel. We are not talking about static charges on pipes, trucks, or any object. We are talking about electrostatic charges *IN* fuel.

Volumes and heaps of deep technical papers have been written on this subject but this article is a pioneering effort toward the non-technical. Have you ever noticed that the greater the number of scientific words that are written on a subject, the less the problem is really understood? That is the situation with static charges in jet fuel.

We like to describe how electrostatic charges build up in fuel by explaining that it is caused by <u>rubbing molecules together</u>. In other words, it is caused by friction -- friction between molecules. The more vigorous the rubbing, the greater the charge becomes. The scientists call this "charge separations". In other words, when the "pluses" separate from the "minuses" you have charge separation. This is when charge separation occurs. Also, the charge becomes bigger and bigger as more of the molecules in a given volume are agitated. If the charges move to the wall of the pipe or tank, they are immediately grounded and can cause no hazard; the whole problem is that the charges cannot easily move through some fuels to a "ground": these are called "low conductivity" fuels. **POSSIBLY YOURS!**

There is one item of equipment that is clearly the champion of all static charge generators -- a filter. The agitation created by splash loading or by pumps, piping, valves, and meters causes a charge to develop, but the filter is the place where the most "molecule separation" occurs -- and the finer the filter, the greater the charge - and the higher the rate of flow through the filter, the greater the charge. If a filter salesman tries to tell you that his filters do not cause any static, <u>throw him out</u>. However, recent studies have demonstrated that Teflon coated separator elements generate lower charge levels than paper separators. It seems logical that there is less friction and charge separation caused by a 74 micrometer screen separator than by a tortuous flow path in a 5 micrometer paper.

Now we should return to the reader in the first paragraph who threatened not to read this issue because he "grounds everything." Obviously, if his fuel always has a high conductivity, the charges will move to grounded metal components. But if he has a fuel with a low conductivity, the charges take a period of time to move to ground. If this "charged" fuel is dispensed into a tank, a spark may jump from the surface of the fuel to a grounded object but tests have proven that the most dangerous situation occurs when there is an unbonded object in the vapor space -- it acts like a capacitor - it stores up charges - then ZAP. Need we explain what happens if the right amount of fuel vapor is in the path of the spark?

GAMMON TECHNICAL PRODUCTS INC.
2300 HIGHWAY 34 MANASQUAN, N.J. 08736
PHONE: 732-223-4600 **FAX:**732-223-5778 **WEB:** WWW.GAMMONTECH.COM

WHAT TO DO

A "rule of thumb" that most technical people seem to accept is to keep the fuel in piping or a pressure vessel for 30 seconds after filtering before dispensing it into an open tank. This period is called "system relaxation time." The theory is that even if the fuel has low conductivity the positive and negative charges will have cancelled one another out or have migrated to a grounded surface in that time. Some companies advocate the use of "anti-static" additives to avoid the need for relaxation time. However, the word "anti-static" is a very bad term. It should be called a conductivity improver.

So now if you do not use the additive, all you have to do is take a look at your filter installation to see if you have 30 seconds relaxation time! We wish we had a little gauge to sell to measure this for you but lacking one, we have worked out a sneaky, non-scientific method using simple arithmetic.

EXAMPLE No. 1:

Maximum flow rate expected: 540 gpm
Piping system: 21 ft. of 8" pipe
140 ft. of 6" pipe
26 ft. of 4" pipe

SOLUTION:

Step 1. Multiply each pipe diameter by itself and then by pipe length:
8 x 8 x 21 = 1344
6 x 6 x 140 = 5040
4 x 4 x 26 = 416
Total = 6800

Step 2. Divide the total by our magic number "25" if using U.S. gallons (or 29 if using imperial gallons):
6800 ÷ 25 = 272 gallons

Step 3. To have 30 seconds relaxation in the system at 540 gpm, take half of the flow rate:
540 ÷ 2 = 270 gallons volume required between the filter and the discharge point. Compare this to the answer in Step 2. You are safe because you have two gallons more than is needed.

EXAMPLE No. 2:

Maximum flow rate expected: 2000 l/m
Piping system: 6 meters of 8" pipe
42 meters of 6" pipe
8 meters of 4" pipe

SOLUTION:

Step 1. Multiply each pipe diameter by itself and then by pipe length:
8 x 8 x 6 = 384
6 x 6 x 42 = 1512
4 x 4 x 8 = 128
Total = 2024

Step 2. Divide the total by our magic number "2" because you are using liters:
2024 ÷ 2 = 1012 liters

Step 3. To have 30 seconds relaxation in the system at 2,000 liters per minute, take half of the flow rate:
2000 ÷ 2 = 1000 liters. You have 12 more liters than you need for 30 seconds relaxation.

NOTE: If you like real formulas, use this one:

$$C = 0.0408 \times (L_1D_1^2 + L_2D_2^2 + L_3D_3^3 + \text{etc.})$$

Where C is capacity in gallons,(as in step 2) L is pipe section length, and D is pipe section diameter. The constant is 0.034 if using Imperial gallons. It is 0.5067 for liter calculations.

FINALE: If you found from your calculations that you did not have enough system relaxation time, we cheerfully offer two alternatives:

1. Reduce flow rate
2. Have the system redesigned

DO NOT SAY "My system must be safe because we have never had an explosion."