**April 10, 2007**

**JF-1A FUEL CONDUCTIVITY SENSOR**
**Technical Application Note 07-005**

# Process and Personal Safety in Loading Low Conductivity Distillate Fuels, Ultra-Low Sulfur Diesel, Aviation JP-1

## Background

All of us working in the oil gas industry are focused on attaining and maintaining a zero accident work place. A large element of this focus is on individual safety. Clearly individual/personnel safety in the workplace is of the utmost importance, and, is the fundamental goal of all safety programs. However, equally important is the safety of the many processes that personnel come directly or indirectly in contact with that expose individuals to unsafe conditions. The lack of focus on "process" safety was unfortunately highlighted in the recent report by the US Chemical Safety and Hazard Investigation Board, in review of the BP's Texas City Refinery Accident. The board reported **"Process safety programs to protect the lives of workers and the public deserve the same level of attention, investment, and scrutiny as companies now dedicate to managing their financial controls[1]".**

The March 2005 explosion at BP's Texas City refinery killed 15 people and injured 170. Yesterday's report also blamed London-based oil giant BP for cost cutting that left the plant vulnerable to catastrophe. (Picture used with permission AP)[2]

[1] US Chemical Safety and Hazard Investigation Report, press conference, Carolyn W. Merritt, as Reported by Associated Press, Boston Globe, Wednesday 21 March 2007, Page D2.
[2] Picture by permission April 2007 by Associated Press, Brett Coomer/Houston Chronicle via Associated Press/File.

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## The safety risk as it relates to distillate fuels

As of 2006 widespread distribution of Ultra Low Sulfur Diesel, (USLD), throughout the United States[3] is now ongoing as required to meet EPA regulations. ULSD exhibits very low electrical conductivity, similar to Aviation Turbine Fuel. Low conduction fuels have the ability to internally generate and hold large static voltages when mechanically worked by pumps or filters. Due to the low conductivity, built up charge in fuel does not relax quickly, creating the potential for discharge in the form of a spark. In the case where the discharge or spark occurs in an explosive vapor filled space, a catastrophic ignition of the vapors may occur. In Scandinavia in the 1990's there were an alarming number of static discharge incidents with the introduction of USLD to this market[4].

High-speed transfer of low conductivity fuels greatly increases the danger of static discharge associated with truck loading operations. API has responded to this risk by revising it Recommended Practice, (RP) 2003. The revised RP defines conductivity levels in fuel, and associated each defined level with a maximum load rate to maintain "process" safety. The revised RP is a step in the right direction; however, it then requires operators to fully limit flow rates even under fault conditions in all aspects of the loading system. Unlike Aviation Turbine Fuel, ULSD is more likely not to be delivered in dedicated transports increasing the probability that switch compartment loading will occur at your facility. Even if the RP is strictly conformed to within your facility, it may not be adhered to by the downstream handlers, in the event that proper notification and warning was not provided, it may still leave you liable.

This application note aims to help you understand how you must review your low conductivity fuel loading "process" to ensure that all steps have been taken to ensure safe loading operations. That simple conformance to the API recommended practice may not result in your "Loading Process" being safe under all conditions of operation. Proper system design and implementation has the advantage that it also largely reduces the probability of a downstream electrostatic incident.

D-2, Incorporated manufacturers the JF-1A in-line conductivity sensor which is designed to provide high-accuracy continuous measurement of conductivity of distillate fuels in both flowing and non-flowing applications.

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[4] Proposal for Diesel Fuel Conductivity Specification, British Petroleum, ASTM Spring 2006.

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## Assurance

API has modified its recommended practice that "safe" distillate fuel handling will be based on the conductivity of the fuel. The corollary of this RP is that if you DO NOT know the conductivity of the fuel in your system, then you cannot handle it safely (unless you maintain flow rates below the lowest rate for the lowest conductivity).

**API RP based on conductivity, therefore:**

**Without knowledge of conductivity, RP cannot be adhered to!**

Note, that in the event of an undefined change in the process you may still find operation outside of the defined "safe" operating zone as defined by the AP. If we step back we immediately realize that most "accidents" occur not from a single element, but from a number of elements, which occurring together resulted in an "unsafe" condition.

It is not a surprise that the API added a footnote to the RP, which states:

> "Introducing the anti-static additive at the final distribution point (such as at a loading rack) alleviates the dilution/absorption concerns. However, the presence of additive in the final product is less certain due to the potential for additive injection **system failure** or variability in conformance to local procedures.
>
> Regardless of where in the distribution system the additive is introduced, if this is considered part of the static protection system, it is incumbent on the operator to verify that an adequate amount of additive is present in the final product. Hence, the **operator must have systems in place** (instrumentation, analyzers, testing, etc.) at all the critical points in the system **to ensure that an adequate increased conductivity is achieved[5]."**

[5] API Recommended Practice 2003 has been updated and revised by a Safety & Fire Protection Subcommittee team with Doug Jeffries as Champion and Ken Crawford providing support. RP 2003 is now presented for ballot. The revisions to RP 2003 from the Seventh (1998) to the Eighth (2006) edition have focused on updates, technical accuracy, readability and addressing the issues associated with a continuing pattern of incidents with low conductivity fuels. This includes concerns associated with Ultra Low Sulfur Diesel (ULSD) fuels to be introduced in the USA in 2006

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In terms of process and personal safety, which terminal would you personally rather load fuel from, one which relies on reduced flow rates and ideal conditions, or a terminal with a fully automatic active anti-static additive control system? Essentially the new API RP requires that all terminals build Anti-Static Additive assurance systems. Otherwise, without such assurance you are leaving your company, your customers, and your employees to a potentially hazardous "process". They may not even be involved in the load, but attending to other duties under the rack when an electrostatic incident occurs.

## Constant "Known" Conductivity Fuel Loading Systems

**Air BP Dock Transfer Stadis 450 Injection Skid,**
**NEREFCO Refinery Rotterdam, The Netherlands**
**(Built and Supplied by D-2 Incorporated)**

D-2 can supply safe fuel additive injection systems which supply fuel that has near "constant' conductivity at all times during the loading process. Although this sounds straightforward, careful engineering and automated control loop design must be implemented to handle the "dynamic" requirements of the system. The system must take into account, highly varying fuel transfer rates, fuel sensitivity to additive, fuel temperature, and, variability in compartment load sizes. The most common misconception we find in speaking with customers is that all that is required is the loaded compartment has the correct "average" conductivity, when actually what is required is that "all" fuel entering the compartment has the a conductivity which allows the flow rate as prescribed by the API RP.

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## Conclusion

The advent of widespread use of ULSD and its corresponding ultra-low conductivity requires suppliers to review the safety of loading especially as more switch tank fuel loading will occur. D-2 Inc has developed effective real time sensors for the in-line measurement of fuel conductivity that has recently been ASTM adopted. This sensor combined with a “continuous stream” injection package from D-2 can ensure and document that “safe” fuel loading occurs at all times in your facility.

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