The State of the Art of Ullage Oxygen Concentration Measurement
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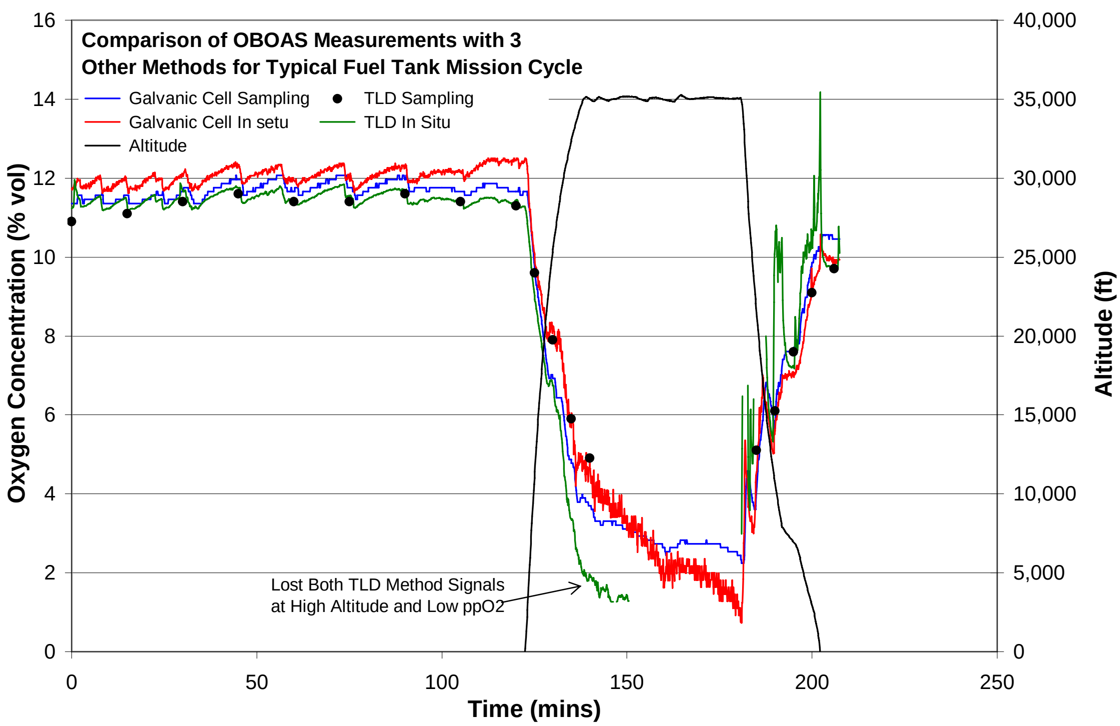
Because of changes in regulatory requirements, fuel tank inerting is of increasing interest to OEMs and operators, to ensure compliance of certain kinds of fuel tanks with new regulations in the fleet. With this increasing emphasis on fuel tank inerting, it would be desirable to have more knowledge of the progression of oxygen concentration in an inert fuel tank ullage to both diagnose and prevent potential problems, and allow for more efficient operation of an inerting system. Measuring oxygen concentration in a fuel tank can be a difficult and problematic endeavor. The environment of an aircraft fuel tank can be incompatible with many oxygen sensors. In the past, extensive sample trains have been developed to obtain an ullage gas sample safely and expose it to a common sensor technology in manner compatible with the calibration requirements of the sensor. These gas sample trains can be heavy, complex, unreliable, and prone to calibration problems. It would be more advantageous to have a measurement system that was contained in the fuel tank ullage (in situ sensor) or required only a small, unregulated gas sample.

Preliminary data has illustrated that light absorption methods as well as fluorescence quenching methods of sensing can represent calibration gases in a variable environment with a reasonable degree of accuracy, but have a long way to go to give the same kind of consistent adherence to known oxygen concentrations as a controlled sample train with a galvanic cell sensor. Although light absorption methods (with tunable laser diodes) have problems measuring low partial pressures of oxygen, they are able to track the behavior of an ullage under typical commercial fuel tank inerting conditions. A commercially available, in situ light absorption sensor/analyzer was able to duplicate calibration gases up to 25,000 foot altitude with a high degree of accuracy.



Block Diagram of Flammability Testing Experimental Setup