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Measurement of Oxygen Concentration in a Boeing 737 Center Wing Fuel Tank During Ground and Flight Testing

A series of aircraft flight and ground tests were performed by the FAA and the Boeing company to demonstrate the potential effectiveness of ground-based inerting (GBI) as a means of reducing the flammability of fuel tanks in the commercial transport fleet. Boeing made available a Boeing B-737 for modification and testing. A nitrogen-enriched air (NEA) distribution manifold, designed, built, and installed by Boeing allowed for instrumented with gas sample tubing and thermocouples to allow for a measurement of fuel tank inerting and heating during the testing. The FAA developed an in flight gas sampling system, integrated with 8 oxygen analyzers, to continuously monitor the ullage oxygen concentration at 8 different locations. This system was designed and integrated to allow for safe operation of the system with different fuel plan. The test plan called for both ground and flight tests with different fuel loads and different wind conditions (5 flight, 5 ground) to demonstrate the effectiveness of GBI.

The Onboard Oxygen Analysis System (OBOAS) was developed by designing an integrated, 8 channel, continuous ullage gas sampling system (OBUSS) with flow through oxygen sensors. Each sensor operated remotely from an oxygen analyzer that provided real-time oxygen concentration data for that sample location. Calibration and operational procedures were developed to provide the best possible accuracy while maintaining an acceptable level of safety given the limitations of the system. Data illustrates the system worked effectively given the goals of the project. Oxygen concentrations of the ullage were measured in flight and during ground operations with different fuel loads and wind conditions. This allowed for the validation of the concept that a commercial transport aircraft could have a significant reduction in fuel tank flammability using ground supplied NEA to inert the ullage.