



Код: 10798

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Progress Towards the Development and Qualification of an All Optical Temperature and Pressure Compensated Fiber Optic Oxygen Sensor for Monitoring Ullage Environment in Aircraft Fuel Tanks

Дрезден, Германия, 2012 год

6 стр; формат: 23,5 x 16 см

Redondo Optics Inc. (ROI) in collaboration with Aviation Safety Facilitators (ASF) is in the process of developing an all-optical pressure and temperature compensated fiber sensor oxygen for use in the in-situ closed-loop-control monitoring of the inert atmosphere environment inside fuel tanks of military and commercial aircraft. The all-optical atmosphere environment control sensor is a passive optical sensor device with no electrical connections leading to the sensors install within the fuel tanks of an aircraft. To control the fuel tank environment, an array of multiple sensors is deployed at multiple locations within the fuel tanks of the aircraft, and a remote multi-channel optoelectronic system is used to monitor the status of all the sensors in real time, and to provide feedback environment information to the OBIGS system. The deployed sensors install in the tanks is connected to the optoelectronic system via a fiber optic conduit. The all optical sensor consists of an integrated multi-parameter fiber optic sensor probe that integrates a fluorescence based optical oxygen optrode with built-in temperature and pressure optical sensors within the same probe for compensation of temperature and pressure variants induced in the fluorescence response of the oxygen optrode. A multichannel frequency-domain fiber optic sensor read-out (FOxSense™) system is used to interrogate the optical signal of all three sensors in real-time and to display the fuel tank oxygen environment suitable for aircraft status and alarm applications. Preliminary testing of the all optical fiber optic oxygen sensor have demonstrated the ability to monitor the oxygen environment inside a simulated fuel tank in the range of 0% O₂ to 21% O₂ concentrations, temperatures from (-) 40°C to (+) 60°C, and altitudes from 0-ft to 40,000-ft.

Доклад. 6-я Европейская конференция по мониторингу технического состояния сооружений, 2012. Редакция Кристиана Боллера.

Ключевые слова:

Embedded fiber sensors, fuel sensors, atmospheric sensors, structural health monitoring, nondestructive inspection, aerospace, military, and miniature

Содержание

Abstract

Introduction

All-optical fiber optic oxygen sensor (FOxSense™) system

Low altitude flight simulation test protocol

Summary

Acknowledgements