

AEROSPACE INFORMATION REPORT

AIR6325™

Issued

2020-11

Fuel Level Point Sensing

RATIONALE

Fuel level measurement in Aircraft tanks can be either continuous or point values. This document covers the design of point values detection systems also called fuel level sensing systems (FLSS) which are generally complementary to a continuous fuel measurement system also called fuel gauging.

FOREWORD

Fuel level sensing systems have been used for many years on commercial and military airplanes to provide fuel control automated shutoff status, information and alerts to the pilot or vehicle management system. Indications may be given for a low or high level of fuel which may impact the mission, or the desired operation of the aircraft. The FLSS may also be used to control various elements in the aircraft fuel system as follows:

- High level sensors preventing overfill or overshoot during pressure ground refueling
- Low level sensors indicating a low fuel quantity, independent of the gauging system
- Low level sensors advising of tank depletion or potential engine fuel starvation
- Low level sensors interrupting operation of a pump to prevent dry-running
- Level sensors to act in parallel with the fuel gauging system to increase the integrity of the fuel transfer control
- Level sensors to provide control of transfers, independent of the gauging systems
- Level sensors used to detect fuel leakage or the presence of fuel in bays adjacent to the main fuel tanks

The FLSS is generally used to increase the overall fuel measurement system safety and integrity by controlling critical operating points with dissimilarity in the design.

This document provides guidelines for the design and installation of a fuel level sensing system as well as for its integration within the aircraft fuel system.

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2020 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
http://www.sae.org

SAE WEB ADDRESS:

Full document details: SAE AIR6325

For more information on this standard, visit
<https://www.sae.org/standards/content/AIR6325>

Documents

Document Sharing Hub

TABLE OF CONTENTS

1.	SCOPE.....	3
2.	REFERENCES.....	3
2.1	Applicable Documents	3
2.1.1	SAE Publications.....	3
2.1.2	ARINC Publications.....	3
2.1.3	FAA Publications	3
2.2	Related Publications	3
2.3	Acronyms and Abbreviations	4
3.	OVERVIEW OF FUEL POINT LEVEL SENSING TECHNOLOGIES	4
3.1	General	4
3.2	Sensor Technologies	5
3.2.1	Float Type Sensors	5
3.2.2	Capacitive Sensors	6
3.2.3	Thermistor Type Sensors.....	6
3.2.4	Zener Diodes.....	7
3.2.5	Optical Sensors	7
3.2.6	Ultrasonic Sensors	8
3.3	Level Sense System Integrity Check	8
3.4	Fuel Tank Ignition Prevention	8
3.4.1	General	8
3.4.2	Safety Factors	9
3.4.3	Component Surface Temperature	9
3.4.4	Energy	9
3.4.5	Filament Heating	10
3.4.6	Separation Distances	10
3.4.7	Safety Analysis.....	10
3.5	Gauging/Level Sensing Segregation	10
3.6	Installation Considerations.....	10
4.	NOTES.....	11
4.1	Revision Indicator.....	11
Figure 1		5
Figure 2		6
Figure 3		7
Figure 4		8

1. SCOPE

This report is intended to identify the various existing technologies used for a fuel level sensing system. In addition to sensing technologies, it describes the basic architecture of fuel level sensing systems and their association with fuel gauging system to increase integrity of fuel measurement and management.

As the fuel level sensing system is generally based on electrical components within fuel tanks, a specific focus is made on fuel tank explosion safety protection.

An overview of the capacitive fuel gauging operation can be found in AIR5691.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AIR5691	Guidance for the Design and Installation of Fuel Quantity Indicating Systems
ARP1870	Aerospace Systems Electrical Bonding and Grounding for Electromagnetic Compatibility and Safety
ARP5412	Aircraft Lightning Environment and Related Test Waveforms
ARP8615	Fuel System Components: General Specification For

2.1.2 ARINC Publications

Available from ARINC, 2551 Riva Road, Annapolis, MD 21401-7435, Tel: 410-266-4000, www.arinc.com.

ARINC Report 611 Guidance for the Design and Installation of Fuel Quantity Systems

2.1.3 FAA Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

AC25.981-1	Fuel Tank Ignition Source Prevention Guidelines
AC25.954.1	Transport Airplane Fuel System Lightning Protection

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

IEC 600079-11	Electrical Apparatus for Explosive Gas Atmosphere
EN50014	Electrical Apparatus for Potentially Explosive Atmospheres

2.3 Acronyms and Abbreviations

AC	Advisory Circular
AIR	Aerospace Information Report
ARP	Aerospace Recommended Practice
ARINC	Aeronautical Radio Incorporated.
BIT	Built-in-Test
CG	Center of Gravity
DC	Direct Current
EASA	European Aviation Safety Agency
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FLSS	Fuel Level Sense System
IEC	International Electrotechnical Commission
LRU	Line Replaceable Unit
NEA	Nitrogen Enriched Air
VDC	Volts Direct Current

3. OVERVIEW OF FUEL POINT LEVEL SENSING TECHNOLOGIES

3.1 General

Fuel level sensing systems typically use one of the following technologies to indicate a wet/dry status of a fuel point measurement, these are:

- a. Float
- b. Capacitance
- c. Thermistor
- d. Zener diodes
- e. Optical
- f. Ultrasonic

Each of these sensing technologies is described below. In principle the level sensing system downstream of the sensor interface will be largely the same, since all sensor technologies are used to derive a wet/dry status which gives an indication of the volume of fuel in the tank. The sensor status can be used for the following functions:

- a. Provide a low fuel alert to the pilot
- b. Perform a shut-off of the refuel valve in case of tank overflow