EI 1583

Laboratory tests and minimum performance levels for aviation fuel filter monitors

7th edition
EI 1583

LABORATORY TESTS AND MINIMUM PERFORMANCE LEVELS FOR AVIATION FUEL FILTER MONITORS

Seventh edition

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FOREWORD

This publication is intended to provide the industry with general mechanical specifications for new aviation fuel filter monitor designs, laboratory test procedures and minimum laboratory performance levels for selected aspects of the performance of filter monitor elements and systems. The aspects of performance selected for inclusion in this publication are primarily those where a laboratory test has been developed with sufficient experience to identify a minimum level of performance. No attempt is made to completely define all necessary tests or aspects of performance for products to be suitable for every application. In all cases the purchaser should discuss the particular application with the manufacturer.

This publication is not in any way intended to prohibit either the purchase or manufacture of filter monitor systems or elements meeting other requirements. It is hoped and anticipated that this publication will assist those involved in manufacturing and purchasing filter monitor systems and elements.

This is the seventh edition of this publication, which supersedes all earlier editions. With the publication of the seventh edition of EI 1583, the sixth edition is hereby formally withdrawn from publication.

It is imperative for manufacturers, purchasers, and users of filter monitors to be aware that the laboratory performance tests and minimum laboratory performance levels described herein may be of reduced utility in predicting in-service performance since it is not possible to replicate exactly in a laboratory the environmental and operational parameters to which a filter monitor system or elements may be exposed when in service in commercial aircraft fuelling applications. Laboratory performance testing of used filter monitor elements (qualified to earlier editions of 1583) removed from field service, has shown that water absorption performance may deteriorate to levels less than specified in EI 1583 for new elements. It has not been possible to identify with certainty the mechanisms that cause such deterioration in service, despite significant collaborative research and investigations by industry representatives. Evidence also suggests that even the performance of new elements may be sensitive to environmental parameters.

Thus, the use of filter monitors that meet the requirements of EI 1583 alone cannot provide assurance that free water in fuel will be prevented from passing onto an aircraft. Filter monitors that meet the requirements of EI 1583 are intended to be part of a comprehensive system to protect aviation fuel cleanliness, and cannot be regarded as fail-safe devices on their own. For further information on systems to protect aviation fuel cleanliness see EI 1550 Handbook on equipment used for the maintenance and delivery of clean aviation fuel. For further information on issues suspected or known to impact the performance of filter monitors (such as the temperature and salinity of free water) see EI 1550 Annex H (in first edition). This information however, is intended to only provide examples, not to capture all issues that must be addressed by a filter monitor manufacturer to produce a product that is fit-for-purpose.

It has also been stated that the use of filter monitors (qualified to earlier editions of 1583) may result in unknown quantities of super-absorbent polymer (SAP) passing downstream of filter monitors, even when filter monitors are operated in accordance with manufacturers' instructions. This edition of 1583 includes an ICP copper quantification method to confirm that during Qualification Test 1 (media migration and starting differential pressure) and 10 (partial water immersion) SAP is not detectable in fuel downstream of a filter monitor element under test. However, manufacturers and users shall note that the use of filter monitors that meet the requirements of this publication alone cannot provide assurance that SAP contamination in fuel will be prevented, since
it is not possible to replicate exactly in a laboratory the environmental and operational parameters to which a filter monitor system or elements may be exposed when in service.

This publication is intended to be applied to the qualification of a model of filter monitor element and system. The destructive nature of these laboratory tests renders them unsuitable for ‘every-element’ quality control testing, see 1.3.3. Once a model of element has been qualified in accordance with this publication it is the intention that all production elements of that model are identical in their design, materials and production techniques, see also section 7.

It is anticipated that purchasers may wish to install filter monitor elements in vessels originally designed for use with other types of filter elements. In these cases the element general mechanical specification and minimum laboratory performance requirements of this publication may be used for the purchase of elements without a new filter monitor vessel.

Any manufacturer wishing to offer filter monitor systems and/or elements stated to comply with this publication is responsible for complying with all the mandatory provisions included herein. It is the responsibility of the manufacturer to further define any application and/or performance limitations that affect the serviceability of filter monitor systems in aircraft servicing. IN NO EVENT SHALL ANY MANUFACTURER REPRESENT A FILTER MONITOR AS BEING ‘FIT-FOR-PURPOSE’ IN AVIATION FUELLING OPERATIONS ON THE SOLE BASIS OF MEETING THE MINIMUM LABORATORY PERFORMANCE LEVELS INCLUDED IN THIS PUBLICATION. Nor shall the minimum laboratory performance tests described in this publication be taken as the only aspects of performance that a user should investigate prior to the routine use in their operations of any equipment that meets the requirements of those tests.

Purchasers are advised to make any enquiries of the manufacturer to confirm that the product is acceptable, and are strongly encouraged to conduct field testing, before deeming a product acceptable. The purchaser should make any investigations and conduct any testing necessary to confirm that the manufacturer has conformed to this publication and that the equipment meets the purchaser’s requirements. The purchaser should not rely solely on the manufacturer’s representation that the manufacturer’s filter monitor has been ‘qualified to’ 1583, or that its filter monitors otherwise ‘meet’ the standard, as laboratory testing cannot assess the long-term durability, mechanical integrity and performance of filter monitor systems or elements in service.

The only change in this edition from the sixth edition is the inclusion of a requirement that SAP is not detectable in fuel downstream of a filter monitor element under test during Qualification Test 1 and 10. As no other changes have been made to the qualification testing requirements that were included in the 6th edition, existing qualifications to EI 1583 6th edition are recognised as also meeting the requirements of this 7th edition if the ICP copper values obtained during both qualification test 1 and 10 were below the lower limit of detection for the method (≤ 50 ppb). This read-across from the 6th to 7th editions applies only to the specific model qualified.
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US Department of Defense
Vitol Aviation
World Fuel Services
1 INTRODUCTION AND SCOPE

1.1 INTRODUCTION

This publication describes laboratory tests and the minimum laboratory performance levels for selected aspects of performance of filter monitor elements and systems. A filter monitor system is comprised of a pressure vessel containing one or more filter monitor elements. Filter monitor vessels may be oriented vertically or horizontally. Any manufacturer wishing to offer filter monitor systems and/or elements stated to comply with this publication is responsible for complying with all the mandatory provisions included herein. However, no attempt is made to completely define the performance of products to be fit for a particular purpose. It is the responsibility of the manufacturer to further define any application and/or performance limitations that affect the serviceability of filter monitor systems in aircraft servicing.

The intended performance of a filter monitor system is to continuously remove particulate matter and water from aviation fuel to levels acceptable for servicing modern aircraft. It is also intended that in service a filter monitor system will restrict the flow of fuel before its capacity for particulate matter and/or water removal is exhausted.

A filter monitor system is not a fail-safe device for protecting aviation fuel cleanliness. The removal of water from fuel by absorption relies on chemical interactions that can be disrupted by extraneous agents, both known and unknown. The performance of filter monitor elements that comply with the mandatory requirements of this publication may also be sensitive to certain environmental or operational conditions, such as low temperatures or high salinity of free water. Filter monitor elements may differ in design in the selection of filtration and water absorbing materials. Different water absorbing materials may respond differently to field parameters such as fuel/water temperature, the salinity of free water, and the presence of trace contaminants. Further, the possibility of filter monitor elements releasing super-absorbent polymer (SAP) into the fuel stream (SAP migration) can depend upon materials selection, element design, element production methods, environmental and operational factors. Further details regarding issues suspected or known to impact the performance of filter monitors are included in EI 1550 Handbook on equipment used for the maintenance and delivery of clean aviation fuel. These issues should be separately addressed between the user and manufacturer to ensure that the performance capabilities of the filtration equipment are suitable for the intended application.

Thus, the use of filter monitors that meet the requirements of EI 1583 alone cannot provide assurance that water in fuel will be prevented from passing onto an aircraft, or that SAP migration from filter monitor elements will not occur. Filter monitor systems must therefore be regarded as only one component in a comprehensive system to protect aviation fuel cleanliness.

In no event shall any manufacturer represent a filter monitor as being ‘fit-for-purpose’ in aviation fuelling operations on the sole basis of meeting the requirements of this publication. Nor shall the minimum laboratory performance tests described in this publication be taken as the only aspects of performance that a user should investigate prior to the routine use in their operations of any equipment that meets the requirements of those tests.
1.2  SCOPE

This publication provides minimum recommendations for:

− Selected aspects of filter monitor system and element performance.
− The general mechanical specifications for new filter monitor elements.
− Laboratory tests and minimum performance requirements for the qualification of new filter monitor elements, including materials compatibility with low flash point fuels.
− Requalification and similarity requirements.

The laboratory tests specified in this publication are intended to provide standard methods of evaluating selected aspects of the performance of new filter monitor system and element designs thought to be relevant to field service. They are not intended to predict the actual performance of filter monitors in field service. Aspects of performance including degradation of water absorption and the migration of SAP may vary with fuel and operational environment. Users should work with their suppliers to ensure that their application of filter monitors provides the performance needed in the particular application.

The scope of this publication is limited to elements of 50 mm (2 in.) nominal diameter up to 76 cm (30 in.) nominal length flowing out-to-in, and 150 mm (6 in.) nominal diameter up to 145 cm (57 in.) nominal length flowing out-to-in or in-to-out. Any model of element can also be qualified as ‘HS’ (High Salt) by passing Qualification Tests 15 and 16 using synthetic seawater (ASTM D1141) in lieu of 0.5% (m/m) NaCl in water.

This publication does not address:

− Specific material requirements for the filter monitor element (other than those known to have an effect on fuel compatibility).
− Nominal diameters of elements other than 50 mm (2 in.) or 150 mm (6 in.).
− Water and/or particulate matter removal performance testing in low flash point fuels.
− Maintenance or service life performance.
− Trigger type elements.
− The operation and performance of filter monitor systems and/or elements in fuels containing any fuel system icing inhibitor (FSII), also called diethylene glycol monomethyl ether (DiEGME). This fuel additive makes unusually difficult demands on filtration and water separation/removal devices and may promote the decomposition of filters and release of SAP into fuel.
− Certain aspects of design and performance necessary to provide products that are fit for a particular purpose. Many aspects of filter monitor performance are neither measured nor controlled by this publication. Filter monitor elements may differ in design in the selection of filtration and water absorbing materials. Different water absorbing materials may respond differently to field parameters such as fuel/water temperature, the salinity of free water, free water, and the presence of trace contaminants. Further, the possibility of these

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1 Although the laboratory tests included in this publication have been specifically developed for 50 mm (2 in.) and 150 mm (6 in.) elements only, the test protocols may be modified for use to evaluate the performance of other element diameters, as agreed between a manufacturer and user/purchaser. In such cases qualification to this publication cannot be claimed.

2 Due to safety issues with the handling of low flash point fuels the water and/or dirt removal tests use only jet fuels. There is an acceptance, based on industry experience, that the measured performance of filters in jet fuels translates across to filter performance in low flash products such as aviation gasoline, jet B etc.
elements releasing SAP can depend upon materials selection, element design, environmental and operational factors. These issues are beyond the scope of this publication, and thus should be separately addressed between the user and manufacturer to ensure that the performance capabilities of the filtration equipment are suitable for the intended application.

1.3 DEFINITIONS

1.3.1 Filter monitor system

A filter monitor system is a pressure vessel containing filter elements. A filter monitor system is one component of a system intended to only remove particulate matter and free water from aviation fuel. A filter monitor system is not, by itself, a fail-safe device. Filter monitor systems shall be regarded as one component in a comprehensive system to protect aviation fuel cleanliness.

1.3.2 Filter monitor element

A filter monitor element is the consumable component of a filter monitor system with particulate matter removal and water absorption capabilities. A filter monitor element is also sometimes referred to as a cartridge.

The filter monitor elements defined by this publication are:

- 50 mm (2 in.) nominal diameter with out-to-in flow, that have water absorption capabilities defined by a water blocking time of at least 10 minutes during Qualification Test 2 50 ppm water removal, rated flow and particulate matter holding capacity defined by a solids blocking time of at least 10 minutes during Qualification Test 6 Solids test.
- 150 mm (6 in.) nominal diameter with out-to-in, or in-to-out flow, that have water absorption capabilities defined by a blocking time of at least 40 minutes during Qualification Test 2 50 ppm water removal, rated flow and particulate matter holding capacity defined by a blocking time of at least 50 minutes during Qualification Test 6 Solids test.
- Any element may be classified as HS if it meets the requirements of Qualification Tests 15 and 16 using synthetic seawater (ASTM D1141) in lieu of 0.5% (m/m) NaCl.

1.3.3 Qualified element model

A qualified element model is one of specific design and construction that is documented by a manufacturer to meet all mandatory tests specified in this publication. Tests are witnessed by a representative of the purchaser/user as described below. Any design, construction, materials or manufacturing changes to the qualified element model that exceed those described in section 7 shall constitute the creation of a new element model requiring full qualification. All production elements are required to be identical in their design, construction and materials to the qualified model. See Foreword.
1.3.4 Single element qualification test

A single element qualification test is a test that is performed with one filter monitor element in a purpose-built pressure vessel (as opposed to a full-scale test) with fuel flowing in single pass mode through the test facility. For a single element qualification test there has to be a sufficient volume of fuel in tank #1 to complete the test.

1.3.5 Full-scale qualification test

A full-scale qualification test is a test performed with a filter monitor system of at least 300 gpm, configured with the full complement of elements as intended for field service with fuel flowing in either single pass or recirculation mode through the test facility.

1.3.6 Water blocking time, or water holding capacity

This is the time taken for an element under test to reach 150 kPa (1,5 bar) pressure differential at full rated flow with a influent water addition rate of 50 ppmv.

1.3.7 Solids blocking time, or solids holding capacity

This is the time taken for an element under test to reach 150 kPa (1,5 bar) pressure differential at full rated flow with an influent solids addition rate of 10 mg/litre.