

Bulletin 2020.3 Dirt Defense Filtration with Electronic Water Sensors August 2020



Following the IATA Super Absorbent Polymer (SAP) Special Interest Group report, the aviation fuel industry has collaborated to evaluate alternative technologies that can be fitted into existing fueling equipment. After rigorous evaluation, ATA103 is being modified to incorporate the first of these replacement technologies: the dirt defense filter with electronic water sensor system. Airlines for America (A4A) will continue working together with the International Air Transport Association (IATA) and the Joint Inspection Group (JIG) to assess other replacement technologies for potential inclusion in ATA103.

As outlined in A4A Bulletin 2019.1, an **interim** decision has been made to continue accepting EI 1583 7th edition filter monitor elements in the ATA103 beyond the specification withdrawal at the end of this year. A4A would like to reiterate that filter monitors have no future in commercial aviation and will be phased out. It is imperative that into-plane fueling providers continue strict adherence to the A4A Bulletin 2017.2 actions and the filter monitor operational parameters in ATA103.

What are Dirt Defense Filters?

EI 1599 qualified dirt defense filters, similar to micro-filters, remove dirt and solid particulates from fuel, but do not remove free water. These filters come in a variety of formats, including 2" and 6" diameter, and can be fitted into existing filter monitor vessels.

What are EI 1598 type Electronic Water Sensors?

Electronic water sensors (EWS), meeting the requirements of EI 1598, can detect and quantify small amounts of free water in jet fuel. These sensors are designed to continually monitor fuel for free water, providing real-time water levels in parts per million (ppm). The EWS, when fitted into refueling vehicle pipework, quantify free water levels during fueling operations.

How does the combination system work?

EI 1599 dirt defense filters, when combined with an EI 1598 electronic water sensor, creates a system that can be used, in some circumstances, as a replacement for filter monitors. The system works by physically removing dirt and particulates as fuel passes through the filter, while the sensor provides real-time free water content. The system, which is connected to the vehicle's deadman system through a logic controller or smart register, alerts the operator and shuts down fueling when excessive water is present.

An indicator light, solidly illuminated, provides continuous feedback when the system is operating properly, and no water is detected. When excessive water is present, the system shuts down the flow of fuel and the indicator light flashes. When there is no signal from the sensor, the indicator light turns off and the deadman system will not engage.

While the combination system does not remove free water, it is designed to shut down fueling when there is excessive free water. With this system, jet fuel with 20 parts per million (ppm) water or less is passed through the dirt defense filter to the aircraft; jet fuel with greater than 20 ppm water will trigger a fueling shutdown to prevent that excess water from reaching the aircraft. If the system

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shuts down, due to water above 20ppm, fueling would need to be completed using equipment with water removal capabilities (i.e., filter monitors or filter water separators).

Important factors in the use of a dirt defense filter with electronic water sensor system

While the dirt defense filter with electronic water sensor system is being incorporated into the ATA103 as one potential replacement for filter monitors, there are several critical factors for operators to consider:

- **Dirt defense filters must *NEVER* be used without an EI 1598 type electronic water sensor; doing so causes unsafe conditions for aircraft operations.**
- The correct installation of EI 1598 electronic water sensors is critical to their proper functionality. Improper installation can cause these sensors to mis-read the free water concentration in fuel, causing unsafe conditions for aircraft operations. Sensors should be installed in accordance with manufacturer instructions and by trained installers.
- This system may not be suitable for all fueling operations. Operations with increased filter monitor changeout frequencies may experience increased fueling shutdowns when using this system. For example, locations that typically have to change filter monitors in the springtime may have increased fueling shutdowns with this system. Although the electronic water sensor system (when properly installed) is designed to stop the fueling if excessive water is detected, locations should consider how often this could happen and determine whether this is suitable for their operation. When the sensor detects excessive water, fueling will need to be completed with equipment that can remove water (i.e., a filter monitor or filter water separator). Operators should consider the potential for operational impacts.
- Operators should consider their typical ambient conditions and compare to the electronic water sensor's specified operating range. Some operations may experience ambient temperatures outside the manufacturer's specified equipment operating range rendering the equipment unable to be used until ambient temperatures are within the acceptable range.
- Mixed fleet operations (some fueling equipment fitted with this system and other equipment fitted with filter water separators or filter monitors) shall have strong operational controls to prevent the inadvertent use of dirt defense filters in equipment that does not have an electronic water sensor. Dirt defense filters look nearly identical to other types of filters and can be mixed up easily. If dirt defense filters are inadvertently installed without an electronic water sensor, this creates an unsafe condition for aircraft operations.
- A4A welcomes operator feedback on Dirt Defense Filters with Electronic Water Sensor System use.

ATA103 Modifications:

Airlines for America is immediately modifying ATA103 to ***allow the use of dirt defense filters with electronic water sensor system***. The below modification will serve as an interim change to ATA103 until a full revision can be published. Other replacement filtration technology continues to be evaluated for potential inclusion in ATA103. **ATA 103, revision 2017.2, is modified as follows:**

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2.1. General

[...]

2.1.2. Records

[...]

Records shall indicate when equipment is not used. Retain records in local files as follows:

Record Type	Record Retention Length
Daily Check Records Weekly Check Records Monthly Check Records Quarterly Check Records Semi-Annual Check Records Annual Check Records Fuel Receipt Records Fuel Quality Test Records	12 months
Filter Change Records Filter Inspection Records Product Reclaim Tank Inspection and Cleaning Records Sump Separator Tank Inspection and Cleaning Records Refueler Tank Inspection and Cleaning Records <u>[EI 1598] type Electronic Water Sensor Data</u>	36 months
Storage Tank Inspection and Cleaning Records Training Records	Indefinitely

[...]

2.1.12. Tool Calibration

Equipment shall be calibrated at the frequency listed below in [\[Table 2.1.1\]](#). Calibration shall be performed by a company that uses standards whose accuracies are traceable to the National Institute of Standards and Technology (NIST) and in compliance with ANSI/NCSL Z540750-1 standards, or equivalent. A calibration certificate shall be provided.

Table 2.1.1 Equipment Calibration Frequency

Item	Frequency of Calibration
[...]	[...]
<u>[EI 1598] type Electronic Water Sensors</u>	<u>[EI 1598] type electronic water sensors shall be verified annually and shall be calibrated when the annual verification indicates that the accuracy of the sensor is outside the manufacturer's specified tolerance range</u>

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[...]

2.8. Aircraft Fueling Equipment Requirements

[...]

2.8.2. Filters

All aircraft fueling equipment shall have a ~~Filter/Separator or a Filter Monitor~~ filter or filter system outlined in [Section 2.8.2.1], [Section 2.8.2.2], or [Section 2.8.2.3].

All filtration vessels shall include:

- (a) Air elimination provisions
- (b) Direct reading differential pressure gauges with an accuracy of +/- 2 PSI
- (c) Manual sump drains - Valves with handles spring loaded to the closed position are recommended
- (d) Upstream and downstream membrane sampling connections, including probes and dust covers
- (e) Pressure relief valve or other device that will prevent over-pressurization due to thermal expansion of fuel. Include a means for accommodating relieved fuel
- (f) Placards indicating upstream/downstream connections for sampling
- (g) Placard indicating date (month and year) of last filter element change
- (h) An operational data plate in accordance with [\[EI 1596\]](#)

NOTE: An API monogram (API placarding) is not necessary to meet the requirements of this document.

[...]

2.8.2.3. Dirt Defense Filter with Electronic Water Sensor System

A multi-component system comprising all the following:

- Dirt defense filter elements meeting the requirements of [Section 2.8.2.3.1]; and,
- Electronic water sensor meeting the requirements of [Section 2.8.2.3.2]; and,
- Programmable logic controller (PLC) meeting the requirements of [Section 2.8.2.3.3]; and,
- Indicator light meeting the requirements of [Section 2.8.2.3.4].

The system provides filtration of dirt and solid particulates only. Dirt defense filter elements are not designed to remove water. Instead, any free water present in fuel is detected by an [EI 1598] type electronic water sensor. The system measures the water in real time, alerts the operator, and shuts down fueling if water exceeds the specified threshold.

WARNING: DIRT DEFENSE FILTERS SHALL NOT BE USED WITHOUT AN [EI 1598] TYPE ELECTRONIC WATER SENSOR, PLC, AND INDICATOR LIGHT.

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USING DIRT DEFENSE FILTERS WITHOUT AN ELECTRONIC WATER SENSOR CREATES UNSAFE CONDITIONS FOR AIRCRAFT OPERATIONS.

Operators that are using both dirt defense filters and another type of filter (such as filter monitors) shall have written procedures to prevent dirt defense filters from being used in a vessel that is not equipped with an [EI 1598] type electronic water sensor. Dirt defense filter elements looks nearly identical to filter monitors. Care should be taken to ensure operators do not inadvertently install dirt defense elements in a vessel intended to be used with a water removal filtration technology, such as filter monitors.

Only dirt defense elements qualified to [EI 1599] and electronic water sensors meeting the requirements of [EI 1598], where the combination system have been subjected to performance testing on a test rig and in-service field trials over a 12-month period, with supportive data made available, meet the requirements of this paragraph. Operators shall confirm with the filter and sensor manufacturer(s) that the specific dirt defense filter and sensor combination have been successfully field trialed prior to use and have met the field trial criteria. Operators should validate that the multi-component system is appropriate for their operating environment(s), e.g. via a small-scale trial prior to proceeding to an extended use.

In addition to the requirements in [Section 2.8.2], dirt defense filter vessels shall be equipped with:

- (a) Pressure limiting device that will shut down flow if 15 psi (the changeout differential pressure of the filter) is reached
- (b) Restrictions on reset procedures in the event of a shutdown
- (c) Ability to perform periodic testing of the differential pressure limiting switch
- (d) An automatic water defense system that will cause fueling to stop when activated by excessive water. Water defense systems shall include provisions for an operational test. NOTE: this is not the same as the [EI 1598] type electronic water sensor
- (e) Placard indicating date (month and year) of last visual inspection of elements and vessel interior

In the event that the pressure limiting device is activated, the operator shall be questioned about the proper monitoring of differential pressure during fueling. Differential pressure records on the vessel shall be examined and corrective action taken if necessary.

In the event that the electronic water sensor alerts to the presence of water and fueling shuts down as outlined in 2.8.2.3.3 (a) or (b), fueling shall be discontinued with this system and shall be continued with a system that is capable of removing water (i.e., a filter monitor or a filter water separator). System shall include restrictions on reset procedures in the event of a shutdown.

2.8.2.3.1. Dirt Defense Filters

Dirt defense filter elements shall meet the requirements of [EI 1599].

NOTE: Dirt defense elements can have some coalescing properties and it is not yet known whether they are prone to microbial growth. Annual visual inspections are critical to monitoring this condition. Coalescing capabilities of dirt defense elements are not adequate to provide water protection for aircraft.

Dirt defense elements shall be replaced on the conditions described in [Section 3.14], not to exceed 36 months.

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2.8.2.3.2. Electronic Water Sensor

Electronic water sensors shall meet the requirements of [EI 1598].

NOTE: These electronic water sensors, meeting the [EI 1598] requirements, are not the same type of sensor as an automatic water defense system. Automatic water defense systems are designed to detect bulk water. This [EI 1598] type electronic water sensor is designed to detect small amounts of free water and return a quantified measurement of that free water in fuel. This [EI 1598] type electronic water sensor cannot be used to meet the requirement for an automatic water defense system.

Proper installation of electronic water sensors is critical for the device to perform accurately. Sensors shall be installed downstream of the filter vessel and in accordance with the sensor manufacturer's specifications. Note: some manufacturers may require installation to be conducted by a qualified installer.

The calibration of electronic water sensors shall be verified annually per manufacturer specifications.

Data from the electronic water sensor shall be retained for 36 months.

2.8.2.3.3. Programmable Logic Controller (PLC)

The system shall have a programmable logic controller (PLC) that is compatible with the electronic water sensor. The PLC shall be capable of accepting input from the electronic water sensor and connecting to the vehicles deadman system. The PLC shall be programmed to:

- (a) Shut down flow of fuel if the electronic water sensor detects water at 20ppm or greater for 10 seconds
- (b) Shut down flow of fuel if the electronic water sensor detects water at 50ppm or greater for 5 seconds
- (c) Control the indicator light as outlined in [Section 2.8.2.3.4].

PLC shall have controls that prevent modification of the programmed set points. PLC shall have restrictions on reset procedures in the event of shutdown, loss of power, or loss of connection with electronic water sensor. Some older design deadman systems can bypass the PLC when in deadman override mode. Operator shall ensure that the PLC will perform the functions in (a) through (c) above, in their fueling equipment's deadman system configuration, including when the deadman override has been activated.

2.8.2.3.4. Indicator Light

The equipment fitted with a dirt defense with sensor system shall have an indicator light. The light shall:

- (a) Be blue in color. If blue lights are prohibited by local regulations, another color shall be used which is unique to the [EI 1598] type electronic water sensor system.
- (b) Be fitted in a location that is visible by the operator during fueling operations. Preferably, the light is placed on or adjacent to the vehicle's fueling control panel and not on top of the vehicle.
- (c) Be controlled by the PLC as outlined in [Section 2.8.2.3.3]
- (d) Remain solid illuminated when the system is on and functioning properly

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(e) Flash to indicate water >20ppm for 10 seconds

(f) Flash to indicate water >50ppm for 5 seconds

The operator shall have written procedures to check that the indicator light functions before each fueling, and actions to take if the light fails to function or stops functioning during fueling.

[...]

2.9. Aircraft Fueling Equipment Checks

[...]

2.9.3. Daily Checks

[...]

2.9.3.2. Filter Sumps

- (a) Filter vessel shall be under pressure, but fuel does not have to be flowing through the vessel when the sample is taken
- (b) Drain approximately one gallon of fuel into a suitable container. Fuel flowing from sump drain valve should be at maximum practicable flow to ensure adequate flushing occurs
- (c) Perform fuel appearance test of filter sumps according to [\[Section 3.1\]](#)
- (d) Record findings of first sample taken according to [\[Section 3.1\]](#)
- (e) Continue to sample until clean, dry fuel is obtained
- (f) Remove unit from service if unable to obtain clean, dry sample after three samples have been drained. Report unusual contamination to aircraft operators if it is anticipated that such contamination may impact aircraft operations

2.9.3.3. Filter Differential Pressure

Under normal flow conditions, check and record differential pressure (Ref. [\[Section 3.9\]](#)).

NOTE: Filter differential pressure shall be periodically monitored during fueling operation. Sudden drops or increases of differential pressure indicates a problem. Fueling shall be immediately terminated and unit removed from service to investigate the problem.

If differential pressure exceeds 15 psi on filter/separators, ~~or~~ 15 psi on filter monitors, or 15psi on dirt defense filters, the equipment shall be removed from service.

[...]

2.9.4. Weekly Checks

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[...]

2.9.4.2. Filter Differential Pressure Recorded at, or Corrected to, Maximum Achievable Flow Rate

At the maximum achievable flow rate, check and record the differential pressure and flow rate. Preferably, flow rate should be above 50% of maximum vessel rated flow. Where the filter cannot be exposed to the maximum achievable flow rate of the facility, use a procedure endorsed by the manufacturer of the filter elements to correct the differential pressure to maximum achievable flow rate and record the value. Record method used.

[...]

2.9.5. Monthly Checks

2.9.5.1. Filtration Test & Free Water Test

Perform a membrane color/particle (Millipore), under flow, downstream of each filter/separator, ~~and filter~~ monitor, and dirt defense filter vessel.

Perform a free water test downstream of each filter/separator, ~~and filter~~ monitor, and dirt defense filter vessel.

NOTE: Use of bottom loading connections on tank trucks for recirculation should be avoided in order to prevent erroneous test results.

(Ref. [\[Section 3.2\]](#) and [\[Section 3.3\]](#))

[...]

2.9.5.13. Dirt Defense and Electronic Water Sensor System

Check operation of system and proper signal management. Use the tool approved by the manufacturer to simulate, under flow, sensor failure modes. Each of the programmed logic conditions shall be simulated. Confirm that the indicator lamp flashes as the correct frequency, and that the vehicle's deadman system shuts down, as appropriate.

[...]

2.9.8. Annual Checks

2.9.8.1. Filter Vessels and Elements

- (a) A visual inspection of all vessel interiors is to be performed on an annual basis regardless of filter element replacement frequency (Ref. [\[Section 3.13\]](#))

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- 1) Verify that the vessel interior is generally clean and free of water, sediment, evidence of microbial growth or other contamination. Verify there is no evidence of any electrical discharges in the vessel or elements. Clean interior and repair coating as necessary
 - 2) Verify that all elements are undamaged and secure
- (b) Verify filter element condition by utilizing procedures outlined in [\[Section 3.14\]](#):
- Filter coalescer elements service life shall not exceed 36 months
 - Teflon and synthetic separator elements may be reused up to 36 months, provided that they are **cleaned and tested** in accordance with the element manufacturer procedures
 - Filter monitor elements service life shall not exceed 12 months
 - Dirt defense elements service life shall not exceed 36 months

[...]

2.9.8.7. Electronic Water Sensors

- (a) Verify the accuracy of electronic water sensors
- (b) Replace or repair, then calibrate defective electronic water sensors

[...]

3.14. Filter Element Replacement Criteria

3.14.1. Element Replacement Criteria and Frequency

[...]

3.14.1.4. Dirt Defense Elements

Dirt defense elements shall be replaced when any of the following conditions are met:

1. Differential pressure exceeds 15psi or there is a sudden drop in differential pressure at a comparable flow rate
2. Continuous sump samples indicate surfactants, microbial or solid contaminants
3. 36-month service life has expired

[...]

Questions or requests for further information should be submitted to fuel@airlines.org
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