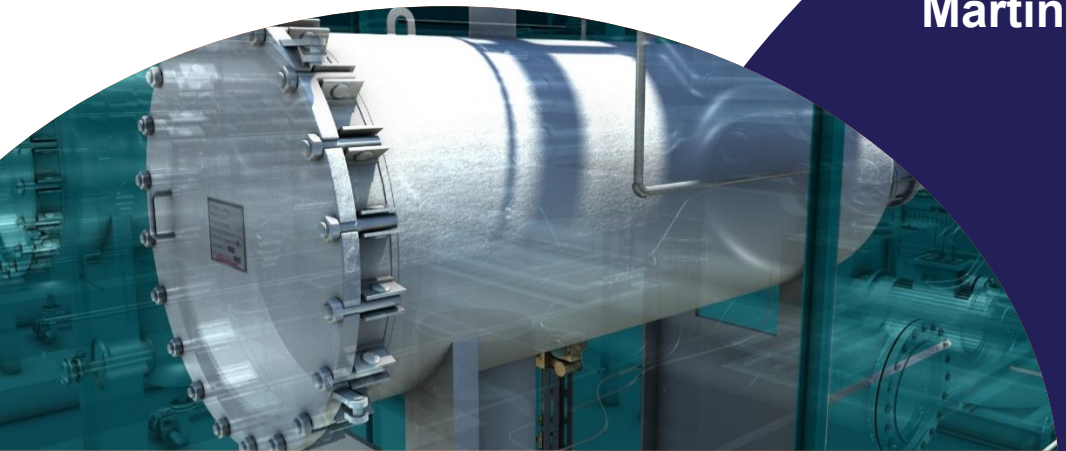
EI specifications, qualification testing and robustness assessment

IATA Fuel Forum
November 2018



Martin Hunnybun, Head of Good Practice – Fuels and Fuel Handling
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Replacing filter monitors

"phasing out of filter monitor filtration and the phasing in of new replacement (drop-in) filtration technologies"

filter element retrofit into filter monitor vessel

Replace elements with another type of filter element

filter vessel replacement

Change to filter/water separator

EI 1589

Materials compatibility testing for filter elements and fuel sensing devices

1st edition, 2016

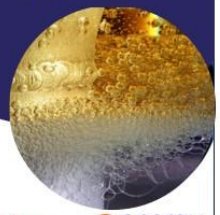
EI 1596

Design and construction of aviation fuel filter vessels

3rd edition, 2018

EI 1550

Handbook on equipment used for the maintenance and delivery of clean aviation fuel



3rd edition

EI 1598

Design, functional requirements and laboratory tests for quantitative electronic sensors

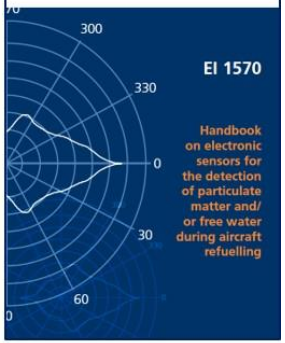
2nd edition, 2012

EI 1592

Design, functional requirements and laboratory tests for qualitative bulk water detectors

1st edition, 2017

EI 1570



Handbook on electronic sensors for the detection of particulate matter and/or free water during aircraft refuelling

EI 1581

Specifications and qualification procedures for filter/water separators

6th edition, 2016

EI 1582

Specification for similarity for filter/water separators

2nd edition, 2011
Reaffirmed, 2016

EI 1588

Laboratory tests and minimum performance levels for aviation fuel water barrier filters

1st edition, 2018

EI 1590

Specifications and qualification procedures for aviation fuel microfilters

3rd edition, 2014

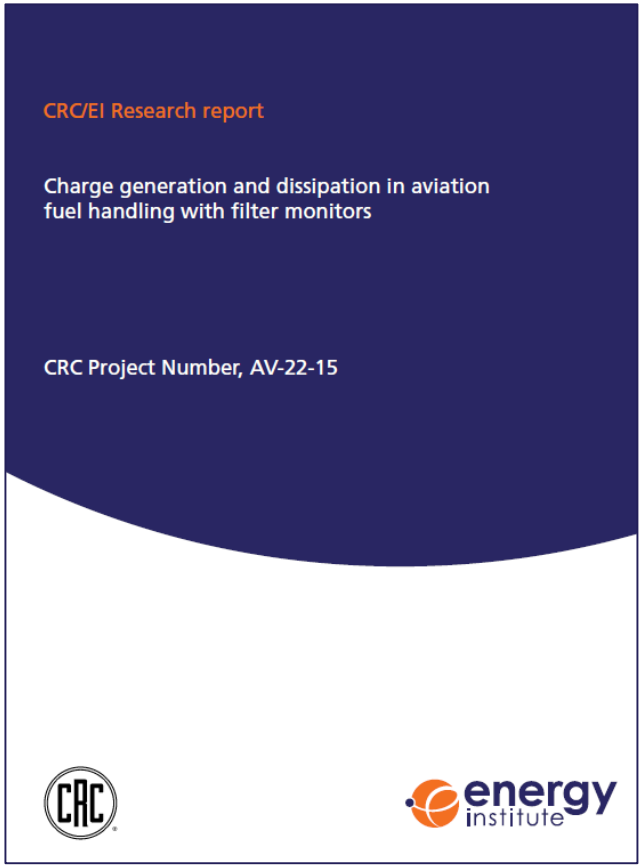
EI 1599

Laboratory tests and minimum performance levels for aviation fuel dirt defence filters

2nd edition, 2017

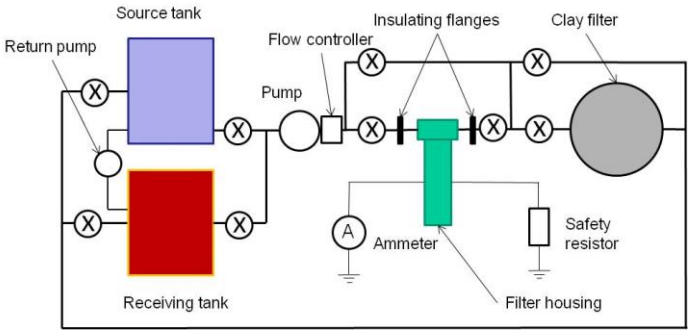
Replacing filter monitors – electrostatic charging of fuel

- CRC/EI study in 2016/17 measured charging of fuel by filter monitor elements
  - AFTON Chemicals rig used, scaled to typical into-plane application
  - Results considered by airframe OEMs to be high, but accepted by them
- Airframe OEMs requested filter monitor replacement technologies to not impart more charge than a filter monitor
- Mechanism to control this required for EI filter specifications, EI1588 and EI 1599



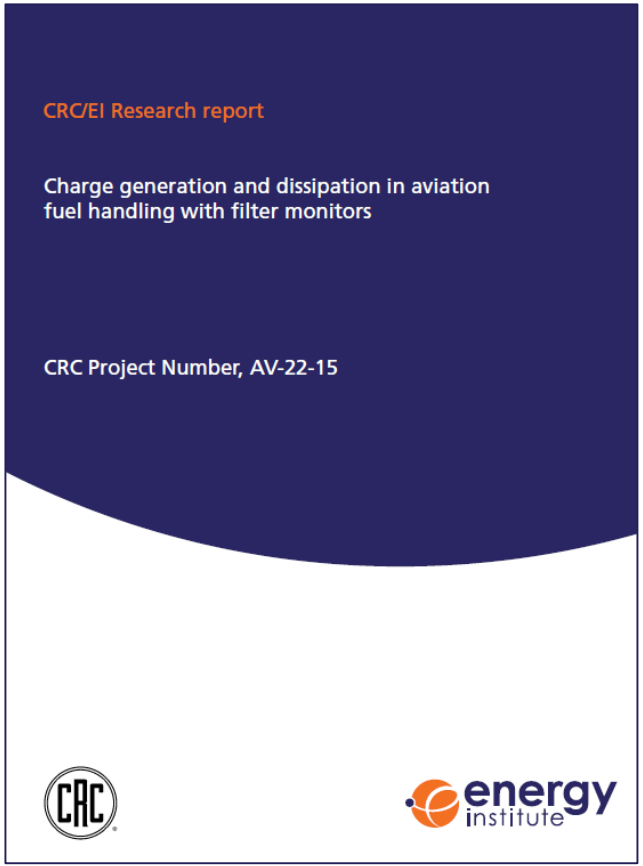
Replacing filter monitors – electrostatic charging of fuel

- Test protocol developed by electrostatic specialist, Harold Walmsley, as a new qualification test
- Two draft versions circulated to generate stakeholder consensus
- Final version now with airframe OEMs (Boeing, Airbus) for agreement to publish
- Represents a significant step-change for industry
- Meeting pass threshold may be a challenge for some replacement technologies



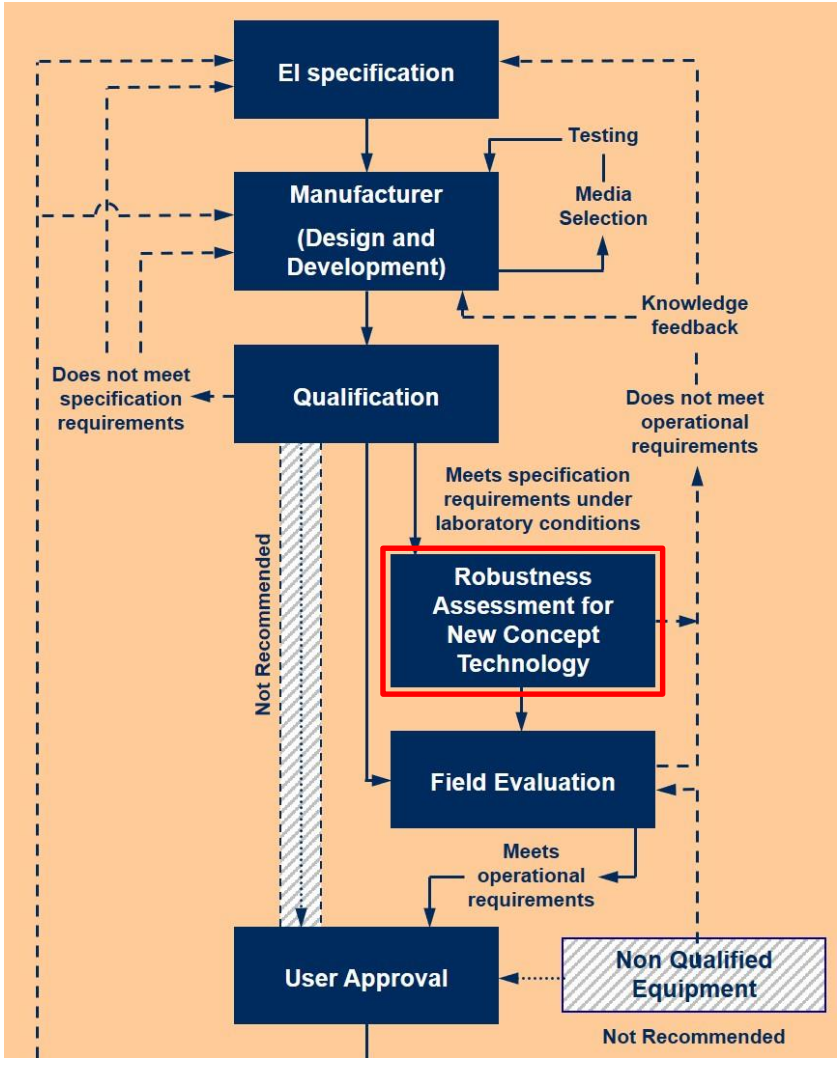
Replacing filter monitors – electrostatic charging of fuel

- Electrostatic test will be added as a mandatory qualification requirement for 1588 (water barrier) and 1599 (dirt defence)
- Failure to perform the new electrostatic qualification test after it is published will invalidate existing 1599/1588 qualifications
- Failure to meet new test pass criteria will invalidate existing 1599/1588 qualifications



Implementation of monitor replacement technology

Draft 1550 3rd edition will be available for stakeholder review, 1Q 2019



Implementation of monitor replacement technology

Development follows usual EI committee process and EI Qualification Test Witnessing Scheme

Filter OEM concept/prototype development

EI committee confirms technology proof of concept and develops EI specification

Filter OEM undertakes Qualification Testing to EI specification

Robustness Assessment Programme for New Concept Technology

Laboratory tests defined by EI committee (includes A4A, CAAC, CSA, IATA, JIG and filter OEMs)

One-off laboratory assessments by filter OEMs, witnessed by EI

EI oversees airport fuel conditioning of filters with rapid high fuel throughput. Conditioned filters sent to filter OEM for lab assessment

One-off prolonged exposure to multiple fuel batches (equivalent to c1 year throughput) on airport vehicle test rig

Output from robustness assessment programme is EI committee statement (includes A4A, CAAC, CSA, IATA, JIG) that the technology is suitable for into-plane field trials (or that further EI specification or filter OEM product development is required)

New Technology Robustness Assessment Programme

- **Covers 50 mm and 150 mm diameter elements**
- **Production batch of 400 (minimum) manufactured**
- **Test filters randomly selected by EI witness, who witnesses all testing**
- **Stage 1 = 20 laboratory single element tests and 1 full scale**
  - Water barriers = 19 tests
  - Dirt defence filters = 4 tests
  - Combination dirt defence +1598 sensor = 14 tests
- **Expected duration 1-3 weeks**

New Technology Robustness Assessment Programme

- **Stage 2 - airport fuel conditioning**
- **Expose water removal technology to rapid high-volume fuel throughput (equivalent to c1yr)**
- **Then laboratory performance testing by filter OEM**
  - 50ppm water removal test (x5)
  - Water slug test (x5)
  - End cap testing to point of failure
- **Expected duration – up to 3 months**

New Technology Robustness Assessment Programme

- **Airport fuel conditioning locations identified:**
  - **Atlanta/Delta**
  - **Calgary/FSM**

FSM MANAGEMENT GROUP

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MENZIES AVIATION

Implementation of monitor replacement technology – current status

Technology	Dirt removal	Dispersed water	Bulk water	New vessel?	EI Spec	Qualification	Robustness assessment		Ready for Field Trial?
							Laboratory	Airport fuel conditioning	
1581 2" filter/water separator	Yes	Yes	No	Yes	Yes	FAUDI Cat C, Type S-M	N/A		Yes
1599 Dirt defence filter	Yes	No	No	No	Yes	FACET 2"	Preliminary testing complete	N/A	No
						FAUDI 2"	Partially complete	N/A	No
						FAUDI 6" O-I	To be done	N/A	No
1598 electronic water sensor	No	Quantifies	Alarms	No	Yes	FAUDI AFGUARD	N/A		Shell trial complete
1599 dirt defence filter +1598 electronic water sensor	Yes	Quantifies	Alarms	No	N/A	N/A	FACET 2"+ AFGUARD	N/A	Q1 2019
							FAUDI 2"+ AFGUARD	N/A	Q1 2019
							FAUDI 6"+ AFGUARD	N/A	No

Implementation of monitor replacement technology – current status

Technology	Dirt removal	Dispersed water	Bulk water	New vessel?	EI Spec	Qualification	Robustness assessment		Ready for Field Trial?
							Laboratory	Airport fuel conditioning	
1588 water barrier filter	Yes	Yes	Yes	No	Yes	Two models in development (none qualified)	To be done after successful qualification	To be done after successful laboratory robustness	No
New concept technology #1	Yes	Yes	Yes	No	Not in development	Model in development	To be done after successful qualification	To be done after successful laboratory robustness	No
New concept technology #2	Yes	Yes	No	No	Not in development	Model in development	To be done after successful qualification	To be done after successful laboratory robustness	No

Replacing filter monitors - summary

- EI specifications in place for dirt defence filter, electronic water sensor and water barrier filter
- New qualification test method for electrostatic charging of fuel to be published 4Q 2018
- Qualifications – one model of 2” FWS system (FAUDI), two models of 2” dirt defence filter (FACET, FAUDI), one model of 6” dirt defence filter (FAUDI)
- Part completion of robustness testing: 2” dirt defence filters from FACET and FAUDI, each with an AFGUARD water sensor

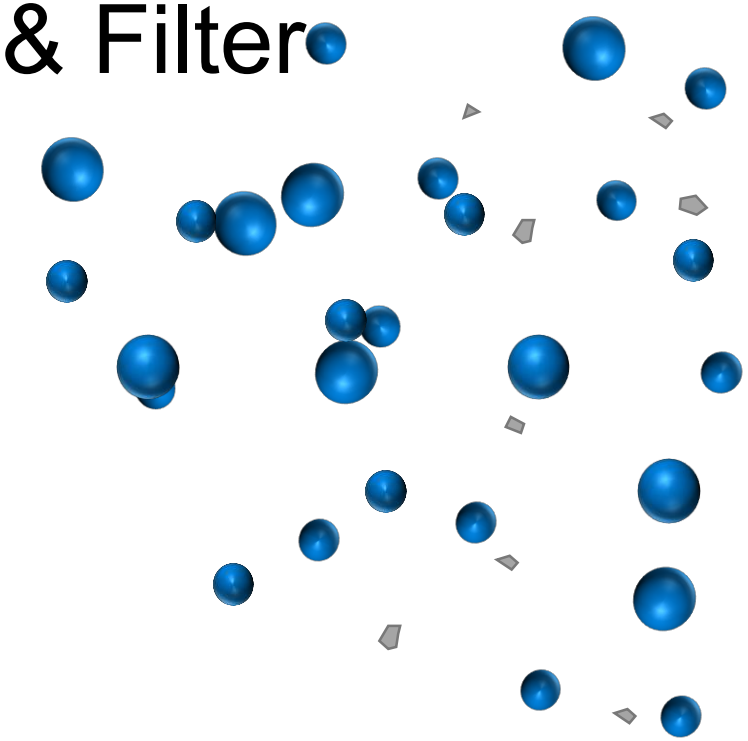
Technology Development Update

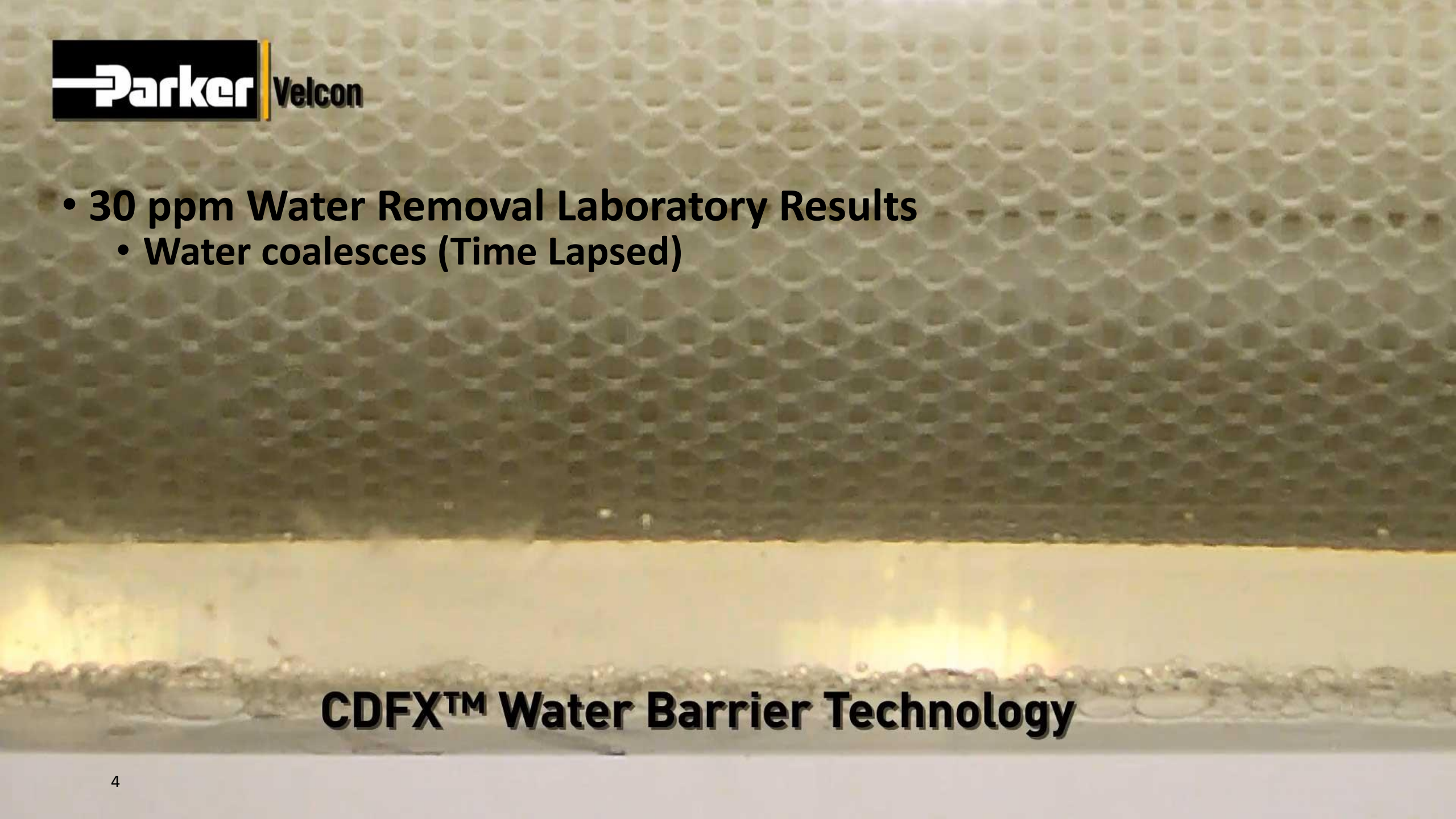
ENGINEERING YOUR SUCCESS.

Drop-in Replacement Technology EI1588 – Barrier Filtration

EI1588 – CDFX™ Barrier Filtration

- Surface/Barrier Coalescer & Filter
  - “Super Separator”
  - Effective against
    - Emulsified water
    - Water slugs
    - Solids




Parker Velcon
• 30 ppm Water Removal Laboratory Results
• Water coalesces (Time Lapsed)
CDFX™ Water Barrier Technology

EI1588 – CDFX™ Barrier Filtration

- Developing solutions from 2” to 6”
  - Same size and flow rate as monitors
- Effective against:
  - Low-water emulsions
  - Water slugs @ >7 bar
  - Effective in Cat-M fuels
  - Extreme solids efficiency
  - Bacterial retentive

EI1588 – CDFX™ Barrier Filtration

- Bacterial Retention
  - ASTM D6974 (Modified)

	Mean CFU / ml	
Microorganism	**Pre-filtration**	**Post-filtration**
Pseudomonas aeruginosa	4575	0
Yarrowia lipolytica	7300	0
Hormoconis resinae	7450	0

H. resinae

ASTM D6974 - Standard Practice for Enumeration of Viable Bacteria and Fungi in Liquid Fuels—Filtration and Culture Procedures

EI1588 – CDFX™ Barrier Filtration

- Status of the technology development?
  - Product Development
  - Element EI Qualification
  - Robustness Testing
  - Field Testing

Combining Two Technologies
EI1599 2nd Ed. – Solids Filtration
EI1598 2nd Ed. – Free Water Sensing

EI1598 – Parker WIF™ Sensor

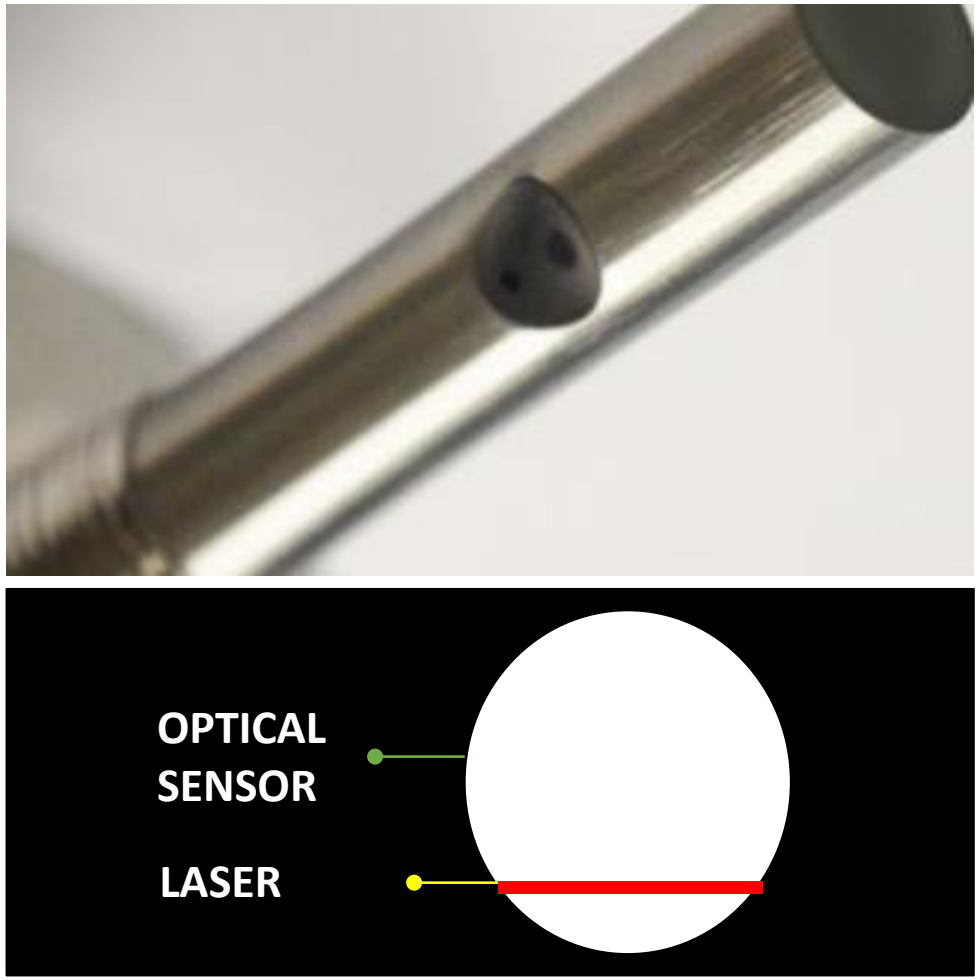
General Specifications

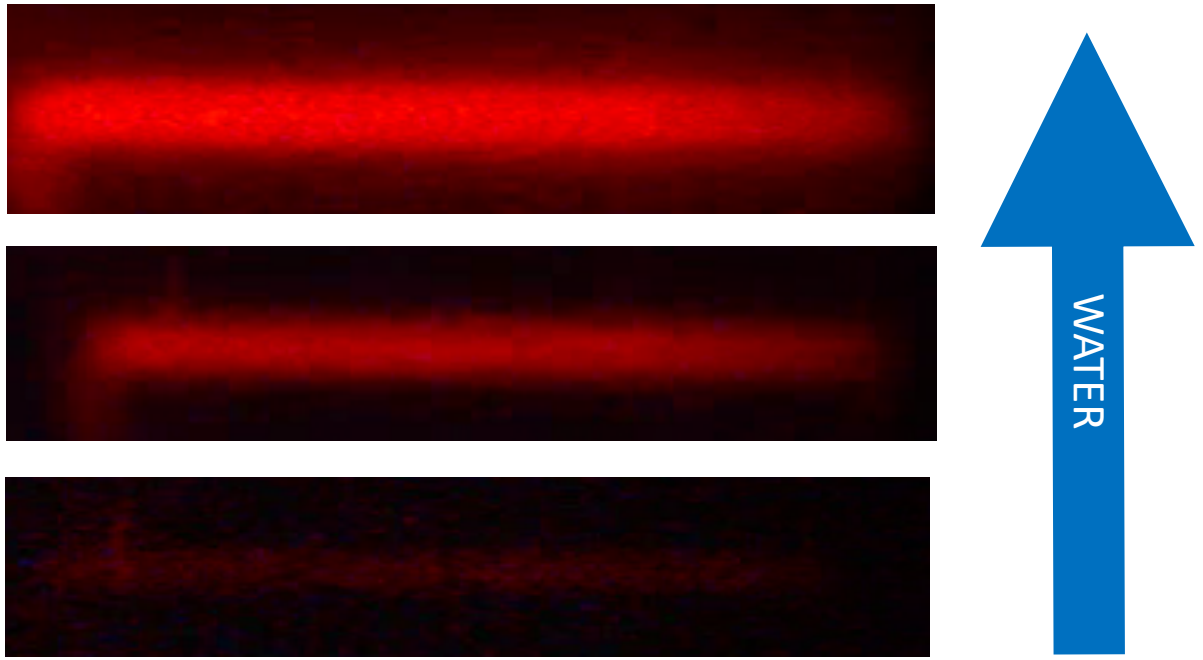
- Meets EI 1598 2nd Edition Criteria
- Output 4-20 mA
- Powered by 9-30 DCV input
- Resolution of free water: 0-50ppm
- Utilizing ¼” common sample port connections
- Stand Alone Electrical Certifications: ATEX & ICEX
  - Easy Installation into existing plumping and electrical systems
- Control Box Available – Deadman control, limit setting, data recording

Simple in Every Way!

EI1598 – Parker WIF™ Sensor

Water Measurement Technology





+/- 2 ppm accuracy

EI1598 – Parker WIF™ Sensor

- Status of the technology development?
  - Product Development
  - Product EI Qualification
  - Field Testing

EI1598 – Parker WIF™ Sensor

- FOW – 2” dirt defense filter
- Offered for sale since 2008 (non-EI qualified)
- Historically used to flush new systems before implementation
- A CDF monitor without SAP
- EI qualified to EI1599 2nd Edition in 2019