

Filter Water Separators and Similarity

Introduction

Into-plane jet fuel cleanliness standards require the use of filtration qualified to EI 1581 or EI 1583. EI 1581 5th edition is the current version of the industry specification for the performance testing of Filter Water Separators (FWS). The filter manufacturers qualify a new FWS to EI 1581 on a test rig to cover a specific flow rate range for the system (vessel configuration and specific coalescer and separator elements). In order to avoid the need for laboratory testing of every FWS system ever installed, systems of closely related configuration can be qualified by "Similarity". EI 1582 2nd edition is the latest version of the Similarity specification that contains methodology to ensure that a vessel will meet the performance requirements of EI 1581 without the need for testing. Similarity is also used to ensure that an existing or new vessel remains qualified to EI 1581 when the model/type of elements are changed.

FWS vessels shall contain only combinations of coalescer and separator elements qualified by a single manufacturer – unqualified mixes of elements from different manufacturers are not permitted. Compliance with Similarity requirements is one of the technical bases supporting the concept that the cleanliness level of filtered jet fuel is fit-for-purpose.

In operation it is realised that operators may have a FWS vessel in service for many years and, during that time, changes in the EI 1581 performance specification may have consequences for the vessel performance and compliance. Also, operators may wish to change the supplier of the coalescer and separator elements, which could also impact performance and compliance to EI 1581. EI 1582 includes a pro-forma sheet (see Appendix below) that can be obtained from the manufacturers whenever any of the above changes are made. The manufacturers adopted this standardised sheet during 2011 and should now provide a completed sheet for each vessel in this format. The properly completed Similarity Sheet comprises the documentation that confirms an installed FWS is qualified to the latest edition of EI 1581.

ACTIONS FOR JIG JOINT VENTURES

All FWS shall comply with EI 1581 5th edition.

New vessels

A new EI 1581 5th edition vessel is compliant if the configuration remains the same as originally delivered and the original Coalescer and Separator element models supplied by the manufacturer are used for subsequent element changes. A Qualification Test Report or an original Similarity Sheet shall be provided by the vendor with each new vessel.

Vessels in service

Similarity sheets should be requested from the manufacturer for vessels that are currently in service but do not have them at the present time. These shall be obtained from the manufacturer at the next element change. An existing in service vessel qualified by Similarity to EI 1581 5th edition remains compliant and the existing Similarity sheet remains valid until there is a change to different element types.


Action: When different element models are fitted to an existing vessel the supplier of the new elements shall issue an EI 1582 2nd edition Similarity sheet and new vessel data plate. The new plate shall be fitted to the exterior of the vessel in addition to the original vessel data plate.

Note: A change in element type may also result in a change in the maximum flow rate for the new vessel system.

The Similarity sheet shall be specific for each vessel and shall be kept with the filter vessel records.

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Appendix

1	Insert Filter Company Logo and/or Name and Address Here					
2	EI 1582 2nd edition Similarity Sheet Reference Number/ID Code:		Insert ID here			
3	1581 Qualification Report Number:	Insert report number here	Prepared for:		Insert customer name here	
4	Parameter	Select Units	Qualified Vessel	Candidate Vessel	Pass/Fail	Notes
5	Vessel Manufacturer					
6	Vessel Model Number					
7	Vessel Serial Number					
8	EI 1581 Category (2.6)				Fail	Category must be the same
9	EI 1581 Type (2.6)				Fail	Type must be the same
10	Number of Element Stages	EA			Fail	Stages must be the same
11	Vessel configuration					
12	Orientation (2.2a)				Fail	Orientation must be the same
13	Vessel Inside Diameter					
14	Element Layout (2.2b & 2.4)				Fail	Layout must be the same
15	Sump					
16	Location (2.2c)				Fail	Location must be the same
17	Volume (2.2c)				*	* Pass, but requires water defence system per 1581 5th ed. 3.2.4.5
18	Inlet Connection Position (2.2d)				Fail	Inlets must be in the same location
19	Outlet Connection Position (2.2e)				Fail	Outlet must be in the same location
20	Element mounting positions (2.2f)				Fail	Location must be the same
21	Water Defense System Present?					
22	Rated flow of vessel (2.5)				Fail	Candidate must be < or = to Qualified
23	1st Stage (filter/coalescer element)					
24	Model Number (2.6)					Model/Series/Family = Qualified
25	Quantity	EA				
26	Number of Elements/Cartridges in Stack	EA				
27	Element/Cartridge Overall Length					
28	Element/Cartridge Effective Media Length					
29	Outside Diameter					
30	Spacing					
31	Between 1st Stage Elements (2.3a)				Fail	Candidate must be > or = to Qualified
32	Between 1st & 2nd Stage Elements (2.3c)				Fail	Candidate must be > or = to Qualified
33	Between 1st Stage Elements & Vessel (2.3b)				Fail	Candidate must be > or = to Qualified
34	Mean Linear Flowrate (2.7)				Fail	Candidate must be < or = to Qualified
35	Volume					
36	2nd Stage (separator element)					
37	Model Number (2.6)					Model/Series/Family = Qualified
38	Quantity	EA				
39	Number of Elements/Cartridges in Stack	EA				
40	Element/Cartridge Overall Length					
41	Element/Cartridge Effective Media Length					
42	Outside Diameter					
43	Spacing					
44	Between 2nd Stage Elements (2.3b)				Fail	Candidate must be > or = to Qualified
45	Between 2nd Stage Elements & Vessel (2.3c)				Fail	Candidate must be > or = to Qualified
46	Length/Outside Diameter (L/D) Ratio (2.6)				Fail	Candidate must be < or = to Qualified
47	Liquid Entrance Velocity (2.8)				Fail	Candidate must be < or = to Qualified
48	Volume					Volume of all 2nd Stage Elements
49	3rd Stage (filter monitor elements in separators)					
50	Model Number					
51	Quantity	EA				
52	Quantity per 2nd Stage Separator	EA				
53	Vessel					
54	Length of Vessel					Deck plate to lid opening
55	Vessel Volume					Volume inside of the vessel
56	Vessel Void Volume					Empty space not occupied by elements
57	Positive water drainage (2.10)				Fail	Candidate must have positive water drainage
58	Area Ratio					
59	Void Volume Ratio (2.9)				Fail	Candidate must be > or = to Qualified
60	$\Sigma S_{AE}/A_{CV}$ (2.9a) Side-by-side		N/A	N/A		Candidate must be < or = to Qualified
61	$\Sigma A_e/A_{CV}$ (All elements to vessel) (2.9b) End opposed		N/A	N/A		Candidate must be < or = to Qualified

For the candidate system to meet EI 1581 by similarity, each entry is required to produce a pass in the pass/fail column. Data are not required in any cells shaded grey.

The passes above confirm that the candidate vessel meets all requirements of EI 1582 2nd edition, and therefore is qualified to EI 1581 5th edition

Name: _____ Company: _____

Signed: _____ Date: _____

2	EI 1582 2nd edition Similarity Sheet Reference Number/ID Code:	Unique identifier on sheet which should also be found on removable name/data plate on vessel
3	1581 Qualification Report Number:	The unique number given on the report of the filter/water separator system qualification, against which the candidate vessel/system is being compared
4	Parameter	Notes
5	Vessel Manufacturer	Fabricators name, normally different than the Filter company supplying elements
6	Vessel Model Number	Located on the original data plate fixed to the vessel
7	Vessel Serial Number	Located on the original data plate fixed to the vessel
8	EI 1581 Category (2.6)	Three EI 1581 Categories, C (Commercial), M (Military), or M100 (Military Thermal Enhanced).
9	EI 1581 Type (2.6)	3 types: S significant levels dirt/water, S-LD low dirt/significant amount of water, S-LW significant levels dirt/low water, for mobile applications only
10	Number of Element Stages	Two possibilities: a 2 stage (filter/coalescer + separator) or 3 Stage (filter/coalescer, separators and monitors)
11	Vessel configuration	
12	Orientation (2.2a)	Vertical or Horizontal vessel orientation
13	Vessel Inside Diameter	
14	Element Layout (2.2b & 2.4)	Two groups of element layouts: Side-by-Side - filter/coalescers and separators are fixed to the same end of the vessel, and End-Opposed - fixed to opposite ends. 'Side-by-side, side-to side' candidate systems can qualify against 'Side-by-side, engaged' systems
15	Sump	
16	Location (2.2c)	Sump location for candidate shall be in relatively the same location as the qualified vessel
17	Volume (2.2c)	Need not scale with flow rate if Water defence present. Otherwise calculate vol/flow.
18	Inlet Connection Position (2.2d)	Inlet location for candidate shall be in relatively the same location as the qualified vessel
19	Outlet Connection Position (2.2d)	Outlet location for candidate shall be in relatively the same location as the qualified vessel
20	Element mounting positions (2.2e)	Element mounting positions shall be in relatively the same location as the qualified vessel
21	Water Defense System Present?	Float valve or electronic water sensor that alarms or shuts off flow when water detected
22	Rated flow of vessel (2.5)	Candidate flow rate shall be less than or equal to qualified system
23	1st Stage (filter/coalescer element)	The filter/coalescer acts to stop dirt and remove free water from the fuel, inside to outside flow
24	Model Number (2.6)	Manufacturers model/series/family number. Candidate shall be the same generic family as qualified. May vary in length and type of fitting (end cap)
25	Quantity	The total number of filter/coalescer elements/cartridges in the vessel
26	Number of Elements/Cartridges in Stack	Some filter/coalescers are stacked on top of each other, two 20" stacked = one 40" filter/coalescer
27	Element/Cartridge Overall Length	Linear length from end cap to end cap
28	Element/Cartridge Effective Media Length	Linear length without the end caps
29	Outside Diameter	
30	Spacing	
31	Between 1st Stage Elements (2.3a)	Closest distance between filter/coalescers, 1581 5th ed. requires at least 0.5" spacing for new vessels
32	Between 1st & 2nd Stage Elements (2.3c)	Closest distance between a filter/coalescer and a separator
33	Between 1st Stage Elements & Vessel (2.3b)	Closest distance between a filter/coalescer and the vessel wall
34	Mean Linear Flowrate (2.7)	The mean flow per linear inch of the effective filter/coalescer length
35	Volume	Total volume of the filter/coalescers, used to calculate the remaining empty space in the vessel
36	2nd Stage (separator element)	Separator stage allows fuel to pass into the outlet but not water
37	Model Number (2.6)	Manufacturers model/series/family number. Candidate shall be the same generic family as qualified. May vary in length and type of fitting (end cap)
38	Quantity	The total number of separators in the vessel, normally less than half the number of filter/coalescers
39	Number of Elements/Cartridges in Stack	Rarely separators are stacked on top of each other, two 20" stacked = one 40" separator
40	Element/Cartridge Overall Length	Linear length from end cap to end cap
41	Element/Cartridge Effective Media Length	Linear length without the end caps
42	Outside Diameter	
43	Spacing	1581 5th ed requires at least 0.5" spacing
44	Between 2nd Stage Elements (2.3b)	Closest distance between separators
45	Between 2nd Stage Elements & Vessel (2.3c)	Closest distance between a separator and the vessel wall
46	Length/Outside Diameter (LD) Ratio (2.6)	Ratio of the total length/outside diameter must be less than or equal to qualified ratio (each stack when stacked)
47	Liquid Entrance Velocity (2.8)	The mean liquid entrance velocity at the surface of the separator
48	Volume	Total volume of the separators, used to calculate the remaining empty space in the vessel
49	3rd Stage (filter monitor elements in separators)	Normally monitor elements located inside the separators. Not to be used with Cat M or M100.
50	Model Number	Manufacturers model number
51	Quantity	Total number of monitor elements in the vessel
52	Quantity per 2nd Stage Separator	Normally 5 per each separator
53	Vessel	
54	Length of Vessel	Linear length from deckplate to lid opening
55	Vessel Volume	The total volume of a vessel measured from deckplate to lid opening
56	Vessel Void Volume	Vessel volume minus the volume of all elements; > empty space = easier performance
57	Positive water drainage (2.10)	Water shall be able to drain freely from the entire vessel and sump of the candidate vessel. If it cannot, the FWS system cannot qualify to 1581 5th edition
58	Area Ratio	
59	Void Volume Ratio (2.9)	Void vol/vessel vol candidate must >= qualified; > void vol ratio = easier performance
60	$\Sigma S_{Ae}/A_{cv}$ (2.9a) Side-by-side	Ratio of the effective element surface areas to cross sectional area (CSA) of the vessel
61	$\Sigma A_e/A_{cv}$ (All elements to vessel) (2.9b) End opposed	Ratio of the CSA of the elements to the inside CSA of the vessel