

DESIGN AND CONSTRUCTION  
OF AVIATION FUEL FILTER VESSELS

API/IP SPECIFICATION 1596

First edition  
November 2006





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# FOREWORD

This publication, which has been prepared jointly by the EI Aviation Committee and the API Aviation Technical Services Sub-Committee, is intended to provide the industry with mechanical specifications for the design and construction of aviation fuel filter vessels. Three types of vessels are covered: filter monitor, filter/water separator and microfilter vessels. A vessel characterised as "meeting the requirements of API/IP 1596" shall comply with all mandatory language in this publication appropriate to that type of vessel as distinguished by the use of the word "shall". While this provides minimum levels for selected aspects of vessel design/performance, this publication is not intended to completely describe all aspects of filter vessel performance and design relevant to successful application. It remains the responsibility of the purchaser to ensure that the vessel is fit-for-purpose in the intended application. Note that the approval of the mechanical design of a vessel is the responsibility of the purchaser.

This publication is not in any way intended to prohibit the manufacture, purchase or use of vessels meeting other requirements.

It is assumed that all users of this publication are either fully trained, or under the supervision of a responsible trained person, who is familiar with all normal engineering safety practice, and that all such precautions are being observed. Users of this publication are responsible for ensuring compliance with the requirements of locally prevailing health and safety legislation.

The API and the EI are not undertaking to meet the duties of employers to warn and equip their employees, and others exposed, concerning health and safety risks and precautions, nor undertaking their obligations under local and regional laws and regulations.

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It is hoped and anticipated that this publication will assist those involved in manufacturing and purchasing filter vessels. Every effort has been made by the API and the EI to assure the accuracy and reliability of the data contained in this publication; however, API and EI make no representation, warranty, or guarantee in connection with this publication and hereby expressly disclaim any liability or responsibility for loss or damage resulting from its use or for the violation of any local or regional laws or regulations with which this publication may conflict.

Suggested revisions are invited and should be submitted to the director of standards, API, 1220 L Street, N.W., Washington, D.C. 20005, or the Technical Department, Energy Institute, 61 New Cavendish Street, London, W1G 7AR.

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# 1

## INTRODUCTION AND SCOPE

### 1.1 INTRODUCTION

This publication has been prepared to provide mechanical specifications for the design and construction of vessels containing filter elements used in aviation fuel handling systems.

### 1.2 SCOPE

This publication provides requirements for:

- Design and construction of filter vessels.
- Vessel accessories.

Although this publication is primarily intended to apply to vessels for civilian applications, many of the requirements may also be applicable to vessels intended for military use. Further advice should be sought from manufacturers for specific military applications.



## 2

# DESIGN REQUIREMENTS APPLICABLE TO FILTER/WATER SEPARATOR, FILTER MONITOR AND MICROFILTER VESSELS

### 2.1 GENERAL

Vessels characterised as meeting the requirements of API/IP 1596 shall be designed in accordance with the requirements of this section, and requirements of either section 3 (for filter monitor vessels), section 4 (filter/water separator vessels) or section 5 (microfilter vessels). The requirements included in this publication supersede those that were previously included in API/IP 1581 5th edition, IP 1583 4th edition and API/IP 1590 2nd edition. The vessel related requirements still included in those publications will be removed as new revisions are issued.

### 2.2 DESIGN CODE

Filter vessels shall be designed and constructed to conform to the latest issue of the *ASME Boiler and pressure vessel code*, Section VIII: *Rules for construction of boilers and pressure vessels*, or other recognised pressure vessel code agreed by the purchaser.

### 2.3 DESIGN PRESSURE

Unless otherwise specified by the purchaser the minimum vessel design pressure shall be 1 035 kPa (150 psi gauge).

### 2.4 HYDROSTATIC TEST PRESSURE

Each filter vessel body shall be hydrostatically tested. Refer to sections 3, 4 or 5 for specific requirements for filter monitor, filter/water separator and microfilter vessels.

### 2.5 MATERIALS OF CONSTRUCTION

#### 2.5.1 Operational environment

The manufacturer shall ensure that the unit shall not be adversely affected by the intended operational environment. The purchaser may define this in terms of temperature range<sup>1</sup>, atmospheric conditions, salinity etc.

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<sup>1</sup> Units may need to be designed so as to not be adversely affected by temperatures as low as -50 °C for some operating environments.

If not specified by the purchaser the standard temperature conditions are defined as:

-29 °C to +70 °C (-20 °F to +160 °F)

Where the purchaser specifies low temperature application, the manufacturer shall guarantee new vessels for operation within the temperature range:

-45,5 °C to +70 °C (-50 °F to +160 °F)

For operations outside of the above temperatures advice should be sought from the manufacturer.

### 2.5.2 Metallurgy

All metal parts in contact with the fuel shall be free of vanadium, zinc, cadmium, copper and their alloys. Vessels may be constructed of stainless steel, aluminium or carbon steel. Carbon steel vessels shall be internally coated with a light-coloured epoxy coating approved by the purchaser. Sensing lines shall be stainless steel.

### 2.5.3 Gaskets, seals and coatings

All gaskets, seals and coatings shall:

- Not deteriorate when exposed to fresh or salt water.
- Not promote microbiological growth.
- Be compatible with all aviation fuels and approved aviation fuel additives.
- Meet relevant industry and/or military specifications.
- Have appropriate pressure ratings.

Note: Pure cork gaskets and compounds containing asbestos are not acceptable.

## 2.6 PIPING CONNECTIONS

All main fuel piping connections larger than 38 mm (1,5 in.) nominal bore shall have a pressure rating equal to or greater than that of the vessel and should be flanged. Connection types other than flanged may be used if specifically requested by the purchaser.

Note: Fire safety issues should be considered when specifying connections.

To avoid element damage, the vessel shall be designed so that high velocity inlet flow does not impinge filter elements. This can be accomplished by locating the inlet connection at an element-free region of the vessel or shielding the elements with a baffle.

It is an operational requirement for filter vessels to

be slow-filled to prevent element damage, internal fire or explosion during filling. A fitting for a narrow bore (25 mm, 1 in.) filling line should be provided either in the filter vessel inlet pipework (for the filling line to connect either side of the gate valve), or in the base of the filter vessel upstream of the filtration stage, as agreed between the purchaser and manufacturer.

Note: The narrow bore filling line should be fitted with a ball valve and should not form a low point that could cause localised entrapment of contamination.

## 2.7 PORTS AND CONNECTIONS

Ports shall be female threaded or flanged according to purchaser request.

Note: Male threaded stubs welded to the vessel are not acceptable for attachment of small valves and fittings since the threads are more susceptible to damage during shipping and handling.

Ports which have parallel threads shall have smooth external faces and dimensions suitable for fittings with an integral O-ring face seal and those utilising bonded sealing washers e.g. Dowty and Stat-O-Seal types.

Weld beads on vertically installed half couplings or pipe stubs should not protrude internally to cause localised entrapment of contamination.

## 2.8 VENT AND PRESSURE RELIEF PORTS

A connection shall be provided at the highest fuel level in the vessel of the inlet and/or outlet chamber, as appropriate, for installation of an air eliminator. Provision for a pressure relief valve shall also be made.

## 2.9 PRESSURE PORTS

Ports shall be provided for connecting appropriate pressure gauges to the filter vessel to read differential pressure between the inlet and outlet piping connections. Provision shall be made for measuring the differential pressure across the stages for multi-stage vessels.

## 2.10 ACCESS TO ELEMENTS

Vessels with lid weights exceeding 18 kg (40 lbs) shall have lids hinged or pivoted to the vessel body. Lids secured with swing-type eye bolts are preferred but users may specify other options. Small lids that are not hinged or pivoted may require a handle to assist with lifting and support lugs on the vessel to assist with

location while fitting.

Vertical vessels that incorporate a sleeved lift column attached to the lid, operated by a hydraulic jack or cam lever, shall incorporate a safety device so that the lid, once raised, cannot inadvertently drop. Typically, this can be achieved by inserting a pin through the lift column above its guide sleeve.

In order to facilitate maintenance of vertical vessels, and especially if the vessel includes hardware or other items assembled to the element mounting plate, the length (from the head lid to the element mounts) to diameter ratio of the main shell should not exceed 1,75:1 (for vessels  $\leq$  61 cm (24 in.) diameter), or 2,5:1 (for vessels  $>$  61 cm (24 in.) diameter), except where the items can easily be reached by hand i.e. the lid to mounting plate length is less than 500 mm (20 in.). Note: Purchasers may specify other L/D requirements.

Sealing of the lid to the vessel end flange or reinforcing ring is preferably done using an O-ring seal rather than a flat gasket.

## 2.11 WORK PLATFORM

Work platforms including access steps and handrails shall be provided where necessary to permit vessels to be internally inspected and elements replaced safely. The work platform shall be provided by the installation contractor unless otherwise agreed by the manufacturer and purchaser.

## 2.12 CLEAN-OUT CONNECTION

All parts of the vessel shall be accessible for inspection and cleaning. Access may be from the main cover, the inlet and outlet connections for vessels mounted on mobile equipment, or alternatively a specially installed clean-out connection of minimum 100 mm (4 in.) internal diameter. The clean-out connection shall be installed on the horizontal axis so that only a minimal amount of water can collect in that area. Where the clean-out connection cannot be located on a horizontal axis every effort must be made to minimise any water collection area.

Removal of the vessel's inlet or outlet piping is not an acceptable method for providing access to the vessel's interior in fixed installations.

## 2.13 DRAIN AND SAMPLE PORTS

Sample ports shall be provided to permit the taking of representative influent and effluent fuel samples under flow conditions. The port size shall be specified by the

purchaser but can be typically 19 mm (0,75 in.) reducing to 13 mm (0,5 in.) for small vessels, or increased to 25 mm (1 in.) or larger on large vessels. Instrumentation ports are typically 6,3 mm (0,25 in.).

Water shall drain freely from the entire vessel and sump. A sump having a flat, level base does not meet this requirement. Vessel designs (i.e. lid sealing schemes) that create void spaces that can trap water do not meet this requirement. All chambers, including the inlet and outlet branches, must be provided with ports so that fuel and/or any accumulated contamination can be completely removed via low-point drains. To facilitate this, surfaces shall avoid localised low points or stagnant areas. The main chamber containing the elements shall incorporate a definite slope toward a low point. For flat plates the minimum slope shall be three degrees. Vertical monitor vessels utilising 50 mm (2 in.) elements are exempt from this requirement as are horizontal vessels on mobile equipment. Where manifolds are used in vertical vessels, the lower dished (concave) end of the vessel shall be acceptable without modification.

Internal weld beads on half couplings or pipe stubs shall not protrude to cause localised trapping of contamination.

The height between any vessel drain/sample port and the ground shall be a minimum of 600 mm (24 in.), unless otherwise agreed by the purchaser. This allows for installation of valves, fittings and extension lines whilst leaving enough clearance for the use of a bucket.

## 2.14 ELEMENT SUPPORTS

The free ends of all elements greater than 46 cm (18 in.) long, regardless of mounting assembly, shall be supported firmly against vibration. Refer to section 3, 4 or 5 for specific requirements.

One method for supporting 150 mm (6 in.) diameter elements is to use a spider plate joining the element ends together and stabilising this against the vessel wall. The spider plate may be bolted to a lug on the vessel wall, also serving as the electrical bonding point, or may be fitted with an adjustable arm edged with a protective sleeve (of a material that meets the requirements of 2.5.3) that presses against the vessel wall. In the latter case, the spider shall be bonded separately to the vessel. In all cases, the resistance between the spider plate and the vessel shall be less than 10 ohms.

The spider shall incorporate a method of accommodating end bolt or tie rod misalignment of up to 12,7 mm (0,5 in.).

Note: For a 0,5 in. UNC or 12 mm O.D. metric coarse thread, the slot shall have an overall length of 38 mm (1,5 in.).

## 2.15 ELECTRICAL CONTINUITY

All metal items inside the vessel shall be in electrical contact with each other and the vessel body. The resistance between any two items shall be less than 10 ohms.

In the case of carbon steel vessels which are internally coated, the exterior of the vessel may be used as a contact point for continuity tests. For aluminium vessels and aluminium bushes (bushings) or check valves installed in a coated steel mounting plate, oxide film shall be removed from a contact point before conducting continuity tests.

Note that care should be taken when applying coatings to avoid electrically isolating metal components. Epoxy coatings have a high resistivity and high electrical breakdown strength. Therefore, the conductive paths needed to provide earthing for elements and related components must not be interrupted by epoxy coatings. If necessary, areas of coating shall be by-passed by bonding links to provide the required electrical continuity.

Care must also be taken to avoid isolating items by the inappropriate use of insulating gaskets, O-rings or glue layers.

## 2.16 BRANCH AND PORT MARKING

Inlet and outlet branches, together with all other ports, shall be clearly labelled to indicate their intended function. Engraving or stamping is not acceptable unless it is deep enough to avoid being obliterated by several coats of paint and is in accordance with any limitations imposed by the design code.

## 2.17 DATA PLATE

A stainless steel or non-ferrous metal data plate shall be securely attached to the vessel and include information as required by section 3, 4 or 5.

Note: Separate plates may be required that convey information in relation to testing of the system (flow rate/element combination) in accordance with API/IP 1581, IP 1583 or API/IP 1590.

Note: Information will need to be updated should a vessel be converted.

## 2.18 EXTERIOR PAINTS

Prior to shipment, the exterior of a vessel shall be cleaned of all dirt, grease, rust and loose mill scale, and one coat of an approved metal primer applied, unless otherwise specified<sup>2</sup>. All nameplates, gauges, etc. where fitted, shall be masked prior to painting.

Note: It is preferable for the exterior of the vessel to be primed prior to the fitment of nameplates to reduce the possibility that corrosion will occur. Alternatively the bracket material for the nameplate can be selected to minimise corrosion.

The paint used shall be fuel resistant, suitable for further coating and sufficiently durable to afford protection against corrosion in humid, saline conditions during shipment, handling and site installation.

## 2.19 STANDARD ACCESSORIES

The following accessories shall be standard on all units and may be fitted by the vessel manufacturer or on site at the discretion of the purchaser.

### 2.19.1 Equipment for measuring differential pressure

In operation filter element condition is determined by checking the differential pressure at rated flow. Sensing lines and fittings shall be made from stainless steel. Isolating valves shall be stainless steel in fixed facilities, while for mobile equipment stainless steel or chromium plated brass may be used as long as compression ferrules, if used, are of suitable hardness.

The possible pressure measuring alternatives are:

- (a) A differential gauge giving a direct reading is recommended. Both electronic pressure transducers and piston-type devices are available. The gauge should be protected with suitable isolating valves (with thermal pressure relief) and for piston-type devices provided with a means for testing free movement of the piston.
- (b) A single pressure gauge with a 3-way valve to enable pressure upstream and downstream of the elements to be measured in turn and the difference determined. This type of gauge shall have pulsation

<sup>2</sup> Stainless steel and aluminium vessels need not be prime painted before shipment unless specified by the purchaser.

dampeners, a range compatible with the system in which it is used, 75 mm (3 in.) to 125 mm (5 in.) diameter face and maximum 0,1 bar sub-division.

Note: This eliminates any fixed bias or error in the gauge. Two separate gauges can give a false result.

#### **2.19.2 Air eliminator**

The filter vessel shall be fitted with a means to automatically vent trapped air from the highest point of the vessel.

Note: The design should be capable of directing any fuel that may be expelled to an area of safety if the vent malfunctions.

#### **2.19.3 Pressure relief valve**

Provision shall be made for the fitting of a pressure relief valve to ensure that the design working pressure of the vessel is never exceeded. Pressure relief provisions should be set in accordance with ASME VIII, or other recognised pressure vessel code agreed by the purchaser.

#### **2.19.4 Sampling connections**

Sampling connections shall be provided at the inlet and outlet of the vessel to enable membrane tests or other fuel quality checks to be carried out.

### **2.20 DRAWINGS AND SIMILARITY DATA**

A set of outline drawings and similarity data shall be provided with each new vessel.

### **2.21 OPTIONAL ACCESSORIES**

The following are optional and must be specified by the purchaser if required to meet local regulations or safety requirements:

#### **2.21.1 Quick disconnect dry-break couplings**

These may be used for connecting a master gauge to check the accuracy of other gauges fitted.

#### **2.21.2 Non-return valve for the air eliminator**

If associated piping and tank heights could allow the vessel to self-drain by gravity, allowing air to enter via the air eliminator, a soft-seated non-return (check) valve should be installed.

#### **2.21.3 Flow limiter**

A flow limiting valve may be required if, due to system design, there is a possibility of the rated capacity of the vessel being exceeded.



# 3

## SPECIFIC DESIGN REQUIREMENTS FOR FILTER MONITOR VESSELS

### 3.1 GENERAL

The acceptability of a design ultimately depends on satisfactory functioning of the vessel and components during the performance tests described in a relevant specification, such as IP 1583, as determined by the purchaser.

New filter monitor vessels shall meet the mechanical requirements contained in section 2 and 3.2 to 3.6.

Note: Details of optional accessories are provided in 3.7.

### 3.2 HYDROSTATIC TEST PRESSURE

For hydrant dispensers and refuellers each filter monitor vessel body shall be hydrostatically tested to the design pressure specified by the applicable code (e.g. ASME). The same hydrostatic test shall also be applied to the upstream side of the division plate with all non-return valves closed or all element entry and exit ports sealed.

For other applications the purchaser should specify this parameter to the manufacturer.

### 3.3 ELEMENT SPACING

Element-element and element-vessel wall contact shall be avoided. The design layout of elements in the vessel shall provide a minimum distance of 6,4 mm (0,25 in.) between 50 mm (2 in.) diameter elements and 12,7 mm

(0,5 in.) between 150 mm (6 in.) diameter elements. These dimensions also apply between the elements and the vessel wall.

### 3.4 ELEMENT MOUNTING

#### 3.4.1 50 mm (2 in.) diameter elements

The sealing bore for vessels using 50 mm (2 in.) diameter elements shall be 33,30 mm to 33,40 mm (1,311 to 1,315 in.) diameter, with a surface finish better than 3  $\mu$ m Ra.

A lead in angle shall be provided of 10° to 20° from a diameter 1,5 mm (0,060 in.) larger than the bore size.

Out-of-roundness shall not exceed 0,025 mm (0,001 in.) total indicator reading (TIR).

It is recommended that the element plate, in carbon steel vessels, be stainless steel, to avoid the loss of tolerances in bores due to the corrosion of the carbon steel.

#### 3.4.2 150 mm (6 in.) diameter elements

For vessels designed to accept elements with flat end gaskets (face seal), the mounting surface shall incorporate a blunted V-shaped knife edge 1,5 mm high (0,06 in.) +10 % / -0 %.

Proprietary adaptors for threaded base elements shall also have a blunted V-shaped knife edge with the same dimensions as given above.

### 3.5 INTERLOCK SYSTEMS

For vessels for 50 mm (2 in.) diameter elements, which include a lid interlock system employing devices to locate on the element ends, a separate spider may not be necessary. However, an intermediate support grid should be provided if the length and weight of wetted elements would cause them to droop, become unseated or otherwise result in the ends becoming misaligned with the end support spider.

When the end support is assembled, there shall be sufficient clearance between the element outer diameter and the intermediate support grid to avoid chafing and allow fuel to pass through without undue restriction. It should also allow sufficient lateral movement without the end support so that when elements are being removed, they can be grasped easily by a gloved hand.

It is recommended that the intermediate plate be designed to avoid the cutting elements.

### 3.6 DATA PLATE

A stainless steel or non-ferrous metal data plate shall be

securely attached to the vessel. This plate shall include as a minimum:

- (a) The manufacturer's name and address.
- (b) The vessel's serial number and model number.
- (c) Rated flow capacity
- (d) Date of manufacture.
- (e) Number and type of elements.
- (f) Recommended maximum differential pressure.
- (g) The design pressure for the vessel.
- (h) Hydrostatic test pressure.
- (i) API/IP specification number.
- (j) Operational temperature range.

It may also include any other pertinent data.

### 3.7 OPTIONAL ACCESSORIES

A lid interlock, if fitted, is an integral part of the vessel. It is designed to ensure that when installing a set of new elements, if one is omitted or not located in a mounting hole, it will not be possible to close the lid.

# 4

## SPECIFIC DESIGN REQUIREMENTS FOR FILTER/WATER SEPARATORS

### 4.1 GENERAL

The acceptability of a design ultimately depends on satisfactory functioning of the vessel and components during the performance tests described in a relevant specification, such as API/IP 1581, as determined by the purchaser.

New filter/water separator vessels shall meet the mechanical requirements contained in section 2 and 4.2 to 4.9.

Note: Details of optional accessories are provided in 4.10.

### 4.2 DESIGN PRESSURE

The vessel's design pressure (maximum working pressure) shall be at least 1 035 kPa (150 psi gauge) at 35 °C (95 °F) or as specified by the purchaser.

### 4.3 HYDROSTATIC TEST PRESSURE

**4.3.1** Each filter/water separator vessel shall be hydrostatically tested in accordance with the applicable design code. In addition, the inlet manifold or chamber shall be blanked off after installation and tested to a minimum pressure of 795 kPa (115 psi gauge). Purchasers may specify the inlet chamber to be tested at 1,550 kPa when the vessel can be converted for use as a filter monitor.

**4.3.2** Where multi-stage systems are used, the outlet manifold shall be blanked off and tested to a minimum pressure of 795 kPa (115 psi gauge) or the required pressure specified for the qualified multi-stage element vessel, whichever is greater.

### 4.4 SPACING OF ELEMENTS

The layout of elements in the vessel shall provide a minimum of at least 12,7 mm (0,5 in.) clearance between elements and the vessel wall. The centre-to-centre distance between elements shall be no less than 16,5 cm (6,5 in.).

### 4.5 ELEMENT MOUNTING ADAPTORS

Threaded mounting adaptors shall be securely mounted to prevent rotation when elements are removed. The adaptors shall be designed to withstand at least 150 % of the recommended assembly torque without permanent distortion, cracking, or failure.

### 4.6 SEALING OF ELEMENT CONNECTIONS

Element connections shall be sealed by one of the following methods:

- (a) A flat end gasket (face seal) against a blunted V-shaped knife edge 1,5 mm high (0,06 in.) +10 % / -0 %.

- (b) A screw base with compressed O-rings and/or a flat end gasket (face seal) against a blunted V-shaped knife edge, as described in (a).
- (c) For open-ended elements, a suitable gasket, a washer, or an O-ring fitted in a recessed washer, shall be specified to seal the end cap and retaining rod screw threads.
- (d) A piston-type O-ring.

All seals shall be composed of Viton A, Buna N, or an equivalent material. See also section 2.5.3.

#### 4.7 EXTERIOR

For vertical vessels, a head lift retaining device shall be fitted on all vessels 46 cm (18 in.) diameter and larger.

#### 4.8 DATA PLATES

**4.8.1** A permanent stainless steel or non-ferrous metal data plate shall be securely attached to the vessel. The nameplate shall include at least the following information:

- (a) The manufacturer's name and address.
- (b) The vessel's serial number and model number.
- (c) The date of manufacture.
- (d) The design code of the vessel.
- (e) The design pressure for the vessel.
- (f) The maximum allowable differential pressure across the deck plate.
- (g) The sump volume (the volume that activates a water defence system when present or else the volume up to the lowest separator stool, filter/coalescer stool, or element whichever is smaller).
- (h) The vessel lid gasket material and part number.

**4.8.2** A second securely attached removable plastic or metal data plate shall also be provided with the following information:

- (a) The vessel's serial number and model number.
- (b) The vessel's API/IP category and type classification.
- (c) The vessel's rated capacity for aviation fuel.
- (d) The count and model numbers of the coalescer and separator elements.
- (e) The manufacturer's recommended element-change pressure differential.

- (f) The recommended assembly torque for element installation.
- (g) The similarity certificate identification code.

#### 4.9 STANDARD ACCESSORIES

##### 4.9.1 Differential pressure gauges for 3-stage vessels

When vessels are equipped with a monitor element or fuse stage (3-stage vessels) then differential pressure gauges (or sensors) shall be installed across the filter/coalescers and also across the separators and monitor stages. Each gauge shall have a suitable 3-way valve on its downstream side, arranged so that when the valve is turned to the "off" position, the gauge is vented. If required by the purchaser to aid in calibrating the gauge, quick-disconnect couplers shall be provided to facilitate attaching a master gauge.

##### 4.9.2 Water defence system

Filter/separator systems used to refuel aircraft shall be equipped with one of the following water defence systems unless the purchaser agrees to eliminate it:

- A water-slug shutoff device as described in 4.10.1 or
- A sump water-level alarm as described in 4.10.2, or
- A water-absorbing/flow-restricting multi-stage device meeting API/IP 1581 (4.4.5.6.2. in 5th Edition.)

Note: The implementation of monitoring procedures to assess the contents of the filter sump after aircraft fuelling is accepted by the industry as an alternative to the above hardware-based water defence systems.

#### 4.10 OPTIONAL ACCESSORIES

##### 4.10.1 Water-slug shutoff device

A water-slug shutoff device is a sensor or float that automatically causes the fuel pump to be shut off or a valve downstream of the filter/water separator to be closed when water fills the sump of the filter/water separator vessel. This device shall be equipped with an external mechanism for testing. If a float control is used, it should be the "ballast" or spring-loaded type, which tests the buoyancy of the float when the external test mechanism is activated.

**4.10.2 Sump water-level alarm**

A sump water-level alarm is a device that notifies the operator when water fills the sump of the filter/water separator vessel. This device shall be equipped with an external mechanism for testing.

**4.10.3 Sump heaters**

In very cold areas, accumulated water can freeze, and clog sumps and drains. Electric jackets or immersion heaters can be provided to remedy this problem.



# 5

## SPECIFIC DESIGN REQUIREMENTS FOR MICROFILTERS

### 5.1 GENERAL

The acceptability of a design ultimately depends on satisfactory functioning of the vessel and components during the performance tests described in a relevant specification, such as API/IP 1590, as determined by the purchaser.

New microfilter vessels shall meet the mechanical requirements contained in section 2 and 5.2 to 5.7. Note: Details of optional accessories are provided in 5.8.

### 5.2 DESIGN PRESSURE

The element mounting assembly shall be designed to withstand a differential pressure no less than 750 kPa (110 psi gauge) in the direction of normal flow.

Note: For applications where the microfilter may be converted to a filter monitor, the purchaser should specify the design differential pressure of the element mounting assembly. (Compliance with section 2 is recommended.)

### 5.3 HYDROSTATIC TEST PRESSURE

Each microfilter vessel body shall be hydrostatically tested to 1 550 kPa (225 psi gauge) or 1,5 times the design pressure specified by the purchaser. The upstream side of the mounting assembly shall be

hydrostatically tested with all ports sealed to a test pressure of no less than 750 kPa (110 psi gauge).

Note: For applications where the microfilter may be converted to a filter monitor, the purchaser should specify the hydrostatic pressure testing requirement (all ports sealed) of the mounting assembly. (Compliance with section 2 is recommended.)

### 5.4 ELEMENT SEALING

Element-to-mounting-adaptor and adaptor-to-vessel sealing arrangements shall provide a positive, non-leaking seal against specified design and shock pressures. Methods used will depend on the element design but will include the following:

- (a) A flat-base gasket seating against a blunted V-type knife-edge. The height of the V section shall be 1,5 mm (0,06 in.) +10 %/ -0 % (centre rod installation).
- (b) Compressed internal ring joint or O-ring (for axial contact threaded base installation).
- (c) Internal O-ring (for radial contact 'push-on' installation).
- (d) Screw-thread base.

Sealing materials shall not deteriorate on exposure to fresh or salt waters. All seals shall be of Viton A, Buna N or equivalent. All materials used shall be chemically compatible with the fuel.

### 5.5 ELEMENT SPACING

Elements shall not contact other elements or vessel walls. For applications where the microfilter may be converted to a filter monitor, the design layout of elements in the vessel shall, unless otherwise specified, provide a minimum separation of 12,7 mm (0,5 in.) between elements and between the vessel wall and any element.

### 5.6 ELEMENT MOUNTING

For vessels designed to accept elements with flat end gaskets (face seal), the mounting surface shall incorporate a blunted V-shaped knife edge 1,5 mm high (0,06 in.) +10 % / -0 %.

Proprietary adaptors for threaded base elements shall also have a blunted V-shaped knife edge with the same dimensions as given above.

### 5.7 DATA PLATES

**5.7.1** A permanent stainless steel or non-ferrous metal data plate shall be securely attached to the vessel. This plate shall include as a minimum:

- (a) The vessel manufacturer's name and address.
- (b) The vessel serial number, unit and model number.
- (c) The date of manufacture.

- (d) The design code.
- (e) The design pressure.
- (f) The hydrostatic test pressure for the vessel and the element mounting assembly (deck plate).
- (g) The API/IP specification number.
- (h) Operational temperature range.
- (i) Vessel lid gasket material and part number.

**5.7.2** A second securely attached removable plastic or metal data plate shall show as a minimum:

- (a) The name and address of the element manufacturer.
- (b) The API/IP specification number.
- (c) The model number of elements.
- (d) The quantity of elements.
- (e) The rated flow capacity.
- (f) The recommended maximum differential pressure for the elements.
- (g) The recommended assembly torque.

Any other pertinent data may also be included.

### 5.8 OPTIONAL ACCESSORIES

Where excessive amounts of air may be passed into the vessel, an air-slug relief system may be installed. This may be a sensor or float-type device that controls the outlet flow rate via, for example, a pilot operated discharge valve, until the liquid level within the vessel returns to normal.

# ANNEX A

## PURCHASER'S SPECIFICATION

The following table is intended to assist purchasers in their use of this publication, by clarifying which clauses are applicable to each type of filter vessel.

**Table A1: Filter vessel specifications**

	<b>Clause 2.1 – 2.20</b>	<b>Clause 3.2 – 3.6</b>	<b>Clause 4.2 – 4.9</b>	<b>Clause 5.2 – 5.7</b>
<b>Filter monitor</b>	<b>X</b>	<b>X</b>		
<b>Filter/water separator</b>	<b>X</b>		<b>X</b>	
<b>Microfilter</b>	<b>X</b>			<b>X</b>
X = requirements of that clause apply Note: Requirements for optional accessories have been excluded from the above table				



## ANNEX B

### UNIT CONVERSION FACTORS

1 U.S. gallon	3,785 litres
1 litre	0,264 U.S. gallon
1 Imperial gallon	4,546 litres
1 litre	0,220 Imperial gallon
1 kg	2,205 lbs
1 lb	0,454 kg
1 psi	0,069 bar
1 psi	6,895 kPa
$T\text{ }^{\circ}\text{F} = 1,8 \times T\text{ }^{\circ}\text{C} + 32$	



# ANNEX C

## REFERENCES

The following publications are referenced in this publication:

API/IP 1581 *Specifications and qualification procedures for aviation jet fuel filter/separators*

API/IP 1590 *Specifications and qualification procedures for aviation fuel microfilters*

ASME *Boiler and pressure vessel code, Section VIII: Rules for construction of boilers and pressure vessels*

IP 1583 *Specifications and laboratory tests for aviation fuel filter monitors with absorbent type elements*