



# AEROSPACE RECOMMENDED PRACTICE

ARP725

REV. B

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Superseding ARP725A

## Evaluating Effectiveness of Filter Element Cleaning Methods

### RATIONALE

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## 1. SCOPE:

This SAE Aerospace Recommended Practice (ARP) presents a procedure for evaluating cleaning methods with respect to contaminant removal and element degradation particularly for metallic filter elements. A procedure for checking durability of cleaning equipment and a referee cleaning method are also included. It is applicable only to the evaluation of cleaning methods proposed for removal of service dirt and not for built-in dirt, liquid oxygen (LOX) cleaning, etc. Supporting information for use with the ARP is also included.

## 2. APPLICABLE DOCUMENTS:

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

### 2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 ([www.sae.org](http://www.sae.org)).

|        |                                                                                                                              |
|--------|------------------------------------------------------------------------------------------------------------------------------|
| ARP599 | Aerospace - Dynamic Test Method for Determining the Relative Degree of Cleanliness of the Downstream Side of Filter Elements |
| AIR844 | Minimizing Corrosion Damage in Stainless Steel Filters                                                                       |
| AIR887 | Liquid Filter Ratings                                                                                                        |
| AIR888 | Fine Wire Mesh for Filter Elements                                                                                           |
| ARP901 | Bubble Point Test Method                                                                                                     |

### 2.2 ISO Publications:

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002 ([www.ansi.org](http://www.ansi.org)).

ISO 12103-1 Road Vehicles - Test dust for filter evaluation - Part 1: Arizona Test Dust

## 3. OUTLINE OF METHOD:

- 3.1 The effectiveness of a proposed filter element cleaning method is determined by evaluating the effectiveness of contaminant removal of the proposed method and degradation in performance of the filter element after cleaning. The durability of the cleaning system, where applicable, should be checked before final adoption of any system.
- 3.2 Effectiveness of contaminant removal is determined by subjecting a known dirty filter element to the cleaning procedure being evaluated and then adding artificial contaminant to the filter element. A comparison of the amount of artificial contaminant retained to the amount of contaminant a known clean filter element will retain is a measure of effectiveness of contaminant removal.

- 3.3 Because of the comparative difficulty of obtaining service-dirtied filter elements, a preliminary screening procedure using only artificial contaminant is included. It readily eliminates those cleaning methods which have little effectiveness.
- 3.4 Filter element degradation is checked by subjecting a filter element to the cleaning procedure being evaluated for 10 cleaning cycles, allowing a period of time to elapse in order to permit any corrosive action to take place, and performing a filter element fatigue test.
- 3.5 Durability is verified by performing an endurance test on the cleaning equipment.
- 3.6 A discussion of the considerations upon which this ARP is based may be found in Section 10.
- 4. EQUIPMENT:
  - 4.1 Equipment for the cleaning procedure being evaluated, including all reagents, solvents, etc.
  - 4.2 Bubble point test equipment, as shown in Figure 1, or equivalent.
    - 4.2.1 Ethanol 3-190 or equivalent brand of denatured alcohol.
  - 4.3 Dirt capacity test equipment, as shown in Figure 2.
    - 4.3.1 Arizona Test Dust per ISO 12103-1 A2 or other specified contaminant, as required (see 5.3 and 6.5). See Appendix A for source.
  - 4.4 Flow fatigue test equipment (see 7.4).
  - 4.5 Amplitude, pH, temperature and/or other measuring equipment, as required (see 8.2).
- 5. PROCEDURE FOR PRELIMINARY SCREENING OF FILTER ELEMENT CLEANING METHODS:
  - 5.1 A new filter element should be subjected to a bubble point test as follows:
    - 5.1.1 The test element containing no oil is installed in a setup similar to that shown in Figure 1. Fluid level is maintained 1/2 inch above the top of the test element. The air pressure within the element is raised in small increments and the element is slowly rotated 360 degrees at each pressure increment. The area of greatest porosity is determined by observing the first bubble on the surface of the element, and the manometer reading in inches of water at which this bubble emits from the element is recorded. Reference ARP901 Bubble Point Test Method
    - 5.1.2 This is the Initial Bubble Point. This value should be recorded for comparison with future test results. Dry the element before performing further tests.
  - 5.2 The clean filter element should then be installed in a housing in a test stand plumbed as in Figure 2. Measure the pressure drop across the filter assembly.

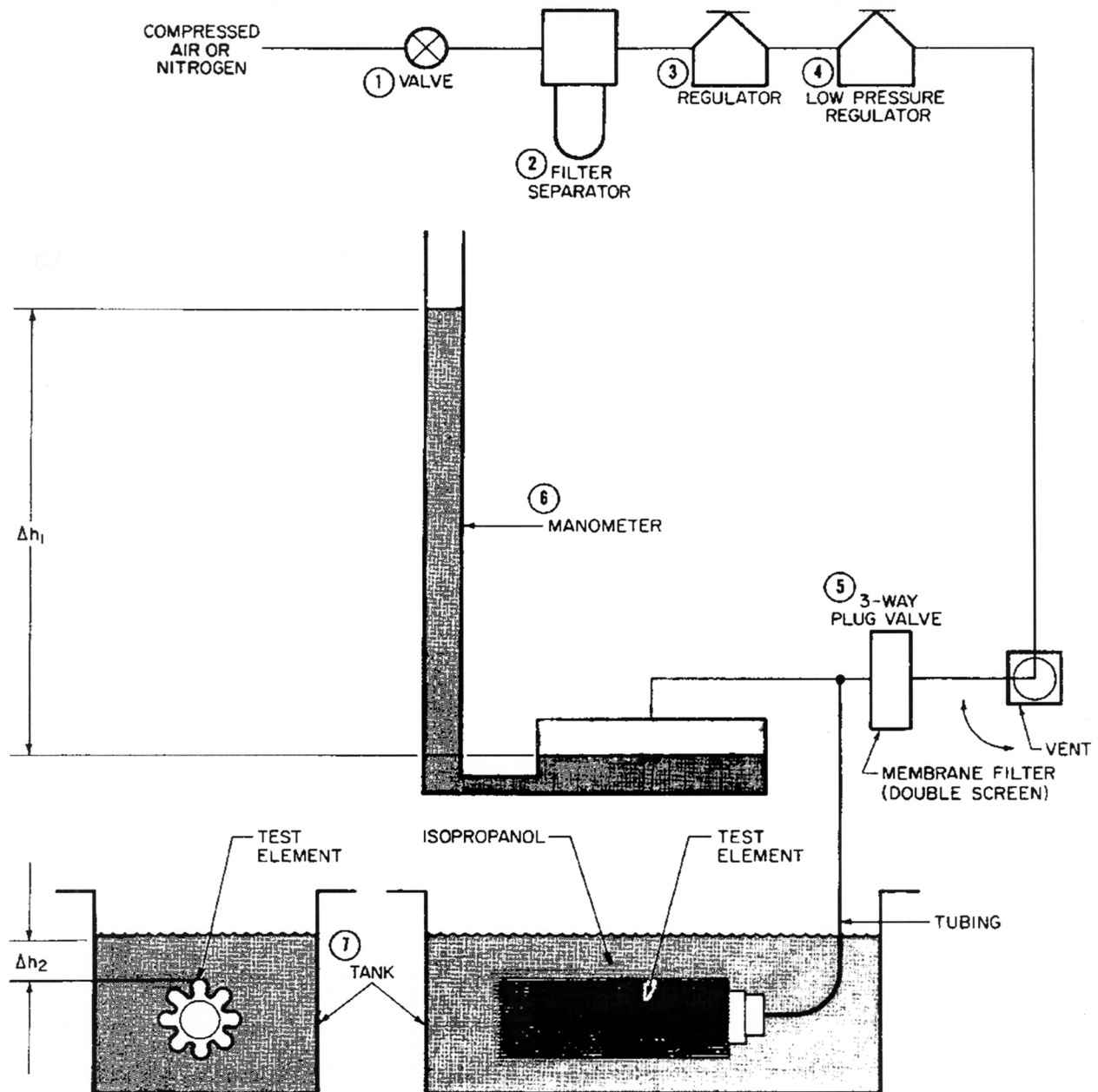
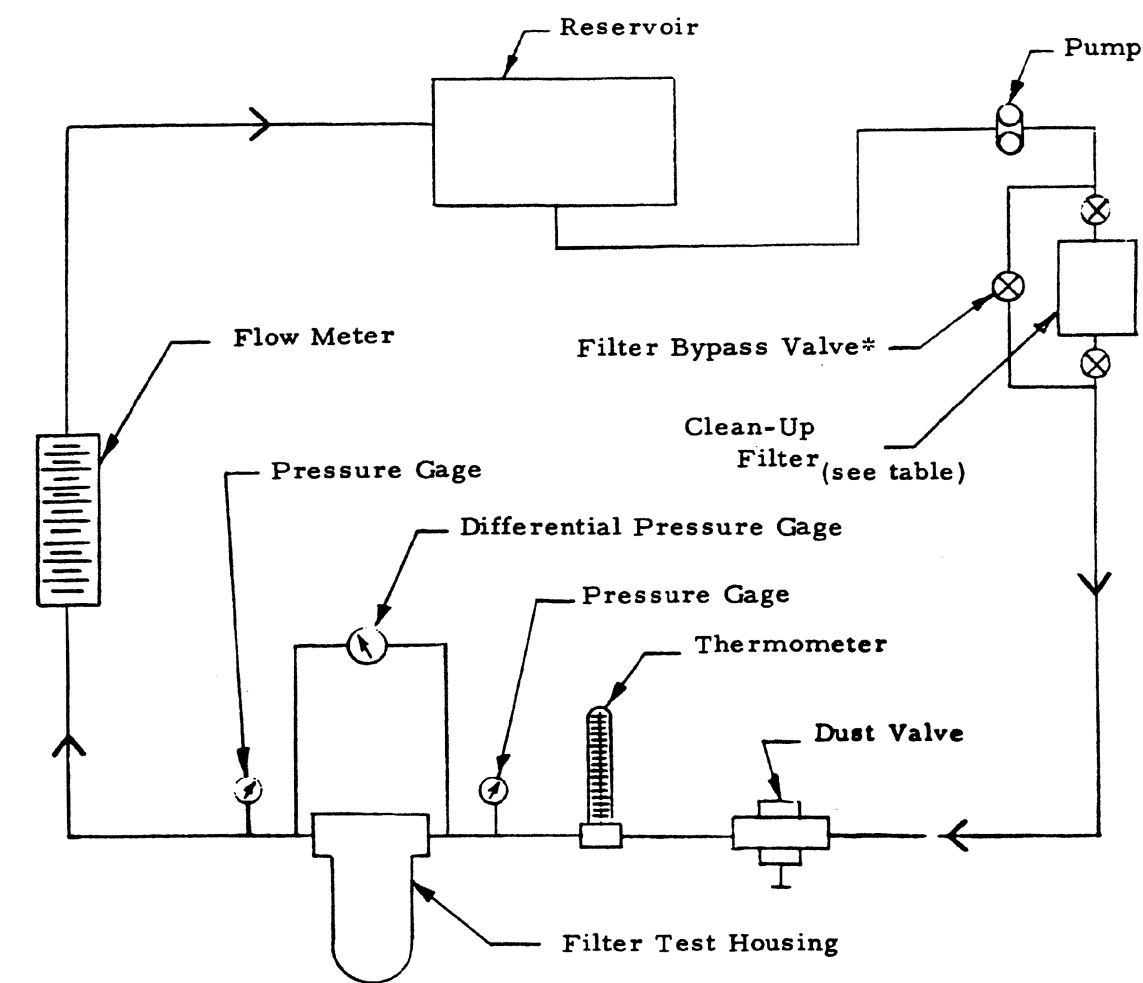


FIGURE 1 - Bubble Point Test Method



\*To be left closed unless otherwise directed in the filter detail specification

| Nominal Rating of Filter under Test, Micrometers | Absolute* Rating of Filter under Test, Micrometers | * Absolute Rating of Clean-up Filter, Micrometers |            |
|--------------------------------------------------|----------------------------------------------------|---------------------------------------------------|------------|
|                                                  |                                                    | Preferred                                         | Acceptable |
| Deleted<br>see AIR887                            | 15                                                 | 3                                                 |            |
|                                                  | 18 and up                                          | 3                                                 |            |
|                                                  | 25 and up                                          | 3                                                 | 15         |
|                                                  | 33 and 110                                         | 15                                                | 25         |
|                                                  | over 110                                           | 25                                                | 70         |

\*Reference AIR887 for absolute rating or equivalent.

FIGURE 2 - Typical Setup for Dirt Capacity Tests

- 5.3 While it is still installed in the test stand of Figure 2, measure the dirt capacity of the filter assembly as prescribed in the filter detail specification, or in accordance with the filter manufacturer's recommended procedure, if a specification does not exist. (Dirt capacity is defined as the amount of a specified standard contaminant which must be added to a filter to cause the pressure drop to reach a certain specified value below relief valve cracking pressure. If a filter relief valve is incorporated in the test stand, it should preferably be blocked for this test.) The dirt capacity measured at this time is the Actual Dirt Capacity, abbreviated ADC (see Table 1 for a list of definitions of abbreviations).

TABLE 1 - Definition of Abbreviations

| Abbreviation | Meaning                 | Reference Paragraph |
|--------------|-------------------------|---------------------|
| ADC          | Actual Dirt Capacity    | 5.3, 6.12           |
| CDC          | Cleaned Dirt Capacity   | 5.5, 6.8            |
| EDC          | Estimated Dirt Capacity | 6.3                 |
| RDC          | Residual Dirt Capacity  | 6.5                 |

- 5.4 Clean the filter element by the method being evaluated.
- 5.5 Measure the dirt capacity of the filter, following the procedure described in 5.3. The dirt capacity measured at this time is called the Cleaned Dirt Capacity, abbreviated CDC.
- 5.6 If the cleaning method used in 5.4 is satisfactory, CDC will be at least 90% of ADC. If the CDC is lower, the element is not clean, and either the cleaning method being evaluated is ineffective, or the element has been damaged. If the element is found to be undamaged and CDC is lower than 90% of ADC, the cleaning method should be discarded as ineffective.
- 5.7 The filter element should be degreased and the procedure of 5.1 should be repeated. The Initial Bubble Point should be recorded and should not vary significantly from the value measured in 5.1. A change of more than  $\pm 10\%$  or  $\pm 0.25$  inch of water column, whichever is greater, is a significant change.
- 5.8 The procedure of 5.2 through 5.7 should be repeated until a total of 10 cleaning cycles have been completed. No more than one cycle should be performed per day. CDC at the end of 10 cycles should be at least 85% of ADC. If CDC at the end of 10 cycles is less than 85% of ADC, the cleaning method being evaluated is not capable of repetitively cleaning dirty filter elements to "as new" condition and should be discarded as unsatisfactory.
- 5.9 The filter element should then be subjected to the procedure of Section 7.
- 5.10 Cleaning methods which have demonstrated satisfactory performance in the preceding screening should be confirmed in accordance with Section 6.