AEROSPACE RECOMMENDED PRACTICE

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ARP 599A

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DYNAMIC TEST METHOD FOR DETERMINING THE DEGREE OF CLEANLINESS OF THE DOWNSTREAM SIDE OF FILTER ELEMENTS

1. SCOPE

This test method describes a procedure for determining the insoluble contamination level of the downstream side of filter elements. Results of this procedure represent the particulate release rate of the tested filter element under the prevailing conditions of the test and may be used for comparative evaluation of the effectiveness of various cleaning methods or cleanliness of elements as received from manufacturers. Because of the variety of conditions which may exist even under the provisions of this procedure, it is difficult to correlate data from one testing agency to another. The data obtained by this procedure do not necessarily indicate qualitatively or quantitatively, the contamination which may be released by a filter element into the operating fluid during service. When properly conducted, however, the procedure will show marked differences between various cleanliness levels of filter elements. Because of the probability of extraneous contamination caused by conducting this test in an uncontrolled atmosphere, all operations should be conducted in an environment equivalent to that for FED-STD-209, Class 100,000.

2. OUTLINE OF METHOD

2.1 A representative portion of the contamination of the downstream side of the filter element under test is removed by placing the filter element in an ultrasonic bath for a set period of time and then withdrawing a sample through the filter under test into a vacuum flask. The sample is then filtered per ARP 598. The insoluble contamination is thus transferred onto the surface of the membrane filter disk where it can be examined microscopically to determine the amount of contamination released from the filter element.

3. APPLICABILITY

3.1 This procedure shall be used only on filters which are not degraded by exposure to ultrasonic cavitational energy.

3.2 Because the amount of contamination released by this procedure is large in comparison to other cleanliness test methods, it is recommended for use primarily for filters to be used in systems with rigid cleanliness requirements and which have been cleaned to very high cleanliness levels.

3.3 The data obtained from this procedure are comparable only to data previously obtained from the same system under the same conditions. "Same Conditions" is defined as nominally equal in (1) operation of the herein described procedure, (2) results of the foil erosion test of 10.2, and (3) the operating conditions as listed in 10.4. Because of the wide variations in frequency and operating characteristics of various ultrasonic systems and because of the variations in cavitational characteristics of various liquids at different temperatures, it is normal to expect variances in results between different testing agencies. Paragraph 12 suggests one method of correlating the expected variations in results.

4. EQUIPMENT

4.1 Beaker, glass or stainless steel, to hold the test liquid in the ultrasonic bath.

4.2 Filter, in line, to clean test liquid entering the container of 4.1.

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4.3 Flask, vacuum, 1000 ml capacity, graduated at 500 milliliters to collect the sample from the filter under test.

4.4 Tubing, stainless steel (or equivalent), 300 series, with internal diameter adequate to maintain a minimum liquid velocity of 21 centimeters per second (0.7 feet per second) during sample withdrawal.
NOTE: This would be approximately 900 milliliters per minute through 3/8 in. tubing.

4.5 One ultrasonic generator, transducer and suitable tank. Transducer shall provide at least 0.5 watts of power per sq cm (3 watts/sq in.) of tank bottom or the same for the transducer surface of an immersible transducer if used.

4.6 Stopper, or appropriate material (polytetrafluoroethylene recommended) to fit 4.3 and to accept 4.4.

4.7 Vacuum source, gauge and regulator capable of maintaining 500 mm of mercury (20 in. of mercury) vacuum minimum during the sample withdrawal period.

4.8 Sampling adapter (see 6.1)

4.9 Forceps with unserrated tips.

4.10 Petri dishes, low profile, plastic or equivalent.

4.11 Sampling equipment as described in ARP 598.

4.12 Microscopic equipment as described in ARP 598.

4.13 Aluminum foil, annealed, household type (approximately 0.038 mm or 1.5 mils thick).

NOTE: The use of an in-line membrane filter in the downstream line for collecting the particles withdrawn in the liquid sample is discouraged because of uneven distribution and retention of particles on the walls of the filter holder. If these problems could be circumvented, then an in-line membrane would be preferable.

5. TEST LIQUIDS

Any one of the following test liquids may be used:

5.1 Trichloroethylene.

5.2 Distilled or deionized water.

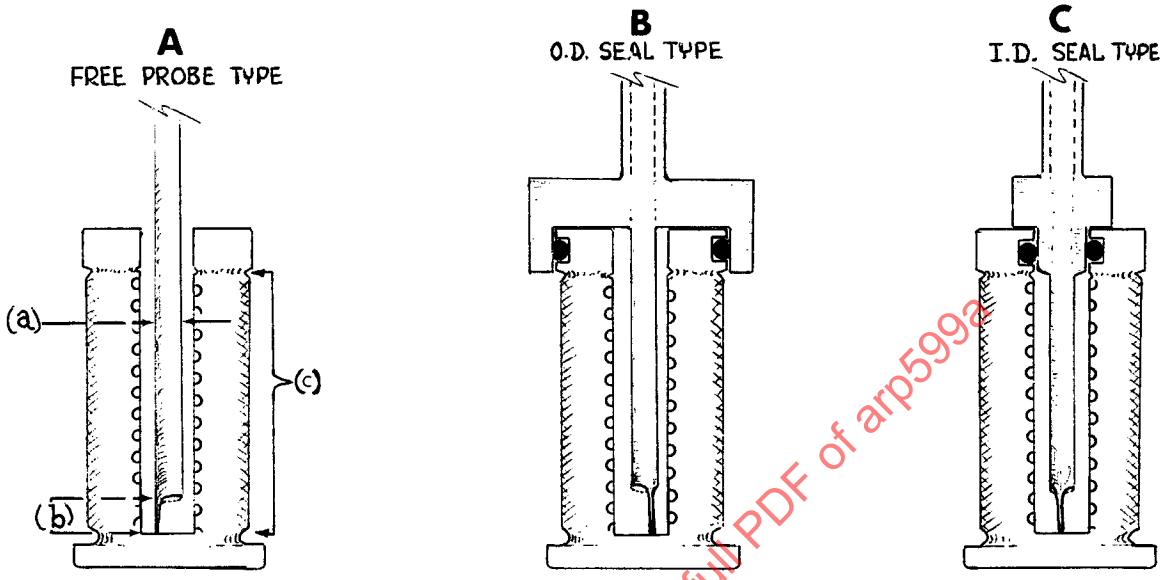
5.3 Trifluorotrichloroethane.

NOTE: 1. Chlorinated solvents should be tested to assure absence (less than 0.3 ppm) of chloride ion prior to use.

2. The chlorinated solvents are toxic to varying degrees. Use only with adequate ventilation and avoid contact with the skin.

6. TYPICAL ANALYSIS APPARATUS

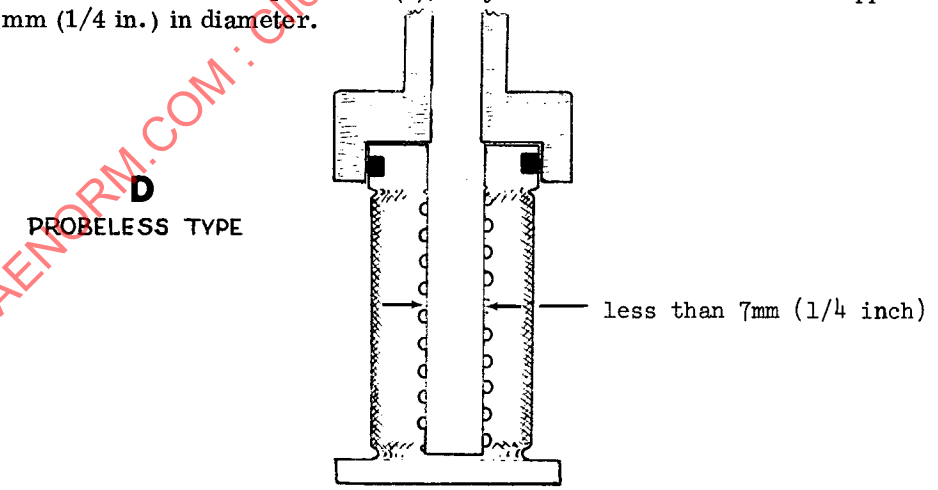
6.1 Sampling Adapters: Four variations of the sampling adapter may be used. The one selected will depend on the configuration and dimensions of the filter to be tested. The "Probe" refers to the part of the withdrawal tube which enters the filter under test as in types (A), (B) and (C).



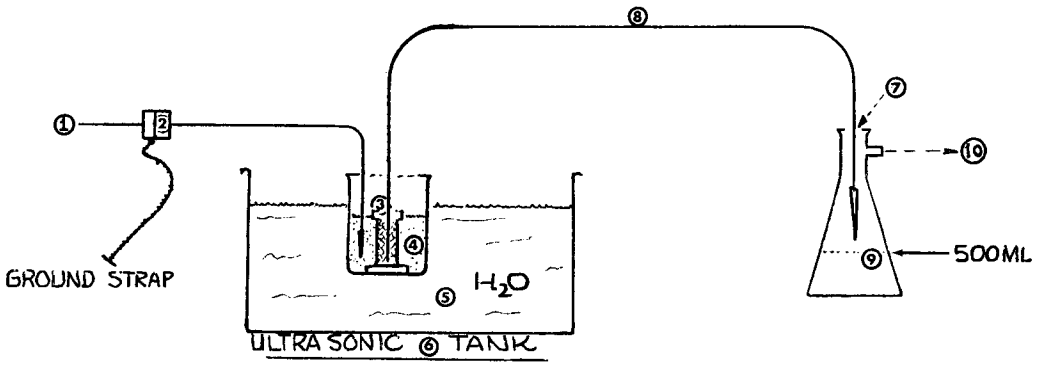
(a) The probe diameter shall be no larger than 3/4 or smaller than 1/4 the diameter of the inner support tube of the filter being tested.

(b) The leg which holds the probe opening away from the bottom of the filter under test shall be between 1/5 and 1/3 the length of (c) as shown in Fig. A.

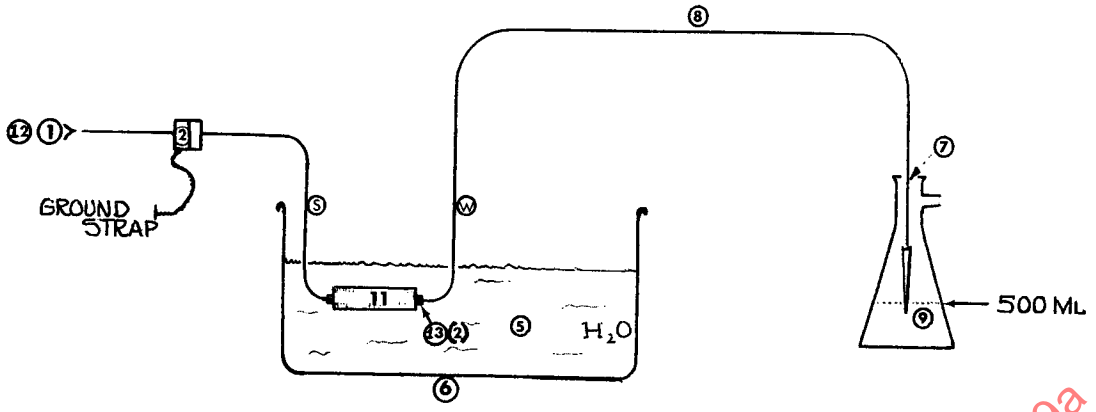
NOTE: The probe, and therefore requirement (a), may be omitted when the inner support tube is less than 7 mm (1/4 in.) in diameter.



6.2 Filter elements removed from housing with upstream side exposed in a filtered test liquid bath:



6.3 Non-separable filter assemblies mounted in-line using filtered test liquid:



(1) From test liquid reservoir
(2) Filter, membrane type recommended, with electrical ground
(3) Filter element under test
(4) Test liquid (paragraph 5) in beaker
(5) Water in ultrasonic bath
(6) Ultrasonic unit
(7) Stopper
(8) Stainless steel (or equivalent) tube
(9) Vacuum flask graduated at 500 milliliters
(10) To vacuum pump
(11) Non-separable filter case containing filter under test
(12) From pressure source
(13) Fitting which will remain leak tight at sampling pressure

7. PROCEDURE FOR BLANK

7.1 Set up equipment to be used for testing filter per 6.2 or 6.3, but do not as yet install filter to be tested. Attach line S to line W for set up per 6.3. Take precautions to assure cleanliness of sampling apparatus and the test liquid. Degas the ultrasonic bath by running for 3 minutes minimum.

7.2 Ready ARP 598 apparatus for testing the cleanliness of liquid samples.

7.3 Withdraw (6.2) or expel (6.3) 500 ml of test liquid from the bath into the graduated vacuum flask with the ultrasonic bath turned on.

7.4 Filter the sample per ARP 598 except test the full 500 ml:

7.4.1 Empty approximately 250 ml into the filtration funnel. Turn on the vacuum.

7.4.2 Agitate the remaining 250 ml in the flask and add to the liquid in the filtration funnel as the level drops. The level must not be allowed to drop below 100 ml until all the sample has been added.

7.4.3 Add approximately 50 ml of filtered test liquid into the sample flask, agitate with a rapid back and forth motion and add to the funnel before the level has dropped to 50 milliliters. The filtration rate may have to be slowed by backing off the vacuum in order to complete this step without the liquid level dropping below 50 ml.

7.4.4 Continue per ARP 598.

7.5 Count all particles over 25 microns in accordance with ARP 598.

7.6 The contamination count should not exceed 5 particles and should be recorded.

7.7 Should the blank value be high, repeat the procedure until the requirement of 7.6 is met.

8. DETERMINATION OF LEVEL OF CLEANLINESS

8.1 The ultrasonic bath shall have been degassed (para. 7.1) prior to test.

8.2 The filter element should be handled with appropriate technique to prevent contamination when the filter is installed in the test set up. The filter shall be dry or dried prior to installing in the test set up.

8.3 Install filter in the test set up. Do not allow the level of liquid to go below the top of the filter media nor allow liquid to enter the filter elsewhere than through the filter media. If a seal is used on the element or the adapter, it must be compatible with the test liquid. With non-separable filters assure the exclusion of air traps in the filter case while under test.

8.4 Ready sample analysis apparatus as in 7.2.

8.5 Turn on ultrasonic field within one minute after immersing the element in the test liquid. The ultrasonic field should be tuned to maximum intensity.

8.6 Expose element to ultrasonic cavitation without liquid flow for a period of 5 min. ± 5 seconds. At the end of this period apply vacuum and withdraw (or pressure and expel, for non-separable filters) 500 ml of test liquid into the collection flask with the ultrasonic bath still on.

8.7 Repeat step 7.4.

8.8 Repeat step 7.5. Record results.

9. REPORTING OF RESULTS

9.1 The following information should be reported with each analysis:

A. Total analysis count as obtained from paragraph 8.8. (Do not subtract the blank of paragraph 7.5.)

B. Total blank count as obtained from paragraph 7.5.

C. The test fluid used.

D. The frequency, model and power (watts per square centimeter or square inch of tank bottom) of the ultrasonic system.

10. DISCUSSION OF METHOD

10.1 Because of the current lack of a satisfactory method for accurate measurement of cavitational energy in the wide variety of ultrasonic cleaning equipment now in use, specific minimum intensity values cannot be specified. It is recommended, however, that all possible steps be taken to increase the effectivity of ultrasonic equipment on the filter element.

10.2 Foil Erosion Control Test: Whenever a test or series of tests are begun employing this procedure, the activity of the ultrasonic unit should be qualitatively checked by observation of the effect of the bath. A strip of aluminum foil (see 4.13) at least 25 mm (1 in.) wide extending into the bath to within 25 mm (1 in.) of the tank bottom should be placed in the position where the filter(s) will be placed during testing. The transfer liquid should be water at not over 44 C (110 F). Activate the ultrasonic energy for 60 seconds. The foil is then removed and examined. A definite erosion of the foil should be in evidence. If this is the first time an aluminum foil erosion test for this procedure has been run, save the foil for future reference in a transparent container. Subsequent aluminum foil erosion tests per this paragraph should be compared to the original reference. This is advised since ultrasonic units can degrade and lower particle yields thereby possibly showing filters to be acceptable that wouldn't have met the requirements as originally established under the original ultrasonic conditions.