Designation: F303 – 08 (Reapproved 2016)

Standard Practices for Sampling for Particles in Aerospace Fluids and Components[1]

This standard is issued under the fixed designation F303; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 These practices cover sampling procedures for use in determining the particle cleanliness of liquids and liquid samples from components. Three practices, A, B, and C, have been developed on the basis of component geometry in order to encompass the wide variety of configurations. These practices establish guidelines to be used in preparing detailed procedures for sampling specific components.

NOTE 1—The term cleanliness used in these practices refers to solid particles in the liquid. It does not generally cover other foreign matter such as gases, liquids, and products of chemical degradation. Cleanliness with respect to particulate contamination does not necessarily give any indication of the other types of contamination.

1.2 All components, regardless of application, may be tested provided (*1*) the fluid medium selected is completely compatible with the materials, packing and fluid used in the test component, and test apparatus, and (*2*) the fluid is handled in accordance with the manufacturer's recommendations and precautions. A liquid shall be used as the test fluid medium. These test fluids may be flushing, rinsing, packing, end use operating, or suitable substitutes for end use operating fluids. (**Warning**—Practices for sampling surface cleanliness by the vacuum cleaner technique (used on clean room garments and large storage tanks) sampling gaseous fluids and handling hazardous fluids such as oxidizers, acids, propellants, and so forth, are not within the scope of the practices presented; however, they may be included in addendums or separate practices at a later date.

Substitute fluids are recommended in place of end item fluids for preassembly cleanliness determinations on components using hazardous end item fluids. After obtaining the sample, the substitute fluid must be totally removed from the test part with particular caution given to the possibility of trapped fluid. It is hazardous to use a substitute fluid for testing assembled parts where the fluid can be trapped in dead ends, behind seals, and so forth.)

NOTE 2—The word fluid used in these practices shall be assumed to be a liquid, unless otherwise stated.

1.3 The cleanliness of assemblies with or without moving parts may be determined at the time of test; however, movement of internal component parts during the test will create unknown quantities of contamination from wear. Practice B covers configurations requiring dynamic actuation to achieve a sample. The practice does not differentiate between built-in particles and wear particles.

NOTE 3—Defining allowable cleanliness limits is not within the scope of these practices.

1.4 The three practices included are as follows:

	Sections
Practice A—Static Fluid Sampling (Method for extracting fluid from the test article for analysis. This applies to components that have a cavity from which fluid may be extracted)	5 – 13
Practice B—Flowing Fluid Sampling (Method for flushing contaminants from the test article for analysis. This applies to components which fluid can pass (*1*) directly through, or (*2*) pass into and out of by cycling)	14 – 22
Practice C—Rinse Fluid Sampling (Method for rinsing contaminants from the test article's surfaces. The rinse fluid is analyzed for contamination. This applies to components that do not have a fluid cavity or for other reasons are not adaptable to Practices A and B)	23 – 31

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1836 Specification for Commercial Hexanes

F311 Practice for Processing Aerospace Liquid Samples for Particulate Contamination Analysis Using Membrane Filters

[1] These practices are under the jurisdiction of ASTM Committee E21 on Space Simulation and Applications of Space Technology and are the direct responsibility of Subcommittee E21.05 on Contamination.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

F312 Test Methods for Microscopical Sizing and Counting Particles from Aerospace Fluids on Membrane Filters
F313 Test Method for Insoluble Contamination of Hydraulic Fluids by Gravimetric Analysis (Withdrawn 1988)[3]
2.2 *Military Standards:*
MIL-T-27602 Trichlorine Oxygen Propellant Compatibles[4]
MIL-H-6083 Hydraulic Fluid Petroleum Base for Pressure[4]
MIL-H-5606 Hydraulic Fluid Petroleum Base for Aircarrier Missiles and Ordinance[4]

3. Terminology

3.1 *Definitions:*

3.1.1 *analytical membrane*—a membrane filter used to collect the contaminant particles for analysis.

3.1.2 *azeotropic mixture*—a solution of two or more liquids, the composition of which does not change upon distillation. Also known as azeotrope.

3.1.3 *blank analysis*—sometimes referred to as "fluid tare," "control level," "reference contamination level," or "background level." The blank analysis is the particulate contamination level of the test fluid when the test part is omitted.

3.1.4 *cleanup membrane*—a membrane used to filter the contaminant particles from the fluid medium.

3.1.5 *component*—an individual piece or a complete assembly of individual pieces.

3.1.6 *field filter holder*—a throw-away or reusable cartridge containing an analytical membrane filter.

3.1.7 *initial cleanliness*—the measure of contamination removed from the test component at the time of test, excluding that defined by operating cleanliness.

3.1.8 *membrane tare*—sometimes referred to as "blank count" or "control filter." When applied to microscope methods, the membrane tare is the quantity of particles determined to be on the filter before the test fluid is filtered. When applied to gravimetric methods, the membrane tare is an amount of weight increase imparted to the control filter when uncontaminated test fluid is passed through.

3.1.9 *operating cleanliness*—the measure of contaminants generated by moving parts in the component during a specified period of dynamic operation.

3.1.10 *solvent filtering dispenser*—an apparatus to dispense a stream of 2.0 µm or finer membrane filtered fluid.

3.1.11 *system tare*—The measure of contamination determined by replacing the test component with a connecting fitting and following the cleanliness test procedure as if checking the test component.

4. Summary of Practices

4.1 Cleanliness is determined by sampling and analyzing fluid that has been in contact with the surface being analyzed. Specific methods are recommended; however, other methods have been recognized due to the wide variety of components and different test equipment used by industry. Recommended and alternative methods are given in Fig. 1, Fig. 2, and Fig. 3.

PRACTICE A—STATIC FLUID SAMPLING

5. Scope

5.1 This practice covers procedures for determining the particulate contamination level of fluids from components that have a cavity from which fluid may be extracted.

6. Summary of Practice

6.1 Fluid is extracted from the component and analyzed to determine the particulate contamination level. Recommended and alternative methods are given in Fig. 1.

6.2 It is recommended that all operations of this practice be conducted in a dust controlled area. Cleanliness level of the dust controlled area shall be consistent with the component contamination limits.

7. Significance and Use

7.1 Although a cleaning action is imparted to the test component, it is not the intent of this practice to serve as a cleaning procedure. Components are normally cleaner after each consecutive test; thus repeated tests may be used to establish process limits for a given component (Fig. 4). A specific set of test parameters must be supplied by the agency specifying cleanliness limits. Fig. 1, Fig. 2, and Fig. 3 may be

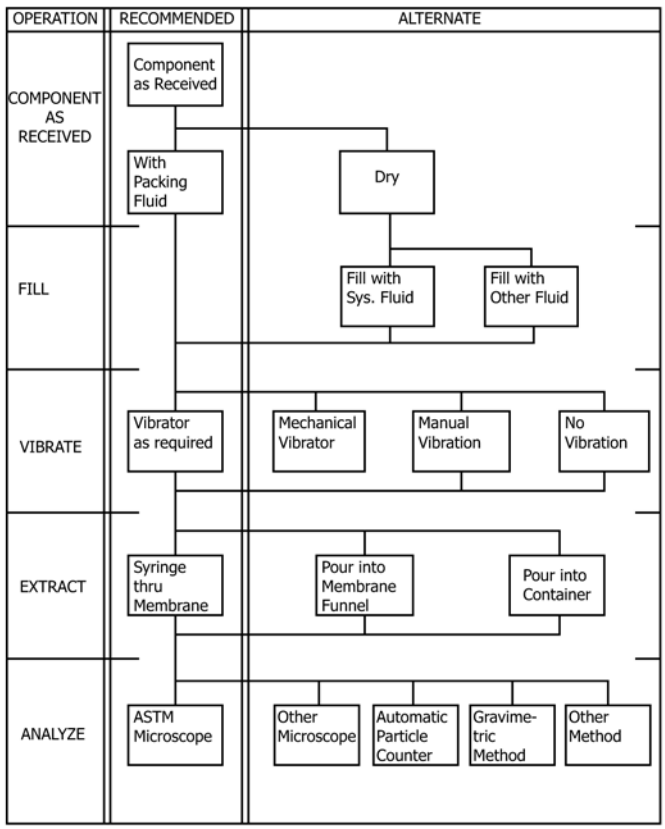

FIG. 1 Recommended and Alternative Methods for Static Fluid Sampling (Practice A)

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, Attn: NPODS.

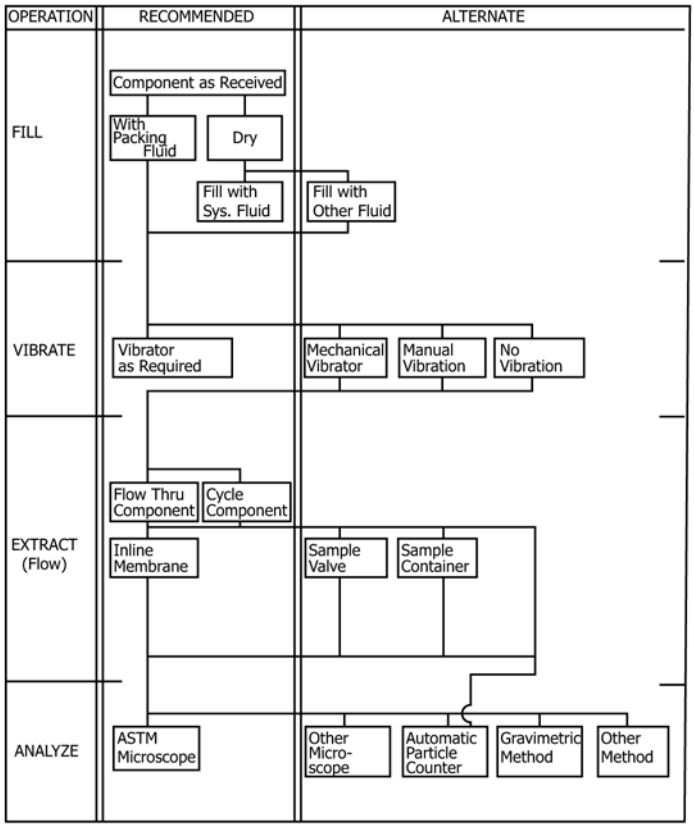

FIG. 2 Recommended and Alternative Methods for Flow Through Sampling (Practice B)

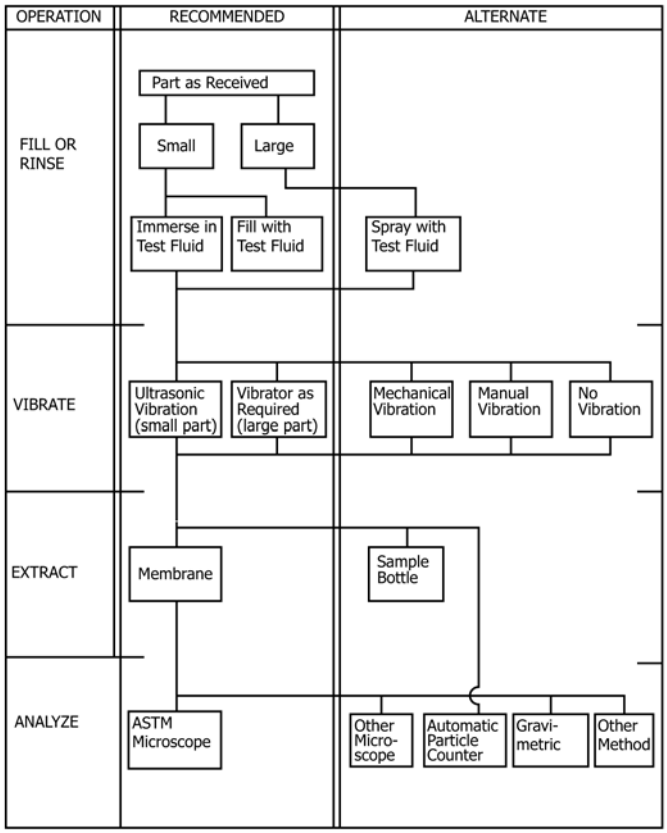

FIG. 3 Recommended and Alternative Methods for Rinse Fluid Sampling (Practice C)

used as a guide to establish the desired parameters of test fluid, vibration, extraction, and analysis.

7.2 The curve in Fig. 4 shows the typical behavior of a component when tested for cleanliness several consecutive times. Stabilization generally occurs before the fifth successive run. The stabilized region starts where a horizontal line through the maximum stabilized value intersects the curve.

7.3 The allowable cleanliness limit of a test component should be based on the cleanliness requirements of the system in which it will be used, and the assigned value should be greater than the maximum stabilized value. When defining the allowable cleanliness limits, an important consideration is that the accuracy of the results decreases as the allowable limit value approaches the stabilized value.

8. Apparatus

8.1 *Apparatus,* as described in Practice F313.

8.2 *Apparatus,* as described in Test Methods F312 or as described in Practice F311.

8.3 *Automatic Particle Counter,* as required.

8.4 *Vibration Equipment,* as specified.

8.5 *Apparatus Setup for Removing Component Fluid Sample,* as shown in Fig. 4.

NOTE 4—Any suitable syringe and solvent dispensing devices may be used.

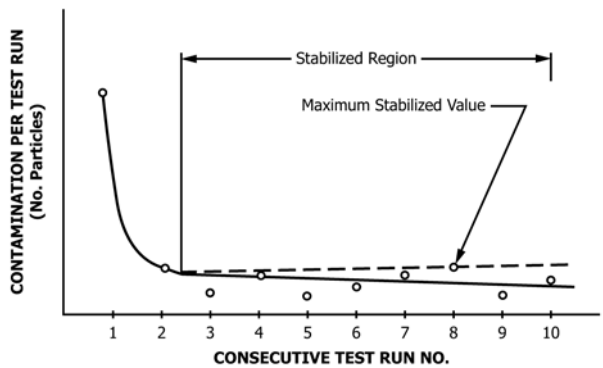

FIG. 4 Contamination per Test Run Versus Consecutive Test Run Number

8.6 *Apparatus Setup for Providing Filtered Fluids,* as shown in Fig. 5 (Note 4).

9. Reagents[5]

9.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society,

[5] A Material Safety Data Sheet (MSDS) can be obtained from the vendor. The following website can also provide MSDS's for all materials: www.msdssearch.com/DBlinksN.htm. Note that the specific fluorocarbon must be identified.

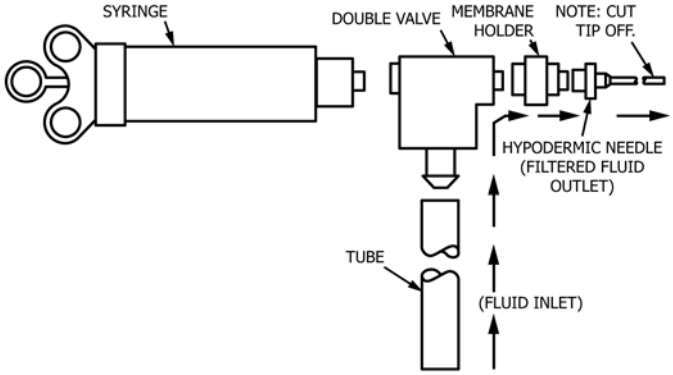

FIG. 5 Apparatus Setup for Providing Filtered Fluids

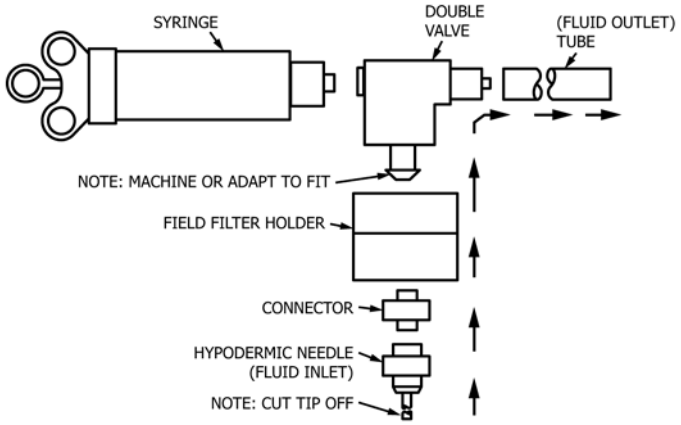

FIG. 6 Apparatus Setup for Removing Component Fluid Sample

where such specifications are available.[6] Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

9.2 Reagents must be compatible with the materials, fluid, and seals used in the component and apparatus.

9.3 All reagents shall be prefiltered through a 2-µm or finer absolute membrane filter prior to use unless this requirement is impractical due to the fluid used or sizes monitored in which case the user must filter as necessary.

9.4 Low surface tension reagents commonly used are as follows:

9.4.1 *Petroleum Ether,*

9.4.2 *Hexane,* in accordance with Specification D1836.

9.4.3 *Isopropyl Alcohol,*

9.4.4 *Fluorocarbons,*

9.4.5 *Mineral Spirits,*

9.4.6 *Trichloroethylene,* in accordance with MIL-T-27602, and

9.4.7 *Azeotropic mixture* of ethyl acetate (47 % vol) and cyclohexane (53 % vol).

9.4.8 *Deionized water.*

NOTE 5—Methyl-chloroform, used in these practices, is toxic, and is being phased out for many applications. Methyl-chloroform has been replaced in this edition of these practices. The replacement solvents were selected based on tests and analyses performed by The Aerospace Corporation and described in SMC-TR-95–28.[7]

NOTE 6—Trichloroethylene has been labeled a potential human carcinogen by the Environmental Protection Agency. Use should be restricted to limit human exposure.

10. Preparation of Apparatus

10.1 *Installation Requirements for* Fig. 6—The following requirements must be accomplished prior to and during assembly of the apparatus shown in Fig. 6. (**Warning**—All connections must be finger tight only.)

10.1.1 Install the double valve and fluid outlet plastic tube.

10.1.2 Remove caps or plugs, or both, from the field filter holder and place them in a covered, precleaned, petri dish.

10.1.3 Install the field filter holder onto the double valve, taking care to place the inlet side of the field filter holder towards the fluid being withdrawn.

10.1.4 Install fluid inlet needle onto the monitor. (**Warning**—The fluid inlet needle must be precleaned prior to each usage.)

10.2 *General Requirements for* Fig. 6*:*

10.2.1 A control blank must be accomplished on the apparatus setup before fluid is withdrawn for component fluid sampling.

10.2.2 It is recommended that the field filter holders be used one time only for component fluid sampling. However, cleaning in sufficient numbers might warrant their reuse, provided it is first determined that the monitors are sufficiently cleaned to permit their reuse without lessening the accuracy of the determination.

10.2.3 Always actuate the syringe plunger slowly when filling or ejecting fluid.

10.2.4 For ease of actuation, the syringe plunger must be lubricated. If the plunger is extremely hard to actuate, check the plunger seal for swelling which would indicate noncompatibility with the fluids utilized.

10.2.5 In order to minimize seal swell, it is desirable to remove the syringe plunger when not in use. Lubricate prior to each reassembly.

10.3 *Installation Requirements for* Fig. 7—The following requirements must be accomplished prior to and during assembly on the apparatus shown in Fig. 7. (**Warning**—See 10.1.)

10.3.1 Eject all fluid from the syringe.

10.3.2 Install the hypodermic adapter and fluid outlet needle onto the double valve. (**Warning**—The hypodermic adapter and fluid outlet needle must be precleaned and the hypodermic adapter filter disk replaced prior to each usage.)

10.3.3 Exercise extreme caution to assemble the hypodermic adapter in the correct configuration. Tighten sufficiently to effect a seal.

[6] *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For Suggestions on the testing of reagents not listed by the American Chemical Society, see *Annual Standards for Laboratory Chemicals,* BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary,* U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.

[7] Aerospace Corporation Report No. TR95 (5448)-1, "Non-Volatile Residue Solvent Replacement." Available from The Aerospace Corporation, P.O. Box 92957, Los Angeles, CA 90009–2957.

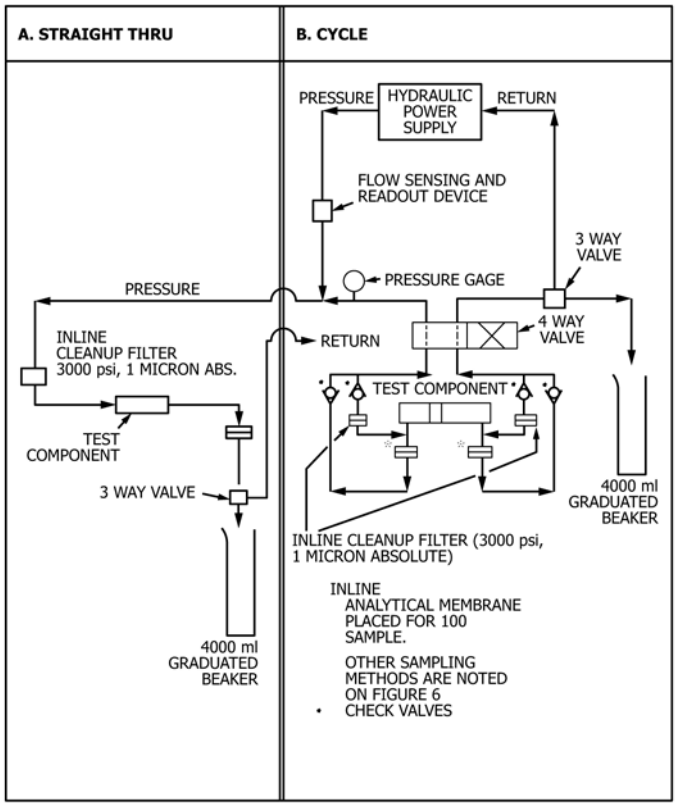

FIG. 7 Component Fluid Sampling Apparatus and Equipment for Practice B

10.4 *General Requirements for* Fig. 5*:*

10.4.1 Periodic control analysis is required in order to guarantee an acceptable contamination level of the component replacement fluid.

10.4.2 Prior to initial use, replace the "as received" hypodermic adapter backup screen with a like diameter backup screen, approximately 35 mesh (500-µm opening), or photoetched screen with 70-µm holes.

10.4.3 The addition of a field filter holder between the double valve and fluid inlet tube will increase the filtration capability. This application would be governed by the quality and condition of the fluid being filtered. (**Warning**—If utilizing a field filter holder, take caution to assemble the apparatus with the field filter holder towards the fluid being withdrawn.)

10.4.4 Do not utilize a field filter holder with paper back-up on the filtered fluid outlet side, as backup media migration may be encountered.

10.4.5 When actuating the syringe plunger, do not fill or eject fluid rapidly.

10.4.6 For ease of actuation, the syringe plunger must be lubricated. If the plunger is extremely hard to actuate, check the plunger seal for swelling which would indicate incompatibility with the fluids utilized.

10.4.7 In order to minimize seal swell, it is desirable to remove the syringe plunger when not in use. Lubricate prior to each reassembly.

11. Procedure

11.1 *Blank Analysis*—Run a blank on the apparatus setup before fluid is withdrawn for component fluid sampling. The blank determination shall be applicable for no more than ten fluid samples at which time a new blank shall be run for each of the following ten applications of the apparatus setup. This blank will determine the environmental and apparatus contamination level. When alternative methods are utilized, these same alternative methods must be utilized in the blank analysis procedure.

NOTE 7—All ten of the applications, for which the blank determination was performed, must be utilized on the same day that the blank is run. A maximum value shall be specified for the blank analysis. Ten percent of the allowable contamination level set for the component is recommended.

11.2 *Component Received With Fluid*—It is recommended that when components are shipped with packing fluid, the packing fluid be analyzed. This minimizes the addition of extraneous contaminants.

11.3 *Components Received Dry*—When components are received dry, it is necessary to fill the component with fluid which will be extracted for analysis. Regardless of the type of fluid utilized, the fluid shall be prefiltered and a maximum blank analysis specified. The component shall be filled as follows:

11.3.1 Prior to removing the component closure, flush the closure and adjacent area with a prefiltered reagent.

11.3.2 The component may be filled with the apparatus setup shown in Fig. 5. It is recommended that system operating fluid be utilized. Verify component compatibility if a fluid other than system operating fluid is used.

11.4 *Vibration*—Vibrate the component for 1 min prior to extracting the fluid sample. Methods of vibration are given in Fig. 1 (see also Section 13).

11.5 *Extraction*—Three alternatives are possible for extracting fluids:

11.5.1 *Syringe Through Membrane:*

11.5.1.1 *Fill*—Prepare the sampling apparatus as specified by Fig. 2 and place the syringe plunger in the fluid withdrawal position. Prior to removing the component closure, flush the closure and adjacent area with a prefiltered reagent. Remove the component closure and place the closure in a covered, precleaned, petri dish. Immediately subsequent, and with the sampling apparatus prepared as specified in Fig. 6, gently place the needle into the closure opening and withdraw a specified volume of fluid. (See **Warning** below.) If it is necessary to tilt the component for fluid extraction, do not allow the fluid to enter the threaded portion of a port, since particles generated by installation and removal of closure may be present. Immediately replace the component closure or cover the component with a precleaned nonfibrous covering (preferably plastic). (**Warning**—Minimize contact between the needle and the component to reduce generation of particles.)

11.5.1.2 *Rinse*—Remove the field filter holder from the syringe. Fill it with rinse fluid using the solvent filtering dispenser, as shown in Fig. 8, being careful not to disturb the particle distribution. Hold the syringe plunger, thereby drawing the solvent through the membrane.

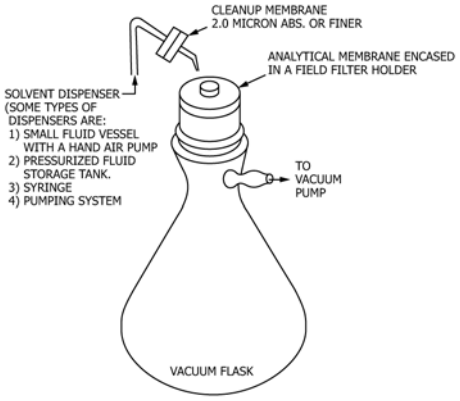

FIG. 8 Membrane Rinse Apparatus

(1) Maintain the field filter holder filter disk in a level position while gently shaking the apparatus. This operation is required to wash down particles from the field filter holder walls with the reagent, and to place all particles in suspension for a good particle distribution on the filter disk. (See **Warning** below.) Withdraw the reagent into the syringe. Then deflect the discharge tube into a beaker and eject the reagent. Cycle the syringe plunger several times in order to hasten the drying of the filter disk.

(2) If the determination will not be immediately run, replace the monitor caps or plugs, or both. (**Warning**—The requirement to maintain the field filter holder in a level position during this operation cannot be overemphasized.)

11.5.2 *Pouring Fluid From the Component*—It is recommended that the component be procured with the system male fitting installed if the component is designed with fluid ports. Pouring fluid from a port would wash out any particles generated by the removal or installation of the component closure.

11.5.3 *Replacing Fluid Extracted for Sampling*—Prefiltered replacement fluid may be added to the component by utilizing the apparatus shown in Fig. 5 or by utilizing a plastic wash bottle. If Fig. 5 apparatus is utilized, withdraw and eject at least one syringe full of fluid in order to remove residual fluids from the syringe. Comply with the precautions noted in 11.5.1.

11.6 *Analysis*—If Fig. 6 apparatus was utilized, verify that the filter disk is dry, or practically dry; then open for filter disk removal. (See **Warning** below.) Flush the forceps with a prefiltered reagent. Carefully remove the filter disk from the monitor with the forceps, and immediately place it under the microscope dust cover on the mechanical stage of the microscope. Handle the filter disk by the disk edge only. For ease of filter disk removal, insert a slender object through the hole in the bottom and push up on the disk back-up. Analyze the filter disk for the number of particles in accordance with applicable methods (Note 8). (**Warning**—Exercise extreme care to avoid generation of particles.)

NOTE 8—Test Methods F312. Other methods of analysis are listed in Fig. 1.

12. Interpretation of Results

12.1 The units used to express the component contamination level will be specified by other agencies but must be consistent with those used in determining the blank analysis or system tare.

12.2 The net contamination is determined by subtracting the value of blank analysis or system tare from the value obtained for the test component. The blank may also be accounted for by reporting its value rather than subtracting it from the gross.

12.3 Method of reporting the contamination level of components are the measure of (*1*) contaminants per unit area exposed surface (*2*) contaminants per test unit, and (*3*) contaminants per unit volume of test fluid.

13. Precision

13.1 Each testing agency has the responsibility of judging the acceptability of its own results. The precision of the results is a function of the procedures and facilities utilized, as well as compliance to the recommended state of the art practices in cleanliness. Identical analysis determinations by different users can be achieved only with identical procedures, identical facilities, and trained conscientious personnel.

NOTE 9—Every effort should be made to eliminate outside contamination during operations of "fill," "rinse," "extract," and "analyze." A clean room environment is recommended to uphold precision.

Vibration is recommended to loosen and suspend contaminants in the test fluid for a representative sample. The type of vibrator and the parameters should be specified for all testing requiring correlation. For optimum correlation, frequency, amplitude, *G* load, and time should be specified. Common methods of vibration are electronic shakers, air vibrators, paint shakers, ultrasonic cleaners, and by hand. (**Warning**—Occasions may arise where vibration is not allowable or is restricted to defined limits. When using ultrasonic vibration, variables that may affect the precision of the test area as follows:

(1) Frequency—Common frequencies of industrial equipment are 20 to 40 kHz.

(2) Power Input to the Transducer.

(3) Transducer—Material, design, placement on tank, and method of adhesion to tank.

(4) Type of Fluid in Both the Tank and Component.

(5) Tank Fluid Level.

(6) Tank Load—Displaced volume of component per volume of liquid in tank.

(7) Position of Component in Tank.

13.2 The usual approach to establishing the accuracy is not applicable to this practice as the true value of cleanliness is a variable which changes with each repeated test. This variable is caused by the cleaning action inherent in the practice. Although the accuracy of the practice is influenced by the care exercised in all phases of the operations, the accuracy achieved relies on other parameters which must be defined outside the scope of this practice. Examples are tare fluid and apparatus cleanliness limits and vibration frequency and acceleration loads.

PRACTICE B—FLOWING FLUID SAMPLING

14. Scope

14.1 This practice covers procedures for determining the cleanliness of fluids in components having a geometry suitable

for the fluid to wet and rinse internal surfaces by (*1*) fluid passing continuously through the component, and (*2*) fluid cycling intermittently into and out of the same port in the component.

15. Summary of Practice

15.1 Each operation includes recommended methods and alternative methods as shown in Fig. 2. Fluid of a predetermined cleanliness level flows through the test component to rinse the internal surfaces. A contamination analysis is performed on the fluid downstream of the test component.

16. Significance and Use

16.1 See Section 7.

17. Terminology

17.1 See Section 3.

18. Apparatus

18.1 *Apparatus,* as given in 8.1 – 8.4.

18.2 *Component Fluid Sampling Apparatus,* as shown in Fig. 5.

18.3 *Membrane Rinse Apparatus,* as shown in Fig. 8.

19. Reagents

19.1 See Section 9.

20. Procedure

20.1 Clean all lines and fittings located between the cleanup membrane and the analytical membrane.

20.2 Determine the system tare. The system tare should be not more than 10 % of the allowable number of particles from the test component. If the system tare value is too high, proceed as follows:

20.2.1 Check the cleanup membrane and replace it if necessary.

20.2.2 Circulate the system for 15 min at a minimum flow rate of 1000 mL per min.

20.2.3 Check the tare and repeat the step given in 20.2.2 until the tare is satisfactory.

20.2.4 If the system does not clean up satisfactorily after three repetitions of the step given in 20.2.2, the connecting hose assemblies should be removed and cleaned.

NOTE 10—Rinse the connecting hoses with a low surface tension solvent. A test tube cleaning brush with nylon bristles and an extended handle may be used to scrub the internal surfaces of the flex hose. Finally, rinse all components with a reagent filtered through an 0.8 to 2.0-µm absolute membrane filter.

20.3 Connect the test component as follows:

20.3.1 Adapt the fittings to the test component to suit the fittings on the system flexible hoses and install the test component into the system, being careful to avoid spillage of any packing fluid from the component.

NOTE 11—The following precautions are recommended to minimize the number of particles entering the system during test part installation:

(1) Wipe fitting threads and fitting internal bore with a solvent saturated clean white cloth. If any discoloration occurs on the wipe cloth, the fitting is not satisfactorily clean. After achieving white cloth cleanliness, ultrasonically clean the fittings, 5 min minimum, rinse inside and out with solvent dispensed through a 2.0-µm or finer membrane filter. The dispenser described in Fig. 8 may be used.

(2) TFE-fluorocarbon tape is suggested for NTP threaded fittings. After the threads are tight, examine the inside of the fitting. There should be no visible threads of TFE-fluorocarbon. Overtightening or careless wrapping may cause shreds which must be removed. Ultrasonically clean and rinse the assembled fittings as described in Item (*1*).

(3) For low pressure systems, use nylon or TFE-fluorocarbon gaskets in place of rubber O-ring gaskets on *AN* ports. O-rings shed large quantities of rubber particles that enter the system, even when the most stringent cleaning and assembling techniques are employed. When O-rings must be used, they should be cleaned using the same procedure as described for fittings in Item (*1*) and they should be lubricated in accordance with Item (*4*).

(4) Lubricate threads of fittings entering the test part. Lubrication helps reduce the number of particles generated in the thread during assembly. The lubricant must be compatible with the test fluid.

(5) Connect the tube fittings by holding the fitting firmly against the tube while the nut is threaded. Do not allow the fitting to rotate as the nut is tightened.

20.3.2 Install a new analytical membrane when using the inline membrane method.

20.3.3 Fill the component and connecting lines with a liquid medium as described in 1.2.

NOTE 12—If the component packing fluid is not the same as the test medium fluid, the following alternatives are possible:

(1) Conduct the test with the dissimilar liquids, providing the liquids are completely compatible and the properties of the system liquid will not be seriously affected. (For example, small volumes of MIL-H-6083 packing oil may be mixed with MIL-H-5606 hydraulic oil).

(2) Use the packing fluid or similar compatible fluid as the test medium.

(3) Use a solvent reagent to conduct the test, providing it is compatible with the test part seals and test equipment. When the inline analytical membrane method is employed, the use of solvent eliminates the necessity of rinsing the oil from the analytical membrane before analysis. (**Warning**—Be especially careful in the selection of solvent, considering aspects such as toxicity, flammability, and compatibility with the liquid used in the test component. Follow the manufacturer's recommendations on handling and storage.)

20.4 Vibrate the component to loosen and suspend contaminants. Vibration equipment of various types is given in Fig. 2, and precautions are described in Section 13.

20.5 Extract the fluid from the component for analysis as follows:

20.5.1 Vibrate for 1 min.

20.5.2 Simultaneously vibrate and extract as described in Table 1.

TABLE 1 Fluid Extraction Parameters

Component Description	Component Volume	Minimum Volume Flush, mL	Minimum Flow Rate, mL per min	
			Oil	Solvent
Straight through flow component	less than 400	4000	250	500
	more than 400	10 times component volume	...	...
Cycle flow component	all volumes	4000 mL and 10 cycles	...	...

20.5.3 Sample the fluid from the component. A100 % sample is recommended as the contaminant particles do not leave the component in a uniform predictable rate.

20.5.4 After stopping both vibration and flow, remove the test component and analytical membrane.

20.5.5 If oil was used as the fluid medium, rinse the analytical membrane with prefiltered solvent using the apparatus shown in Fig. 8, or the rinse procedure given in 11.3.1. Allow the membrane to dry before analysis.

NOTE 13—The analytical membrane should be treated with caution during the removal and rinse operations to avoid outside contamination or physical damage. Fig. 8 shows the rinse apparatus. Continue vacuum for a few minutes to dry the membrane. Slowly release the vacuum or the membrane may tear.

20.5.6 Extraction procedures other than the analytical membrane procedure are given in Fig. 4.

20.6 Analyze the fluid from the component for contamination content.

NOTE 14—Other methods of analysis are given in Fig. 2.

NOTE 15—Particle distribution on the inline analytical membrane is usually uneven, varying from heavy concentrations on the periphery to light concentrations in the center. Counting analysis must be performed on 100 % of the membrane filtering area due to the uneven distribution unless a statistical method such as that described in Test Methods F312.

21. Interpretation of Results

21.1 See Section 12.

22. Precision

22.1 See Section 13.

PRACTICE C—RINSE FLUID SAMPLING

23. Scope

23.1 This practice covers a procedure for transferring particulate contamination from a component to a rinse which is analyzed for cleanliness. The practice is applicable for a component that does not have a fluid cavity or whose geometry is such that Practices A and B are not applicable.

24. Summary of Practice

24.1 The component to be sampled is immersed in or sprayed with test fluid (a liquid medium) of a predetermined cleanliness level. Particles are thereby transferred from the component to the medium and the net increase of medium contamination is determined.

25. Significance and Use

25.1 See Section 7.

26. Terminology

26.1 See Section 3.

27. Apparatus

27.1 *Apparatus,* as given in 8.1 – 8.4.

27.2 *Glass or Metal Containers,* of sufficient size to completely house the component being tested is required for small components. Apparatus for larger components must be determined as needed.

28. Reagents

28.1 See Section 9.

NOTE 16—Additional reagents may be specified by the testing agency but must be compatible with the test component, equipment, and apparatus.

29. Procedure

29.1 *Blank Analysis*—A blank analysis or system tare must be established by performing the entire sampling and analysis procedure with the test component omitted. The amount of test fluid used will be the same as that required when conducting the actual test. The blank analysis value should be no more than 10 % of the allowable value from the test component.

29.2 *Rinse Procedure*—If the component to be checked is small enough to be immersed in a container, the procedure described in 29.2.1 – 29.2.4 shall be used. Rinsing and sampling techniques for larger components must be developed for each specific test item as the need arises.

29.2.1 Select a metal or glass container of sufficient size to completely house the component being checked. (The part must be completely surrounded by test fluid during vibration.)

29.2.2 Add test fluid of a predetermined contaminant level to the test container. The minimum amount of test fluid required to completely immerse the test component should be used, but the exact amount of fluid added must be recorded.

29.2.3 Immerse the component to be tested in the fluid using a support wire that is compatible with the fluid.

29.2.4 If the component to be tested is a container such as a plastic bag, pour the test fluid directly into the container.

29.3 Application of ultrasonic vibration to the container is recommended to loosen and suspend contaminants in the test fluid (see 13.3).

29.3.1 Expose the test component to vibration for 5 min.

29.3.2 Both recommended and alternative methods of vibration are given in Fig. 3.

29.3.3 Rinse the test component with a small amount of rinse fluid from a solvent filtering dispenser and add the rinse liquor to the immersion fluid.

29.4 *Extraction*—All or some aliquot of the rinse fluid must be collected for analysis. If an automatic particle counter is to be used, the rinse fluid may be transferred to a sample bottle for analysis or it may be analyzed directly. When microscopic or gravimetric methods are to be used, the particulates must be transferred to a membrane filter before analysis. The specific analysis method being followed will usually cover extraction and analysis procedures.

29.5 Analyze the fluid in accordance with Test Methods F312.

NOTE 17—Other methods, that the user may find more advantageous, are given in Fig. 3.

30. Interpretation of Results

30.1 See Section 12.

31. Precision

31.1 See Section 13.

32. Keywords

32.1 aerospace applications; aerospace fluids/propellants; flowing fluid sampling; particulate contamination; rinse fluid sampling; sampling—aerospace fluids; sampling—electronic materials/applications; static fluid sampling; sampling aerospace fluids from components; practice