

ERRATA
HS J806 JUN83
Oil Filter Test Procedure

On page 10, in the right-hand column, section 13.3.6 Note: should include the address change of:

Penn Anderson Equipment Co.
P.O. Box 305
Oakmont, PA 15139

On page 18, in the right-hand column, under Note:, the last two lines should read:

from Penn Anderson Equipment Co., P.O. Box 305, Oakmont, PA 15139.

On page 39, in the right-hand column of Appendix A, the second paragraph should read:

Ready-mixed SOFTC 2A contaminant is available in 1 gal (3.8 L) and larger lots at the Sherwin-Williams Company, 2325 Hollins Ferry Road, Baltimore, Maryland 21230. Reference should be made to Product No. TM-450.

On page 47, in the left-hand column, in the second entry, the address should read:

Penn Anderson Equipment Co.
P.O. Box 305
Oakmont, PA 15139

Also on page 47, in the right-hand column, this entry should be added:

SOFTC-2A Contaminant
Sherwin-Williams Company
2325 Hollins Ferry Road
Baltimore, Maryland 21230
Reference Product No. T-M450

Oil Filter Test Procedure HS J806 JUN83

Report of the Engine Committee, approved September 1958,
last revised June 1983

S. A. E.
LIBRARY

SAE Recommended Practice

Published by:
Society of Automotive Engineers, Inc.
400 Commonwealth Drive
Warrendale, PA 15096

 **Documents**
Document Sharing Hub

ISBN 0-89883-413-9

Copyright 1984 Society of Automotive Engineers, Inc.

This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user.

PRINTED IN U.S.A.

The ϕ symbol is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.

INTRODUCTION

The purpose of this lubrication oil filter test code is to provide means for evaluating the performance characteristics of full-flow oil filters on bench equipment. This, combined with data collected from "in service" applications, may be used for establishing standards of performance for filters tested in this manner. Since the lube oil filter becomes an integral part of the engine lubrication system, it is subjected to variations in operating conditions that are difficult to duplicate. However, with the equipment and procedures set forth in this test code, comparisons with effective filters for "in service" applications can be made with a high degree of confidence.

In order to achieve the highest degree of reliability from the test results, the procedures and equipment must conform with those outlined in the test code. Throughout this test code, no limitations have been placed on performance requirements and/or tolerances, as these are considered the responsibility of the user and manufacturer.

The total test code is comprised of distinct chapters to provide the test methods necessary to evaluate various functional capabilities and mechanical properties of the filter. Each chapter is complete with the recommended materials, apparatus, methods, and procedures for testing and evaluation. They are as follows:

1. Resistance to Flow
2. Filterability
3. Single Pass Efficiency
4. Media Migration
5. Collapse
6. Anti-Drainback
7. Environmental
8. Installation and Removal
9. Mechanical
10. Relief Valve

In addition to the test procedures, an Appendix with sections covering contaminants, oil sample analysis, and miscellaneous equipment is included.

Throughout the individual test methods, references are made to specific equipment which is recommended. However, equivalents may be substituted wherever noted.

TABLE OF CONTENTS

φ Chapter 1

Resistance to Flow	1
1. Scope	1
2. Test Material	1
3. Test Apparatus	1
4. Test Preparation	1
5. Test Procedure	1
6. Presentation of Data	1

φ Chapter 2

Filter Capacity and Contaminant Removal	
Characteristics of Full-Flow Filters	5
1. General Information.	5
2. Scope	8
3. Purpose	8
4. References	8
5. Definitions and Symbols	8
6. Units	8
7. Letter Symbols	8
8. Graphic Symbols	8
9. General Procedure Outline	8
10. Measurement Accuracy	8
11. Test Equipment	8
12. Test Materials	8
13. Test Equipment Validation	8
14. Test Preparation	11
15. Test Procedure	13
16. Suggested Test Conditions	14
17. Calculation and Reporting of Test Results	15
18. Variations of Test Conditions	17
19. Reliability of Test Results	18

φ Chapter 3

Single Pass Particle Retention	
Capability Test	19
1. Scope	19
2. Test Materials	19
3. Test Apparatus	19
4. Test Preparation	20
5. Calibration Procedure.	21
6. Test Procedure	21
7. Evaluation of Results.	22

φ Chapter 4

Media Migration Test	23
1. Scope	23
2. Test Materials	23
3. Test Apparatus	23
4. Test Preparation	23
5. Test Procedure	23
6. Presentation of Data and Evaluation of Results	23

φ Chapter 5

Collapse Test for Lube Oil Elements	25
1. Scope	25
2. Test Materials	25
3. Test Apparatus	25
4. Test Preparation	25
5. Test Procedure	25
6. Presentation of Data and Evaluation of Results	25

φ Chapter 6

Anti-Drainback Valve Test	27
1. Scope	27
2. Test Materials	27
3. Test Apparatus	27
4. Test Preparation	27
5. Test Procedure	27
6. Presentation of Data	28

φ Chapter 7

Ability to Meet Environmental Conditions	29
1. Scope	29
2. Test Method for Effect of Water in the Oil on Filter Capacity	29
3. Test Method with High Oil Temperature for Element Integrity	29
4. Test Method for Determination of Oil Additive Removal by Filter	29

φ Chapter 8

Installation and Removal	31
1. Installation Seal Retention	31
2. Installation Sealing Torque	31
3. Removal Torque Test Method	31

φ Chapter 9

Mechanical Tests	33
1. Pressure Impulse Fatigue Test	33
2. Vibration Fatigue Test	34
3. Hydrostatic Burst Pressure Test	35

φ Chapter 10

Relief Valve Performance	37
1. Scope	37
2. Test Material	37
3. Test Apparatus	37
4. Test Preparation	37
5. Test Procedure	37
6. Presentation of Data	37
7. Definition of Terms	37

CHAPTER 1

RESISTANCE TO FLOW

1. **Scope**--The Resistance to Flow test determines the pressure loss which will result when the fluid is passed through the filter element under predetermined conditions of flow and fluid viscosity. This procedure may be used to establish flow capacities.

2. Test Material

- φ 2.1 **Test Oil**--SAE J1260, Standard Oil Filter Test Oil (RM 99) or as specified.

3. Test Apparatus

3.1 A flow stand consisting of a pump, flow-meter, thermometer, and manometer or differential pressure gage as shown in Fig. 1, or the SAE standardized oil filter test stand.

3.2 Filter housing or mounting plate with pressure taps located to give pressure loss across the element. See Figs. 2 and 3 for housing and mounting plate.

3.3 In the event special housing design is necessary, special emphasis to locate inlet and outlet pressure taps properly must be considered.

4. Test Preparation

4.1 Install filter assembly on stand and add test oil.

4.2 Recirculate oil through bypass system until required temperature is reached.

4.3 Circulate oil through stand with a cleanup filter to clean system. One hour recirculation is recommended. (It is suggested that cleanup filter be installed in series with the test filter and used during the test.)

5. Test Procedure

5.1 Circulate oil through housing at part flow. When temperature stabilizes, take pressure differential readings at 20% increments of rated flow, including a reading at 20% over rated flow.

5.2 If the filter housing does not have pressure taps located to provide element loss only, an empty housing differential pressure must be determined. The difference between pressure loss for the empty housing and housing with element indicates loss across element only.

6. Presentation of Data

6.1 Tabulate pressure differential at each required flow and temperature.

6.2 Plot a flow rate versus pressure loss curve, using ordinate for pressure loss and abscissa for flow rate.

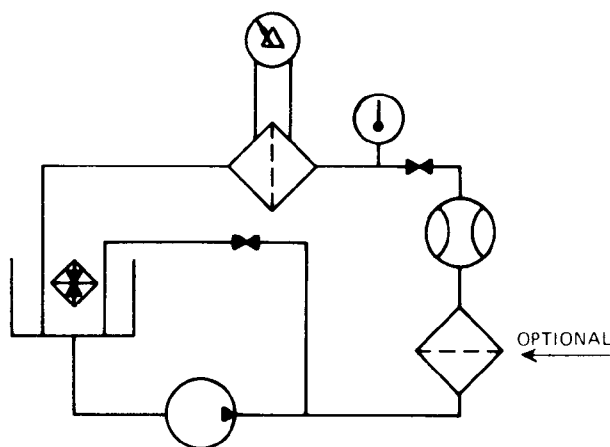


Fig. 1 - Flow Stand

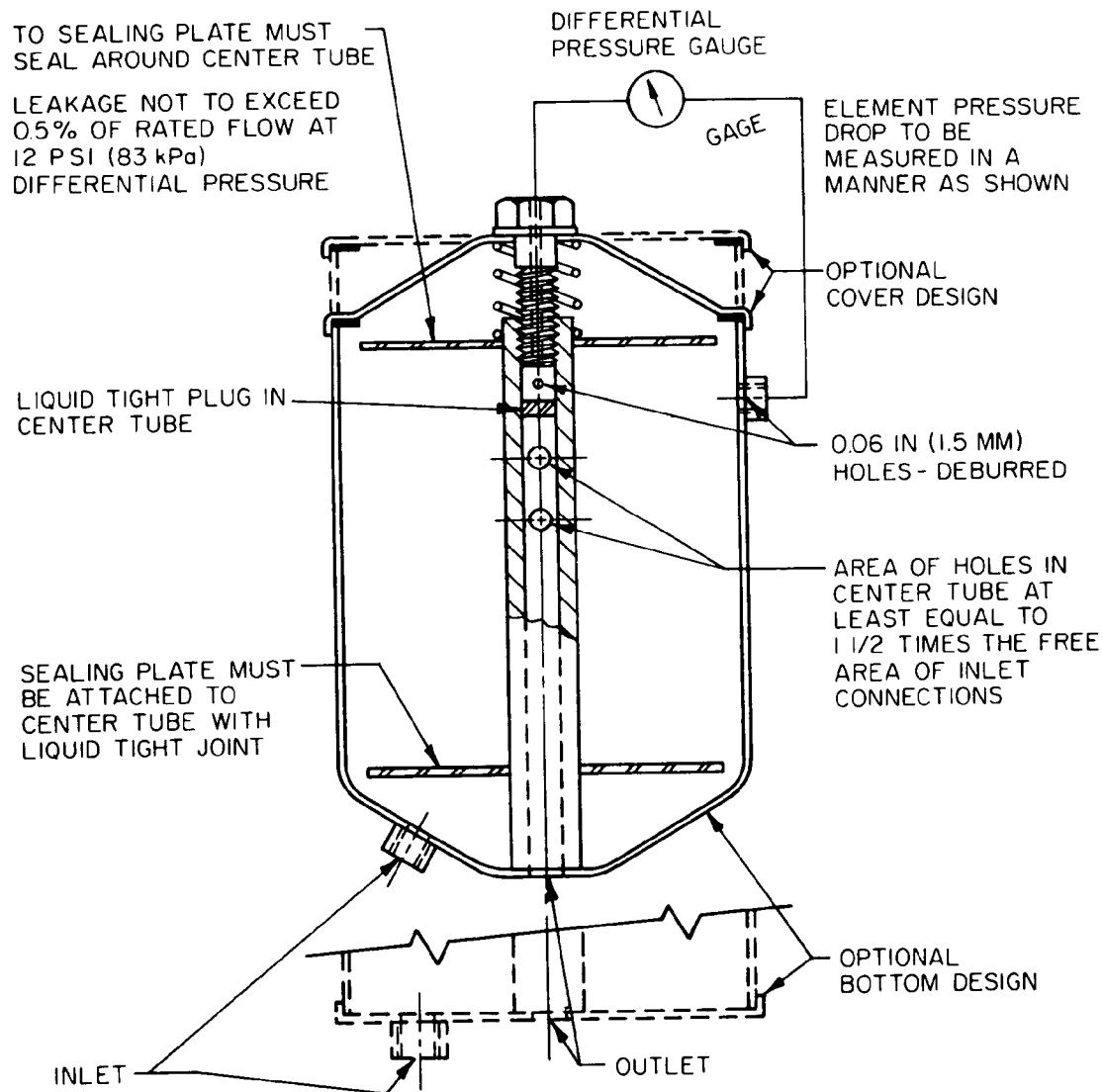


Fig. 2 - Test Filter Housing for Full-Flow Elements

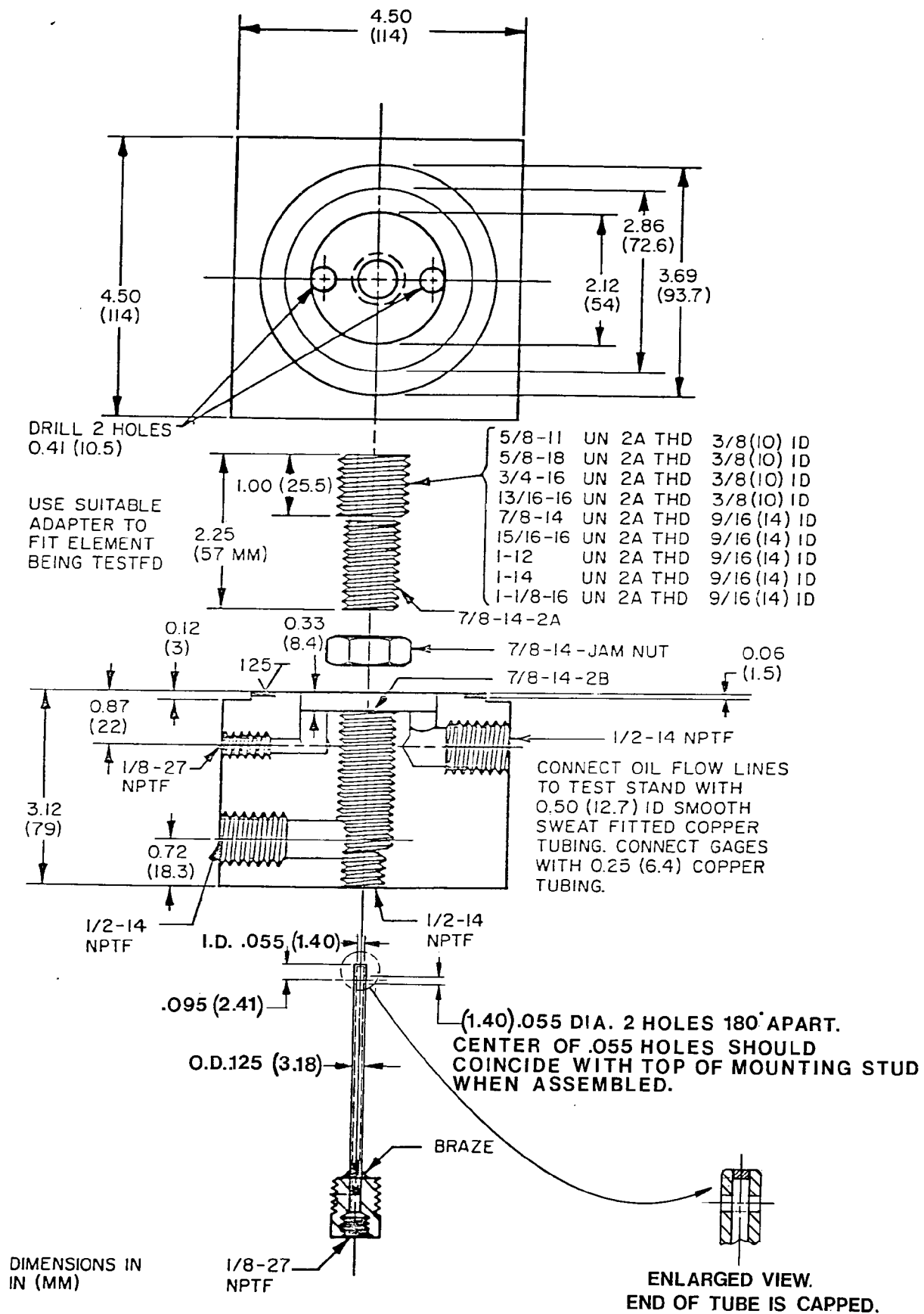


Fig. 3 - Universal Test Fixtures for Spin-On
Elements

CHAPTER 2

FILTER CAPACITY AND CONTAMINANT REMOVAL CHARACTERISTICS OF FULL-FLOW FILTERS

1. General Information--Oil filter tests have been performed for many years on a variety of equipment utilizing various procedures. As a result, the information accumulated did not necessarily correlate with information from other manufacturers or users. With this condition existing, most of the manufacturers and users developed their own standards based on procedures that each used. Obviously, no universally recognized characteristics for defining the filterability of the filter could be established.

Considering the above, the Filter Test Method Subcommittee has attempted to establish criteria for evaluating the filterability characteristics of an oil filter. These criteria involve several individual and separately determined characteristics which should be given equal consideration and are as follows: contaminant holding capacity, particle size retention, and ability to maintain oil cleanliness.

To clarify further, it is necessary to define these characteristics:

Contaminant Holding Capacity--The amount of contaminant removed and held by a filter from the oil during a constantly recirculating flow of contaminated oil while attaining a predetermined pressure drop across the filter. This pressure drop is associated with the setting of a filter bypass valve.

Particle Size Retention--The measure of the degree of retention of particles of various sizes by the filter. Retention measurement can be made by particle counting or gravimetric efficiency when a known size range of particles is introduced to the filter on a single pass basis.

Oil Cleanliness--The measure of the level of contaminant present in the oil at various intervals of time. The cleanliness can be expressed as a weight of contaminant per unit of oil or as a ratio of contaminant removed to contaminant presented.

This Chapter and Chapter 3 on Single Pass Efficiency have been prepared to be used in determining these characteristics. However, it is necessary to standardize all phases of the test to obtain repeatable and meaningful test results. Consequently, these test methods prescribe the test oil, contaminants, analysis procedure, and test stands required.

The oil prescribed in the filterability test method is SAE J1260, Standard Oil Filter Test Oil (RM 99). This oil is an additive type, blended in quantities large enough to provide the filter testing industry a supply for 1-1/2 to 2 years. Control of the oil is maintained by physical and chemical properties, infrared spectrum, and filterability tests. These filterability tests are conducted using reference filters to establish if the filterability of the oil is equivalent between blends or if adjustments to results are required to correlate with previous tests.

The test contaminants recommended, SOFTC-2A and AC Fine Test Dust, are used for evaluating various aspects of filterability. Both fall into the broad range of contaminants being generated under the infinite variables of field operation. SOFTC-2A is a sludge type contaminant and AC Test Dust is an abrasive type, each closely controlled with respect to composition and particle size. Continuing investigations are underway to identify and define further actual contaminants encountered in the lube systems; as this study progresses, changes in the test contaminants will be made to keep more in line with the field conditions.

For the Filterability Test, oil is circulated through the filter at a constant flow rate while contaminant is added at a predetermined rate. The test equipment, oil, and contaminants, along with other critical parameters, are specified in this method to minimize variations between tests and laboratories. Filterability may be used to evaluate various filter designs, for quality control, and possible correlation with engine wear.

This procedure describes a test as it is to be run on an automated SAE stand, but other equipment can be used with the procedural changes necessary to accommodate the mechanics of the stand.

With the necessity of standardization of equipment, two test stands have been developed. Class A stand is for flow rates to 8 gpm (30 L/min) and Class B is for flow rates of 7--15 gpm (26--57 L/min). Where higher flow rates are required, stands built to the same design criteria sized for the increased flow should be used. These larger stands could substitute manual control for any of the automated

features of Class A and B stands. The automated features have been included to permit overnight unattended operation and are as follows: flow rate control, continuous pressure and temperature recording, automatic sampling, and test stand protection from high pressure, high temperature, low sump level, or loss of control power.

In addition to the necessity of standardization of the equipment and materials used for these tests, there are a number of test conditions which have to be established. These conditions, for the most part, will be dictated by the application for which the filter is intended and consist of flow rate, contaminant, contaminant add rate, oil temperature, and volume of oil. Consideration should also be given to the test purpose, such as: differentiating between filter designs, quality control, and/or attempted correlations of bench tests and field performance.

It is recognized that no bench test can duplicate the conditions existing in service and compensations must be made to accommodate this mode of testing. These compensations take the form of constant conditions and accelerated contaminant add rates as contrasted with variable conditions and low add rate for contaminants under normal operative conditions. Consequently, constant flow and add rates for contaminants as shown in Table 1 and Section 7 of this Chapter are recommended, along with 180°F

(82°C) oil temperature, for most testing. If the "in service" application differs to the extent that these conditions will not develop meaningful data, the tests should be changed accordingly.

The test methods for evaluation of lube filters are complex and the interpretation of the results can be difficult and misleading. Results can be drastically altered by seemingly insignificant changes in any of the four major components of testing procedure, materials, analysis, and equipment. This test method and specified equipment will provide a reliable bench test which has been designed with special emphasis on control of equipment and other variables. Therefore, the following test procedure, along with the Single Pass Efficiency Test, are recommended to establish filter filterability.

This procedure has been performed by a number of laboratories with calibrating filters and a statistical analysis of the results performed. Use of these calibrating filters, along with the analysis of results, provides a means of calibrating the equipment and detecting changes in materials. New batches of materials are qualified by performing tests with calibrating filters to insure that results do not change from batch to batch.

While the procedure does not measure instantaneous (single pass) efficiency, this can be determined on new filters as described in Chapter 3. This, along with cumulative effi-

Table 1--Specified Test Conditions--Entry into Table 1 is made by either knowing the Filter Size Rating Class or the recommended test flow rate of the filter to be tested.

In general, it has been found that a contaminant addition rate as specified in Table 1 will yield a test duration in the range of 15--30 h. This test duration is sufficient to yield accurate results in a reasonable length of time. Although an optional provision has been made in Table 1 to allow accelerated test conditions to be used, filters used for the same application should be tested under identical conditions.

It is recommended that the test termination differential pressure should be either 75% of the filter bypass valve theoretical opening differential pressure, 8 psi (55 kPa) differential pressure for most automotive applications,

or a differential pressure agreed upon by the user and supplier. If practicable, the valve should be blocked closed prior to the start of the filterability test. If a test is conducted with an unblocked valve and an uncharacteristic flattening of the differential pressure rise curve is experienced during the test, the results of the tests should be considered suspect until the characteristics of the differential valve have been determined.

The SAE Class A automated test stand is usable for Filter Classes A--H, with the Class B test stand usable for Filter Classes H--L. The overlap at Class H filters necessitates that the Flow Control Circuit Flow Rate be 4 L for the Class A test stand and 8 L for the Class B test stand.

φ TABLE 1--SPECIFIED TEST CONDITIONS FOR LUBRICATING OIL FILTER ELEMENT CAPACITY TESTS SAE J806 JUN83

Filter Rated Flow ^a	Filter Size Rating Classes ^{b,i}	Test Flow Rate ^c	Test Flow Rate ^c	Starting Test Oil Volume ^d	Test Oil Turnover per Minute at Starting Volume	Contaminant		Contaminant Oil Slurry Addition Rate ^g	Flow Control Circuit Flow Rate ^h	Test Flow Rate ^c
						ACFTD Addition Rate Solids ^e	Organic Addition Rate Solids ^f			
Litres per Hour	Class	Litres per Hour	Litres per Minute	Litres	Frequency	Grams per Hour	Grams per Hour	Millilitres per Hour	Litres per Minute	U.S. Gallons per Minute
180--480	A	480	8	3.64	2.2	1.2	2.4	88	4	2.1
481--600	B	600	10	4.54	2.2	1.5	3.0	88	4	2.6
601--720	C	720	12	5.45	2.2	1.8	3.6	88	4	3.2
721--900	D	900	15	6.82	2.2	2.25	4.5	88	4	4.0
901--1140	E	1140	19	8.64	2.2	2.85	5.7	88	4	5.0
1141--1440	F	1440	24	10.91	2.2	3.6	7.2	88	4	6.3
1441--1800	H	1800	30	13.64	2.2	4.5	9.0	88	4 or 8	7.9

The final gravimetric levels for tests run at 2.2 turnover frequency may not be comparable to tests run at 4 turnover frequency.

1801--2280	J	2280	38	17.27	2.2	5.7	11.4	88	8	10.0
2281--2820	K	2820	47	21.36	2.2	7.05	14.1	88	8	12.4
2821--3000	L	3600	60	27.3	2.2	9.0	18.0	88	8	15.9
3601--4500	M	4500	75	18.75	4	11.25	22.5	176	12	19.8
4501--5700	N	5700	95	23.75	4	14.25	28.5	176	12	25.1
5701--7200	P	7200	120	30.00	4	18.0	36.0	176	12	31.7
7201--9000	Q	9000	150	37.50	4	22.5	45.0	264	12	39.6
9001--11 400	R	11 400	190	47.50	4	28.5	57.0	264	12	50.2
11 401--14 400	S	14 400	240	60.00	4	36.0	72.0	352	12	63.4
14 401--18 000	T	18 000	300	75.00	4	45.0	90.0	440	12	79.3
18 001--22 200	U	22 200	370	92.50	4	55.5	111.0	528	12	97.7

Flow in Excess
of 22 00l

X

Test conditions to be agreed upon between user and supplier.

^aSuppliers' specifications, rated under the conditions of this test.

^bClass letter designation assigned for convenient reference. See paragraph 18.1 for scaled down tests.

^cUnless otherwise agreed upon between user and supplier, test by class size rated flow. Maintain test flow rate within $\pm 2\%$ of true value.

^dAdjust starting test oil volume to within $\pm 2\%$ of true value and maintain throughout test.

^e0.15 g solids/h/L/min flow rate (2.5 mg/L base upstream gravimetric level). Maintain base upstream gravimetric level within 0.25 mg/L (see Note).

^f0.30 g solids/h/L/min flow rate (5.0 mg/L base upstream gravimetric level). Maintain base upstream gravimetric level within 0.50 mg/L (see Note).

^gQuadrant and pump type contaminant addition system described in Figs. 4 and 4a (see Note).

^hThese flows have been used on automated test stands with flow controllers. Use the minimum volume required to control flow on all other test stand designs.

ⁱFor large filters not completely conforming to Table 1, see paragraph 16.2, nonconformance related to (d).

NOTE: Conditions under e, f, g may be accelerated up to 50X when agreed upon by user and supplier. Multiple quadrant or contaminant addition systems may be required. Retain contaminant concentration in delivery system as defined by e, f, g.

Base Upstream Gravimetric Level is defined as the mass of contaminant admitted to the test system per minute per litre per minute test flow rate.

ciency information, gives an indication of the particle separation characteristics of the filters being tested.

The Filter Test Method Subcommittee considers this method as satisfactory but not final and will amend it as further development investigations dictate.

φ **2. Scope**--To include an SAE standardized filterability test for determining the contaminant holding capacity and contaminant removal characteristics of full-flow oil filters.

φ **3. Purpose**--To provide a precise test procedure for determining contaminant capacity and contaminant removal characteristics of a full-flow oil filter.

φ **4. References**

4.1 SAE HS J806 JUN83, Oil Filter Test Procedure, Appendix A, Contaminants.

4.2 SAE HS J806 JUN83, Oil Filter Test Procedure, Appendix B, Methods for Oil Sample Analysis.

4.3 SAE HS J806 JUN83, Oil Filter Test Procedure, Chapter 3, Single Pass Particle Retention Capability Test.

4.4 ISO 1000-1973, International Standard SI Units and Recommendations for the Use of Their Multiples and Certain Other Units.

4.5 ISO/R 1219, Graphical Symbols for Hydraulic and Pneumatic Equipment and Accessories for Fluid Power Transmission.

4.6 SAE HS J806 JUN83, Appendix D, Source Information.

4.7 SAE HS J806 JUN83, Appendix E, Spin-On Oil Filter Base Mounting.

4.8 ISO 2942-1974, Hydraulic Fluid Power--Filter Elements--Determination of Fabrication Integrity.

φ **5. Definitions and Symbols**

5.1 For meanings of symbols not defined within this document, see Ref. 4.5.

φ **6. Units**

6.1 The International System of Units (SI) is used in accordance with Ref. 4.4.

φ **7. Letter Symbols**

7.1 Letter symbols are used in accordance with Ref. 4.4.

φ **8. Graphic Symbols**

8.1 Graphic symbols are used in accordance with Ref. 4.5.

φ **9. General Procedure Outline**

9.1 Set up and maintain apparatus as described in Sections 11 and 13.

9.2 Run tests as described in Section 15.

9.3 Present data per paragraph 17.2.

9.4 Select scaled down tests per paragraph 18.1.

10. Measurement Accuracy φ

10.1 Measure flow and pressure within 2% of the true value.

10.2 Measure temperature within 1°C of the true value.

11. Test Equipment φ

11.1 A filter test circuit--SAE Standardized Oil Filter Test Stand as described in Fig. 4 or equivalent designed stand.

11.2 An appropriate filter housing or standard filter mounting base for spin-on filters described in Figs. 2 and 3, Chapter 1, and Ref. 4.7, SAE HS J806 JUN83.

11.3 Analytical apparatus for oil sample analysis per Ref. 4.2.

11.4 Use the following or proven equivalent: Waring Blender Model #7011S. Its 1 L stainless steel container (#SS610) has a drawn one piece shell and its two speed motor has nominal no load speeds of 21 000 rpm and 18 500 rpm.

11.5 Timer capable of measuring minutes.

11.6 Contaminant addition device described in Fig. 4a.

12. Test Materials φ

12.1 Test Fluid--SAE J1260, Standard Oil Filter Test Oil (RM 99).

12.2 Test Contaminants

12.2.1 SOFTC 2A (See Ref. 4.1).

12.2.2 AC Fine Test Dust (See Ref. 4.1).

12.3 n-Pentane or petroleum ether.

12.4 No. 1 Fuel Oil or Stoddard Solvent.

13. Test Equipment Validation φ

13.1 This is required only when the equipment is first placed in service or is modified. Since there is more than one type of contaminant addition system being successfully used, the method of contaminant addition is optional as long as the equipment can be validated.

NOTE: For tests having a duration of less than 8 h, the SAE Class A and B 3.2 litre standard quadrant should not be used since sizeable variations in dispensing rate occur in the initial stages of the dispensing cycle. If a smaller quadrant contaminant addition device is used, it should be sized so that at least one-third of the total volume is dispensed during the test.

13.1.1 Validation of the Quadrant Contamination Addition Device

13.1.1.1 Validate at the maximum contaminant concentration which will be used.

$$C = \frac{\text{Desired g/h solids add rate (From Table 1)}}{A}$$

C = Concentration of contaminant in quadrant, grams of solids/litre

A = Calibrated delivery rate quadrant, L/h

13.1.1.2 Prepare the contaminant slurry as described in paragraph 14.3.

13.1.1.3 Fill the contaminant quadrant addition device and allow it to stand for 1.5 h, with agitator running, to release any air introduced in blending and to allow the temperature to stabilize.

13.1.1.4 Tilt the quadrant forward to begin flow of contaminant mixture. Start quadrant rotation and allow it to rotate for 30 min to allow the dispensing rate to stabilize. Collect the mixture dispensed during this interval for the determination of solids concentration.

13.1.1.5 Allow the mixture to dispense for 22 h into a suitable receptacle and measure the total volume dispensed in a graduated container accurate within 1% of the volume measured.

13.1.1.6 Determine the solids concentration of a 0.010 L sample of the mixture dispensed in paragraph 13.1.1.4 per Ref. 4.2.

13.1.1.7 Determine the solids concentration of a 0.010 L sample of the mixture remaining in the quadrant per Ref. 4.2.

13.1.1.8 Repeat steps 13.1.1.1 up to and including 13.1.1.7 two additional times.

13.1.1.9 The maximum volume deviation from the average of the three determinations should be no greater than 4% for any determination.

13.1.1.10 The maximum concentration deviation from the average of the nine determinations made should be no greater than 3% for any determination.

13.1.2 Validation of Variable Delivery Rate Pumps for Contaminant Addition Constructed in Accordance with Fig. 4a

13.1.2.1 Validate at the maximum contaminant concentration which will be used. Refer to Table 1.

13.1.2.2 Prepare the contaminant slurry as described in paragraph 14.3.

13.1.2.3 Charge the contaminant addition reservoir and allow it to stand for 1.5 h with agitator running to release any air introduced in blending and to allow the temperature to stabilize.

13.1.2.4.1 For variable stroke piston pumps, adjust the pump stroke to give the displacement which will result in the desired delivery rate.

13.1.2.4.2 For variable speed peristaltic pumps, adjust the pump speed to give the desired delivery rate with the tubing used.

13.1.2.5 Start the pump and allow it to run for 2 h.

13.1.2.6 Collect the mixture dispensed during this period and measure the total volume dispensed in a graduated container accurate within 1% of the volume measured.

13.1.2.7 If the total volume of the mixture dispensed deviates more than 4% from the theoretical value, correct by adjusting the pump stroke or speed and repeat steps 13.1.2.1 up to and including 13.1.2.6 until this level of accuracy is reached.

13.1.2.8 Determine the solids concentration of a 0.010 L sample of the mixture dispensed per Ref. 4.2.

13.1.2.9 If the solids concentration deviates more than 2% from the theoretical value, correct by changing the degree of agitation or the agitator location and repeat steps 13.1.2.1 up to and including 13.1.2.6 (omit volume measurement) and 13.1.2.8.

13.1.2.10 After reaching the required level of accuracy, adjust the solids concentration, if necessary, so that the specified rate of solids dispensed will be maintained at the volumetric delivery rate determined and repeat steps 13.1.2 up to and including 13.1.2.6 and 13.1.2.8 three times.

13.1.2.11 The maximum deviation from the theoretical value for total solids dispensed should be no greater than 3% for any determination.

NOTE: Since there is a possibility that, with peristaltic pumps, tubing fatigue can change the delivery rate over a period of time; with this method, the contaminant should be dispensed for twice the maximum expected test duration and the validation procedure repeated. The validation requirements remain the same (paragraph 13.1.2.11).

NOTE: Delivery rate to be 88 ± 4 mL/h or multiples thereof. For variable speed delivery positive displacement pumps, constant speed motors with speed controlled through mechanical transmission may be more consistent in delivery. For variable stroke piston pumps, a maximum rate of 100 strokes/min is recommended.

The configuration of the reservoir and the type of agitator is left as optional. The only requirements are that the system can be validated and that the circulating pump and the agitator do not reduce the primary particle size of the contaminant.

Agitation rate in the contaminant reservoir is to be sufficient to maintain a uniform suspension of solids, but not so vigorous as to pull air into the slurry. Minimum reservoir size is to be sufficient to contain 3.2 L of contaminant slurry under agitation. Larger reservoirs can be used with any test class.

Select a delivery pump sized to deliver contaminant at a rate equal to that specified in Table 1. Since tubing fatigue and set can affect the delivery rate of peristaltic pumps, it is recommended that delivery rates be determined before and after the test when this type of pump is used, to insure that the desired addition rate is maintained. For any delivery pump suspected of being subject to drift in output during use, this same recheck should be made.

13.2 Orifice and Flow Controller Calibration (SAE Class A and Class B Test Stands)

13.2.1 Remove the filter mounting base and install between the inlet and outlet ports of the test stand an integrating flowmeter, flow totalizer, or other calibrated flowmeter.

13.2.2 Make sure that the orifice to be calibrated is securely in place and that the orifice and all lines are clear.

13.2.3 Fill the sump with 6 L SAE oil (Class A stand) or 5 gal (19 L) SAE oil (Class B stand).

13.2.4 Turn the flow controller to manual position. Close bypass valve and fully open main valve.

13.2.5 Turn on main switch and turn shunt switch to "start" position. Set pump drive for minimum delivery.

13.2.6 Set thermostat to maintain a temperature of 150°F (65°C) at the inlet to the flowmeter. Circulate oil until the temperature has stabilized (about 30 min).

13.2.7 Make sure the valve on the line which sends the pressure signal to the controller is open.

13.2.8 Reset the pump to deliver just over 5 psi (35 kPa) on flow controller.

13.2.9 Open the bypass valve slowly until the flow controller reads exactly 5 psi (34.5 kPa). Measure and record the flow rate to the nearest 0.05 gpm (0.19 L/min).

13.2.10 Continue opening the bypass valve until the flow controller reads exactly 4.5 psi (31.0 kPa). Measure and record the flow rate at this setting.

13.2.11 Continue in 0.5 psi (3.5 kPa) increments until the entire range of the flow controller has been covered. It may be neces-

sary to close the main valve partly for the lowest pressure readings on the flow controller.

13.2.12 Repeat the calibration at 180°F (82°C) and at 210°F (100°C).

13.2.13 Plot flow as a function of the flow controller pressure for each of the three temperatures. These are the calibration curves for the orifice and flow controller.

13.2.14 The calibration procedure should be repeated every 3 months or at any change in orifice, test fluid, or after any repairs to controller or pump have been effected.

13.3 Validation of Test Circuit (SAE Class A and Class B)

13.3.1 Validate the test system constructed in accordance with Fig. 4.

NOTE: Install a trap-free connector in place of the test filter. (See Fig. 5.)

13.3.2 Select the specified test conditions from Table 1, for the minimum Filter Size Rating Class, at which the test system will be operated.

13.3.3 Adjust the total test system fluid volume specified in Table 1 in accordance with Filter Size Rating Class selected under paragraph 13.3.2.

13.3.4 Conduct a test according to Section 15 for a period of 8 h.

13.3.5 Determine the solids concentration per Ref. 4.2.

13.3.6 Compare the contaminant concentration in the samples collected with the theoretical value. At termination (8 h) the actual concentration of all samples should be within 10% of the theoretical value.

NOTE: For the Class A stand, additional assurance that materials as well as equipment will produce reproducible results can be developed by performing this test using calibrating filters. These filters which carry a Class C size rating are identified CCF-1-80. Subsequent batches of calibration filters will be identifiable by the year of production as coded by the last two numbers. They are available from:

Penn Anderson Equipment Co.
1832 Graham Blvd.
Pittsburgh, PA 15235

Complete instructions for their use accompany each set of filters.

Sourcing for calibration filters may be reassigned by the SAE Filter Test Methods Subcommittee. The Subcommittee may introduce additional sizes of calibration filters as dictated by industry requirements. Inquiries in regard to calibration filters may be directed to the Chairman: SAE Filter Test Methods Subcommittee.