# AIR CLEANER TEST CODE—SAE J726 MAY81

**SAE Recommended Practice**

Report of the Tractor and Equipment Division, approved January 1941, completely revised by the Engine Committee April 1979, editorial change May 1981.

## INTRODUCTION

The air cleaner test code has been established to cover dry type air cleaners used on internal combustion engines and to present a uniform method of determining and reporting air cleaner performance.

The objective of the test code is to provide a uniform means for evaluating the performance characteristics of air cleaners on bench test equipment. The data collected by this test code can be used to establish standards of performance for air cleaners tested in this manner. Variations in actual field operating conditions are difficult to duplicate. However, with the procedures and equipment set forth in this test code, comparisons of air cleaner effectiveness can be made.

To simplify and improve the clarity of this test code, Part 1 (General Information), covers general information and definitions applicable to all air cleaner testing covered in this test code. Part 2 (Automotive Air Cleaner Test Procedures) covers the testing of dry type air cleaners normally used on automobile internal combustion engines. Part 3 (Industrial Air Cleaner Test Procedures), covers the testing of industrial dry type air cleaners for mobile and stationary internal combustion engines.

***1. General Information***

**1.1 Purpose**—The purpose of this test code is to establish and specify uniform testing procedures, conditions, equipment, and a performance report to permit the direct laboratory performance comparison of dry type air cleaners.

**1.2 Scope**—The basic performance characteristics of greatest interest are airflow restriction or pressure drop, dust collection efficiency, dust capacity, and air cleaner structural integrity. This test code therefore adresses itself to the measurement of these parameters.

**1.3 Units of Measurement**—For the purpose of this test code, all air flow measurements will be expressed in standard cubic meters per hour (scmh). All pressure measurements will be expressed in kilopascals (kPa) and temperature measurements will be expressed in degrees Celsius.

**Useful Equivalent Conversions**

| | |
|---|---|
| 1 kPa = 4.019 in w.g. | 1 in w.g. = 0.2488 kPa |
| 1 kPa = 0.2953 in Hg | 1 in Hg = 3.3865 kPa |
| 1 kPa = 0.1450 psi | 1 psig = 6.895 kPa |
| 1 $m^3$/h = 0.58858 cfm | 1 cfm = 1.699 $m^3$/h |
| 1 m/min = 3.2808 ft/min | 1 ft/min = 0.3048 m/min |

**1.4 Definitions**

1.4.1 Air Cleaner—For the purpose of this test code, air cleaners shall be of the dry type and may consist of one or more stages of filtration.

1.4.2 Unit Under Test—Either a single air cleaner element or a complete air cleaner assembly.

1.4.3 Single Stage Air Cleaner—An air cleaner which does not incorporate a separate precleaner.

1.4.4 Multi-Stage Air Cleaner—An air cleaner consisting of two or more stages, the first usually being a precleaner followed by one or more filter elements. If two elements are employed, the first shall be called the primary element, and the second one shall be called the secondary element.

1.4.5 Precleaner—A device usually employing inertial or centrifugal means to remove a portion of the test dust prior to reaching the filter element.

1.4.6 Test Airflow—A measure of the quantity of air drawn through the air cleaner outlet per unit time. The flow rate shall be expressed in cubic meters per hour corrected to standard conditions (scmh).

1.4.7 Rated Airflow—The flow rate specified by the user or supplier and may be used as the test air flow.

1.4.8 Scavenge Air Flow—A measure of the quantity of air employed to remove the collected dust from a precleaner, expressed as a percentage of test airflow.

1.4.9 Pressure Drop—($\Delta P_d$) A measure, in kilopascals, of the difference in static pressure measured immediately upstream and downstream of the unit under test.

1.4.9.1 Refer to Appendix A for correcting recorded pressure drop values to standard conditions.

1.4.10 Restriction—($\Delta P_r$) A measure, in kilopascals gauge, of the static pressure measured immediately downstream of the unit under test.

1.4.11 Assembly Restriction/Pressure Drop—The air flow pressure resistance across the complete assembly (test shroud and/or housing and element).

1.4.12 Tare Restriction/Pressure Drop—The air flow pressure resistance across the test shroud and/or housing only, (no element).

1.4.13 Element Restriction/Pressure Drop—The assembly restriction/pressure drop, minus the tare restriction/pressure drop.

1.4.14 Terminating Restriction/Pressure Drop—The air flow pressure resistance across the unit under test at which the capacity is measured.

1.4.15 Absolute Filter—The filter downstream of the unit under test to retain the contaminant passed by the unit under test.

1.4.16 Efficiency—The ability of the air cleaner or the unit under test to remove contaminant. This will be expressed by the following formulas:

1.4.16.1 *Automobile Air Cleaners*

$$\text{Efficiency, \%} = \left( \frac{\text{Increase in weight of unit under test}}{\text{Increase in weight of unit under test} + \text{Increase in weight of the absolute filter}} \right) \times 100$$

1.4.16.2 *Industrial Air Cleaners*

$$\text{Efficiency, \%} = \left( 1 - \frac{\text{Increase in weight of absolute filter}}{\text{Weight of dust fed}} \right) \times 100$$

1.4.17 Capacity—The quantity of contaminant removed and defined as follows:

1.4.17.1 *Automobile Air Cleaners*—The total weight *gain* in grams, of the unit under test at the terminating restriction or pressure drop.

1.4.17.2 *Industrial Air Cleaners*—The total weight in grams, of test dust *fed* to the air cleaner to produce a specified terminating restriction or pressure drop.

1.4.18 Standard Condition—All air flow measurements are to be corrected to a standard condition of 26.66°C at 101.32 kPa (80°F at 29.92 in Hg).

**1.5 Measurement Accuracy**

1.5.1 Measure air flow rate within 2% of the actual value.

1.5.2 Measure pressure drop and restriction within 0.025 kPa (0.1 in of $H_2O$) of the actual value.

1.5.3 Measure temperature within 0.5°C (2°F) of the actual value.

1.5.4 Measure weight within 1% of the actual value except where noted.

1.5.4.1 Weigh the absolute filter(s) to ±0.01 g.

1.5.5 Measure relative humidity with an accuracy of 2% R.H.

1.5.6 Measure barometric pressure within 0.3 kPa (0.1 in Hg).

**1.6 Test Conditions and Material**

1.6.1 Test dust contaminant[1] shall be standardized and shall be of two grades labeled *fine* and *coarse*. The following chemical analysis is typical:

**TABLE 1—CHEMICAL ANALYSIS OF TEST DUST**

| Chemical | % of Weight |
|---|---|
| $SiO_2$ | 67–69 |
| $Fe_2O_3$ | 3–5 |
| $Al_2O_3$ | 15–17 |
| CaO | 2–4 |
| MgO | 0.5–1.5 |
| Total Alkalis | 3–5 |
| Ignition Loss | 2–3 |

1.6.2 The particle size distribution by weight as measured with a Roller Analyzer shall be as follows:

**TABLE 2—PARTICLE SIZE DISTRIBUTION BY WEIGHT, %**

| Size, Microns | Fine Grade | Coarse Grade |
|---|---|---|
| 0–5 | 39 ± 2 | 12 ± 2 |
| 5–10 | 18 ± 3 | 12 ± 3 |
| 10–20 | 16 ± 3 | 14 ± 3 |
| 20–40 | 18 ± 3 | 23 ± 3 |
| 40–80 | 9 ± 3 | 30 ± 3 |
| 80–200 | — | 9 ± 3 |

1.6.3 Absolute Filter Materials—The absolute filter[2] shall consist of fiberglass media with a minimum thickness of 12.7 mm (½ in) and a minimum density of 9.5 kg/$m^3$ (0.6 lb/$ft^3$). The fiber diameter shall be 0.76–1.27 $\mu$m (0.00003–0.00005 in) and the moisture absorption shall be less

[1] Obtainable from AC Div., General Motors Corp., Flint, MI.

[2] Absolute filter material No. FM-004 Owens Corning Fiberglass (or equivalent).

than 1% by weight after exposure of 49°C (120°F) and 95% relative humidity for 96 h. The filter shall be installed with nap side facing upstream in an airtight holder that adequately supports the media. The face velocity shall not exceed 50 m/min (165 ft/min) to maintain media integrity.

1.6.4 Absolute Filter Weight—The absolute filter shall be weighed, to the nearest 0.01 g after the weight has stabilized and while in a ventilated oven at 107 ± 2°C (225 ± 5°F).

Note: If stabilization cannot be determined, a minimum time of 4 h is required.

1.6.5 Temperature and Humidity—All tests shall be conducted with air entering the air cleaner at a temperature of 24 ± 8°C (75 ± 15°F) and a relative humidity of 50 ± 15%.

Note: Since atmospheric conditions affect test results, when comparing performance of filters designed for the same application, tests should be conducted within the narrowest range of temperature and humidity possible.

**1.7 Reference Section**

1.7.1 SAE J1124 (June, 1976), Glossary of Terms Related to Fluid Filters and Filter Testing.

1.7.2 SAE J916c (June, 1978), Rules for SAE Use of SI (Metric) Units.

1.7.3 Fluid Meters—Their Theory and Application—6th Edition 1971. Manual published by the ASME.

***2. Automotive Air Cleaner Test Procedures***

**2.1 General**

2.1.1 The automotive air cleaner test code has been established to cover dry type air cleaners generally used in automobiles. Air cleaners used in truck, off-highway, construction, and some industrial applications are classified as industrial types and are covered in Part 3 (Industrial Air Cleaner Test Procedures), of the SAE J726c (September, 1979) test code.

*ed.* 2.1.2 The test methods and equipment for oil bath air cleaners shall be as specified in the applicable paragraphs of SAE J726b. There will not be an update in this or subsequent revisions of this test code.

**2.2 Test Equipment**

2.2.1 To determine resistance to air flow, contaminant holding capacity, contaminant removal characteristics, sealing characteristics, and rupture/collapse characteristics, use equipment described in Figs. 2A, 2E, 2F, 2H, and 2K (test set-ups).

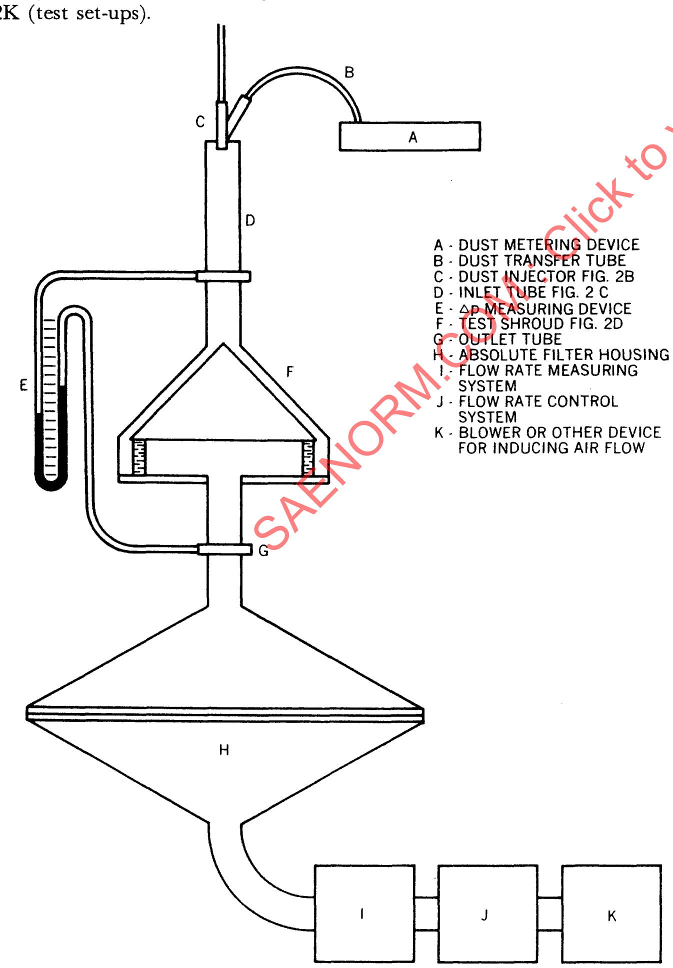



FIG. 2A—EFFICIENCY/CAPACITY AIR FILTER ELEMENT TEST SET-UP

2.2.1.1 Use a dust metering device which when used with the dust injector described in Fig. 2B with sufficient compressed air supply, is capable of metering dust over the range of delivery rates required. This dust feed system shall not change the primary particle size distribution of the contaminant. The average delivery rate shall be within 5% of the desired rate and the deviation in delivery rate from the average shall be no more than 5%.

2.2.1.1.1 Validation of the dust feed system.

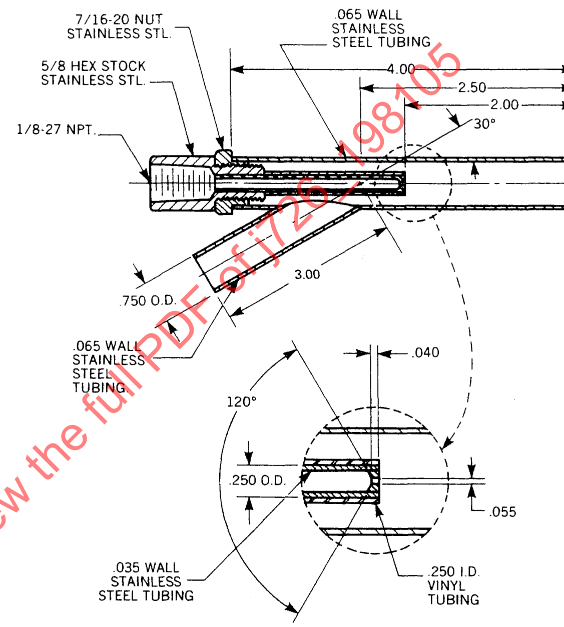
2.2.1.1.1.1 Charge the dust metering device with a pre-weighed amount of dust.

2.2.1.1.1.2 Simultaneously start dust feed system and timer.

2.2.1.1.1.3 At five minute intervals, determine the weight of dust dispensed. Continue weight determinations of dust increments for 30 min.

2.2.1.1.1.4 Determine the average delivery rate and the maximum deviation in delivery rate.

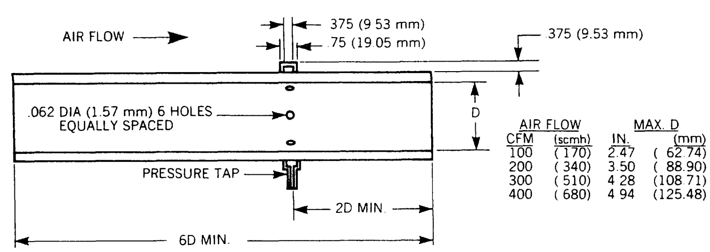
2.2.1.2 Use a dust transfer tube sized to maintain a minimum velocity of 914 m/min (3000 ft/min) for dust suspension.




CONVERSION TABLE

| INCHES | mm |
|---|---|
| .040 | 1.02 |
| .055 | 1.40 |
| .190 | 4.83 |
| .250 | 6.35 |
| .750 | 19.05 |
| 2.000 | 50.80 |
| 2.500 | 63.50 |
| 4.000 | 101.60 |
| 3.000 | 76.20 |

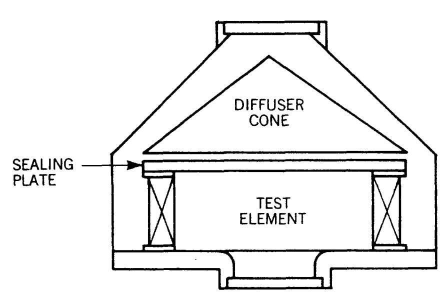
FIG. 2B—DUST INJECTOR




D TO BE SUCH THAT AIR VELOCITY* IS NOT LESS THAN 3000 ft/min (914.4 m/min) FOR DUST SUSPENSION.

*FOR VARIABLE AIR FLOW CYCLE, USE THE AVERAGE TEST FLOW.

FIG. 2C—INLET TUBE




DIMENSIONS TO BE SUCH THAT AIR VELOCITY* IN THE CONE SECTION IS NOT LESS THAN 3000 ft/min (914.4m/min) TO MAINTAIN DUST SUSPENSION AND THERE IS NO SIGNIFICANT ACCUMULATION OF DUST ON HORIZONTAL SURFACES (ELEMENT END SEALING PLATE OR BASE OF SHROUD). SEALING SURFACES TO BE SMOOTH AND FLAT.

*FOR VARIABLE AIR FLOW CYCLE, USE THE AVERAGE TEST FLOW.

FIG. 2D—TEST SHROUD

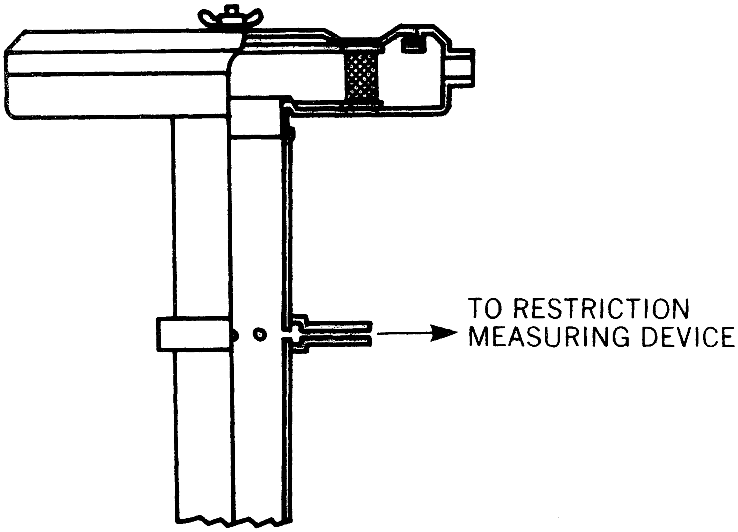



FIG. 2E—AIR CLEANER ASSEMBLY RESTRICTION TEST SET-UP

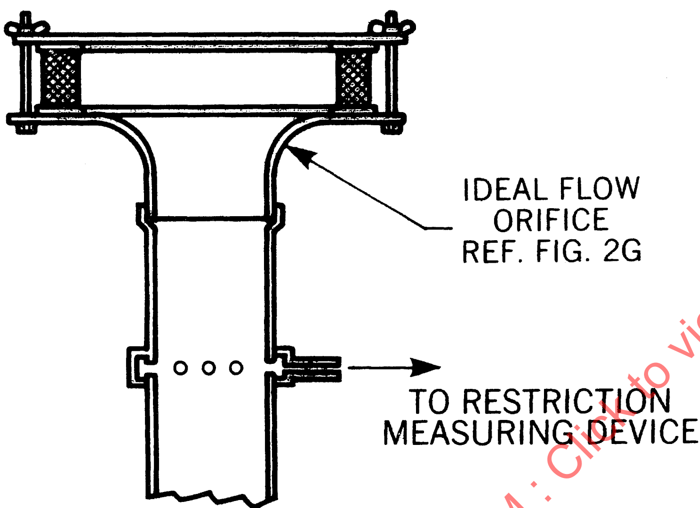



FIG. 2F—ELEMENT RESTRICTION TEST SET-UP

2.2.1.3 Use the dust injector described in Fig. 2B.

2.2.1.4 Use an inlet tube conforming to Fig. 2C.

2.2.1.5 Use a manometer or other differential pressure measuring device with the accuracy described in paragraph 1.5.2.

2.2.1.6 For air filter element testing use a test shroud conforming to Fig. 2D.

2.2.1.6.1 For air cleaner assembly testing use a housing and set-up agreed upon by supplier and user (Ref. Fig. 2H).

2.2.1.7 Use an outlet tube conforming to Fig. 2C except that the overall length is four diameters min (air velocity is not critical).

2.2.1.8 Use an absolute filter whose efficiency is a minimum of 99% for the contaminant presented to it and whose size is such that the air velocity through it does not exceed 50 m/min (165 ft/min).

NOTE: Refer to paragraph 1.6.3 for materials which have been found to meet this validation requirement.

2.2.1.8.1 Validation of absolute filter efficiency.

2.2.1.8.1.1 Arrange two absolute filters in tandem.

2.2.1.8.1.2 Perform a filter efficiency test and determine the weight increase of each absolute filter.

$$\text{Absolute filter efficiency (\%)} = \left(1 - \frac{B}{A}\right) \times 100$$

where: A = Weight increase of upstream absolute filter.
B = Weight increase of downstream absolute filter.

2.2.1.9 Use an air flow rate measuring system having the accuracy described in paragraph 1.5.1.

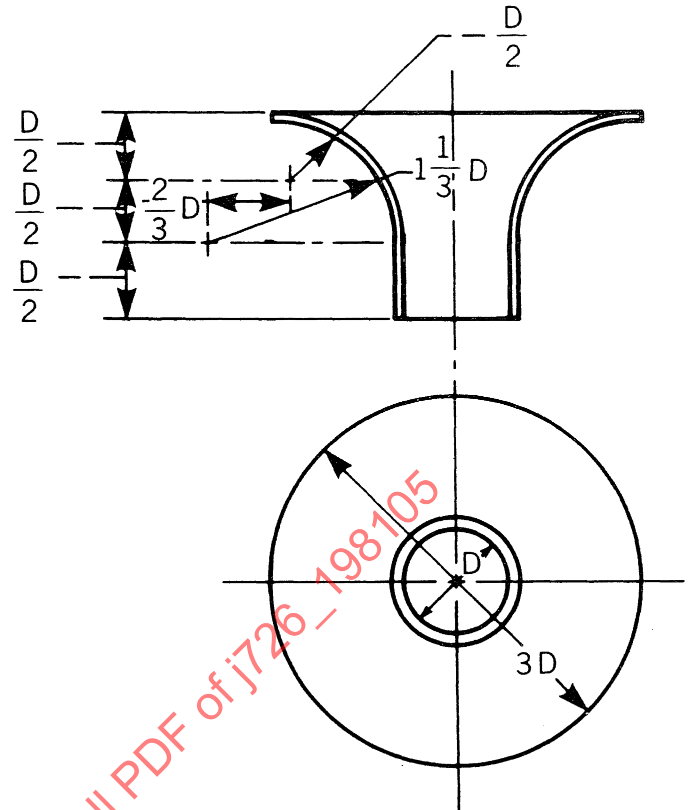



FIG. 2G—IDEAL FLOW ORIFICE

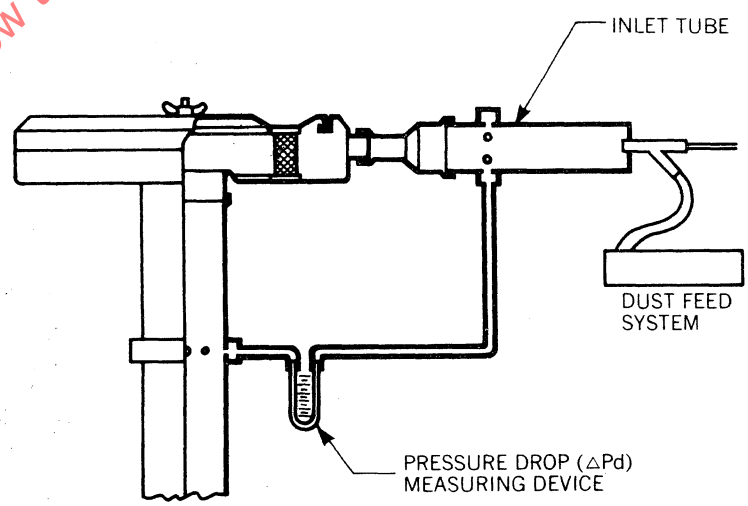



FIG. 2H—EFFICIENCY/CAPACITY AIR CLEANER ASSEMBLY TEST SET-UP

2.2.1.9.1 Validate the air flow rate measuring system according to Ref. 1.7.3. The air flow meter shall be an accepted design, such as a calibrated orifice, traceable, once removed to a standard calibrating source. Corrections shall be made for variations in absolute pressure and temperature at the meter inlet and the air flow rate shall be expressed in cubic meters per hour corrected to 26.66°C at 101.32 kPa (29.92 in Hg and 80°F).

2.2.1.10 Use an air flow rate control system capable of maintaining the indicated flow rate within 1% of the selected value during both steady state and variable air flow operation.

2.2.1.11 Use a suitable means for inducing air flow through the system having sufficient flow rate and pressure characteristics for the filters to be tested. Pulsation of flow rate shall be low enough so as to not be measureable by the flow rate measuring system.

2.2.2 Use an oven capable of maintaining the temperature at 107 ± 3°C (225 ± 5°F) for stabilizing absolute filter weight.

2.2.3 Use a balance mounted on the oven (balance pan inside oven) having a sensitivity of 0.01 g for weighing absolute filters.

**2.3 Air Flow Restriction and Pressure Drop Test**

2.3.1 The purpose of this test is to determine the static pressure drop across the unit under test which will result when air is passed through under predetermined conditions.

2.3.2 Condition the unit to be tested at least 30 min under temperature and humidity conditions equivalent to those in the test area. Tests should be performed at a temperature range of 16–32°C (60–90°F) with a relative humidity range of 35–65%.

2.3.3 For test unit restriction, set up test stand as shown in Fig. 2E or 2F. Seal all joints to prevent air leaks. Connect pressure taps.

2.3.4 Measure and record the static pressure drop versus flow rate over the range on interest or as specified. A minimum of five (5) readings is recommended.

2.3.5 For tare restrictions, use Fig. 2E or 2F without the air cleaner. Repeat paragraph 2.3.4.

NOTE: It is possible, due to inertial effects, for this value to be greater than the assembly restriction.

2.3.6 Determine test unit net restriction by subtracting values obtained in paragraph 2.3.5 from values obtained in paragraph 2.3.4.

2.3.7 Record data.

**2.4 Efficiency Test**

2.4.1 The purpose of this test is to determine the retention capabilities of the unit under test. This test can be conducted with either constant or variable air flow and with coarse dust or fine dust contaminant. If desired, efficiency tests can be performed concurrently with Capacity Test (paragraph 2.5).

2.4.2 Three types of efficiency tests can be performed. These are:

2.4.2.1 Full life efficiency determined when terminating pressure drop ($\Delta P_d$) is reached.

2.4.2.2 Incremental efficiency determined at 10, 25, and 50% of the terminating pressure drop ($\Delta P_d$) minus the initial pressure drop ($\Delta P_d$).

2.4.2.3 Initial efficiency determined after the addition of 20 g of contaminant or the number of grams numerically equivalent to 10% of the test air flow in scmh whichever is greater.

2.4.3 Determination of efficiency at constant test air flow can be performed at the rated air flow or any percentage thereof as agreed upon by the user and supplier.

2.4.3.1 Based on the test flow, calculate the dust contaminant feed rate using a dust concentration of 1.0 g/m$^3$ (0.028 g/ft$^3$) of air.

2.4.3.2 Condition unit under test according to paragraph 2.3.2 and then weigh, in grams, to within 1% of the actual value.

2.4.3.3 Weigh the absolute filter with a precision of 0.01 g after the weight has stabilized in an oven at 107 ± 3°C (225 ± 5°F).

2.4.3.4 Set up test stand as shown in Fig. 2H for air cleaner assemblies, or as shown in Fig. 2A for air filter elements. Seal all of the joints to prevent air leaks.

2.4.3.5 Record temperature and relative humidity.

2.4.3.6 Weigh out specified test dust equal to 125% of estimated capacity of test unit. Record weight to nearest 0.1 g, and place in dust metering device.

2.4.3.7 Weigh and record dust feed system with dust, in grams, to within 1% of actual value.

2.4.3.8 Start air flow through stand and stabilize at test flow. Record pressure drop ($\Delta P_d$).

2.4.3.9 Set the flow rate to that at which the test dust is to be added if this is different from the test flow rate used in paragraph 2.4.3.8.

2.4.3.10 Start dust feeder and adjust feed rate to inject dust at the concentration calculated in paragraph 2.4.3.1.

2.4.3.11 At prescribed time intervals (a minimum of five points is recommended), record pressure drop ($\Delta P_d$) at test flow and elapsed test time.

2.4.3.12 Continue test until terminating pressure drop is reached.

2.4.3.13 Repeat paragraph 2.4.3.5.

2.4.3.14 Repeat paragraph 2.4.3.7 and determine difference in weight. This amount is the dust fed.

2.4.3.15 Carefully remove the unit under test without losing any dust. Note any evidence of seal leakage or unusual conditions. Weigh, in grams, to within 1% of the actual value. The increase in weight of the unit under test is this weight minus the weight determined in paragraph 2.4.3.2.

2.4.3.16 Brush any observed dust on the downstream side of the test unit onto the absolute filter. Carefully remove the absolute filter. Repeat paragraph 2.4.3.3 and determine the difference in weight. This is the increase in weight of the absolute filter.

2.4.3.17 Calculate the material balance of the test dust. This value must be within the range of 0.98–1.02 to be a valid test.

$$\begin{array}{c}\text{Material balance}\\ \text{of test dust}\end{array} = \left( \frac{\begin{array}{c}\text{Increased weight}\\ \text{of absolute filter}\end{array} + \begin{array}{c}\text{Increased weight}\\ \text{of unit under test}\end{array}}{\text{Total weight of dust fed}} \right)$$

2.4.3.18 Calculate the efficiency by the following method:

$$\text{Efficiency \%} = \left( \frac{\begin{array}{c}\text{Increase in weight}\\ \text{of unit under test}\end{array}}{\begin{array}{c}\text{Increase in weight}\\ \text{of unit under test}\end{array} + \begin{array}{c}\text{Increase in weight}\\ \text{of the absolute filter}\end{array}} \right) \times 100$$

2.4.4 Variable air flow efficiency can be determined by using a variable air flow cycle similar to Fig. 2J.

2.4.4.1 Based on the average test flow for the cycle being used, calculate the dust feed rate as in paragraph 2.4.3.1. Dust feed rate should remain constant.

2.4.4.2 All pressure drop determinations are to be made at maximum air flow.

2.4.4.3 Perform test as in paragraph 2.4.3 using variable air flow in place of the constant air flow.

**2.5 Capacity Test**

2.5.1 The purpose of this test is to determine the total weight gain of the unit under test at the terminating pressure drop. This test can be conducted with either constant or variable air flow and with coarse or fine test dust contaminant. If desired, capacity determination can be performed concurrently with Efficiency Test (paragraph 2.4).

2.5.2 Perform test as described in paragraph 2.4.3.1–paragraph 2.4.3.15.

2.5.3 Assuming a constant ratio of elapsed time versus weight gain of the test unit, plot curve of restriction versus weight gain. Refer to paragraph 2.4.3.11 for restriction and time interval data. Use the following formula to determine the weight gain values:

$$\begin{array}{c}\text{Weight gain at}\\ \text{end of each}\\ \text{time interval}\end{array} = \left( \frac{\text{Total time to end of interval}}{\text{Total time to end of test}} \right) \times \begin{array}{c}\text{Total weight gain}\\ \text{of unit under test}\end{array}$$

2.5.4 The capacity of the test unit is the point at which the curve reaches the terminating restriction.

**2.6 Flow Pressure Collapse Test**

2.6.1 The purpose of this test is to determine the ability of an air filter element to withstand a specified differential pressure and/or the differential pressure at which collapse occurs.

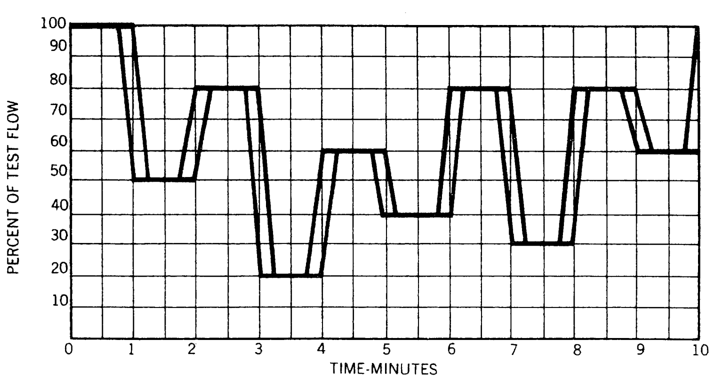



FIG. 2J—TYPICAL VARIABLE FLOW CYCLE AVERAGE FLOW 60%

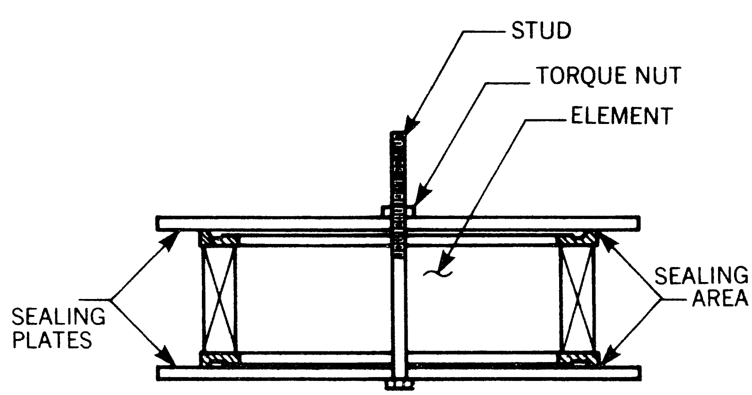



FIG. 2K—TEST ASSEMBLY

# TEST DATA REPORTING FORM SAE J726c

Part 2 Automotive Air Cleaners

TEST UNIT DESCRIPTION ______________________ DATE ______________

MANUFACTURED ______________ TEST CONDUCTED BY ____________ EQUIPMENT NO. ____________

## TEST CONDITIONS

RATED AIR FLOW ______ scmh    TEST AIR FLOW ______ scmh    STEADY ______    VARIABLE ______

TEST DUST: Fine _____ Coarse _____ BATCH NO. __________ TERMINATING RESTRICTION OR PRESSURE DROP __________

RELATIVE HUMIDITY BEFORE TEST _________ %   AFTER TEST _________ %

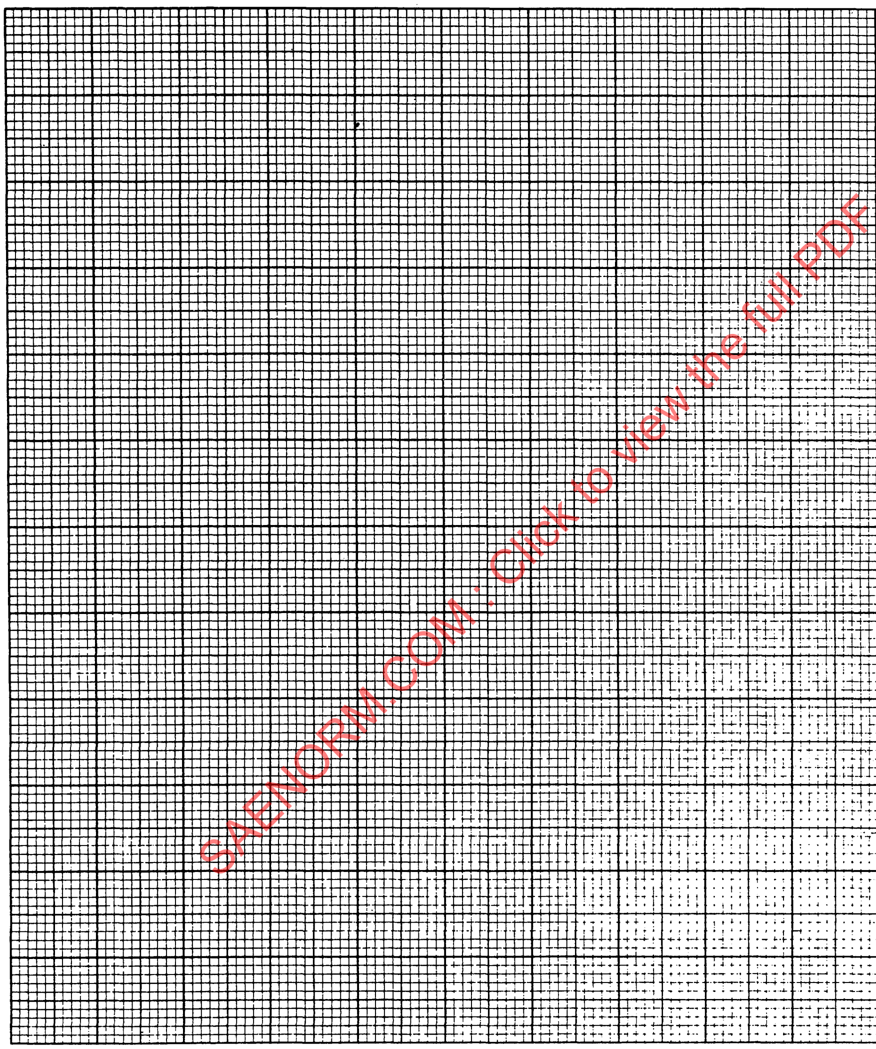
BAROMETRIC PRESSURE BEFORE TEST _________ kPa   AFTER TEST _________ kPa

TEMPERATURE BEFORE TEST __________ °C   AFTER TEST ________ °C

## TEST RESULTS

AIR FLOW—scmh

RESTRICTION OR PRESSURE DROP kPa



GRAMS DUST

FULL LIFE EFFICIENCY ____________ %

INITIAL EFFICIENCY
____________ % ____________ g

INCREMENTAL EFFICIENCY AT PER CENT OF TERMINATION
@ 10% Eff. ____________ %
@ 25% Eff. ____________ %
@ 50% Eff. ____________ %

INITIAL RESTRICTION
________ kPa @ ____________ scmh
(See Graph)

CAPACITY
g __________ to __________ kPa
(See Graph)

MATERIAL BALANCE FOR VALIDATION OF TEST ____________

FLOW PRESSURE COLLAPSE REMARKS
____________________
____________________
____________________
____________________

SEAL TEST REMARKS
____________________
____________________
____________________
____________________

TEMPERATURE EXTREME TEST
Hours each ____________
Hot __________ °C  Cold __________ °C
Times Repeated ____________
Remarks ____________

GENERAL COMMENTS: ______________________________

FIG. 2L

2.6.2 Set up test stand to perform basic dust capacity test as per Fig. 2A or 2H. Element from prior capacity of efficiency test or new element can be used for this test.

2.6.3 Increase air flow through stand and if necessary, feed dust at any convenient rate until the specified pressure drop ($\Delta P_d$) is reached or the element collapse is evidenced by any decrease in pressure drop ($\Delta P_d$) or increase in air flow.

2.6.4 Record maximum pressure drop ($\Delta P_d$) attained, reason for terminating test, and condition of element after test.

**2.7 Seal Effectiveness Test**

2.7.1 The purpose of this test is to determine the seal effectiveness of air filter elements.

2.7.1.1 Locate filter element between two transparent plates as shown in Fig. 2K and torque to specified requirements.

2.7.1.2 Check visually for any irregularities or voids in seal area. Proper sealing can normally be identified by dark or wet appearance continuous throughout the sealing contact area.

2.7.1.3 Report and comment on seal quality and torque required to effect a seal.

**2.8 Temperature Extreme Test**

2.8.1 The purpose of this test is to determine the effectiveness of the air filter to withstand temperature extremes.

2.8.2 Locate filter element between two temperature resistant plates as shown in Fig. 2K and torque to specified requirement.

2.8.3 Subject assembly to the specified hot and cold cycle. In absence of specific values, the following is recommended:

24 h at 121 ± 3°C (250 ± 5°F)
24 h at −40 ± 3°C (−40 ± 5°F)
24 h at 121 ± 3°C (250 ± 5°F)
24 h at −40 ± 3°C (−40 ± 5°F)

Allow unit under test to adjust to room temperature between cycles.

2.8.4 After test cycle, allow to adjust to room temperature. Remove plates and inspect element for conditions that will impair performance. If necessary, repeat paragraph 2.4 Efficiency Test.

2.8.5 Report all conditions of test and visual observations.

**2.9 Presentation of Data**

2.9.1 The purpose is to standardize a test data reporting form. Refer to Fig. 2L.

***3. Industrial Air Cleaner Test Procedures***

**3.1 General**

3.1.1 This section of the air cleaner test code has been established to cover dry type air cleaners generally used in heavy trucks, construction equipment, agricultural tractors, and industrial applications. Air cleaners used in automobiles are classified as automotive and are covered in Part 2 (Automotive Air Cleaner Test Procedures), of the J726c (September, 1979) test code.

3.1.2 Performance tests shall be performed on a complete air cleaner including precleaner, primary element, and secondary element, if normally provided. The tests shall consist of an airflow restriction/pressure drop test, an initial efficiency test, and a combined efficiency and dust capacity test.

3.1.3 TEST DUST AND CONCENTRATION—It is difficult, if not impossible, to select a test dust size distribution and concentration which will be representative of all service conditions. Therefore, based on primarily practical considerations, the different types of air cleaners have been classified as to their most probable service conditions, and the test dust grade and concentration selected accordingly:

| Air Cleaner Type | Test Dust | Concentration |
|---|---|---|
| Single Stage | Fine | 1 g/m$^3$ (0.028 g/ft$^3$) |
| Multistage | Coarse | 2 g/m$^3$ (0.056 g/ft$^3$) |

**3.2 Test Equipment**

3.2.1 TEST DUCT—The test duct shall consist of the following major components and be arranged as shown in Fig. 3A.

1. Dust feeder.
2. Dust injector.
3. Dust mixing duct with piezometer ring.
4. Air cleaner under test.
5. Downstream piezometer tube.
6. Absolute filter.
7. Airflow meter.

3.2.2 DUST FEEDING SYSTEM—The dust feeding system shall consist of a dust feeder and a compressed air operated dust injector. The dust feeder shall feed the test dust at a continuous and uniform rate and the quantity fed shall be determined by weight measurement to the nearest 0.1 g. The open tray type dust feeder as shown in Fig. 3E is recommended, but other types are optional.

The purpose of the dust injector is to effect a consistent high degree of dust dispersal and shall not change the particle size distribution of the contaminant and shall be configured as shown in Fig. 3F. The injector shall be operated with a minimum supply pressure to the nozzle of 550 kPa (80 psig) and the minimum quantity of aspirated air during operation shall be 70 m$^3$/h (40 cfm) (see Fig. 3G). For flow industrial air cleaners, approximately

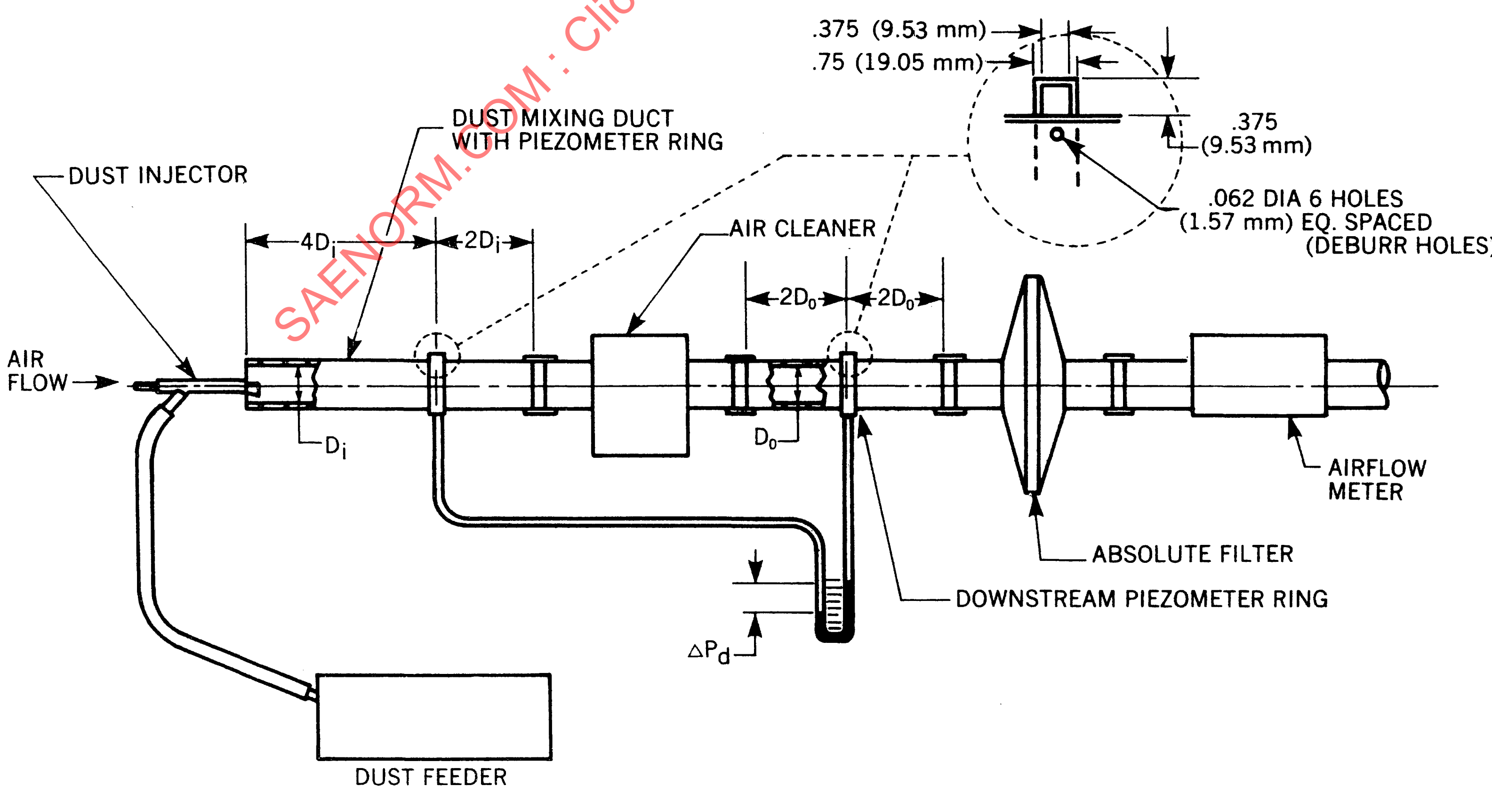



FIG. 3A—TUBULAR INLET AIR CLEANER TEST DUCT ASSEMBLY

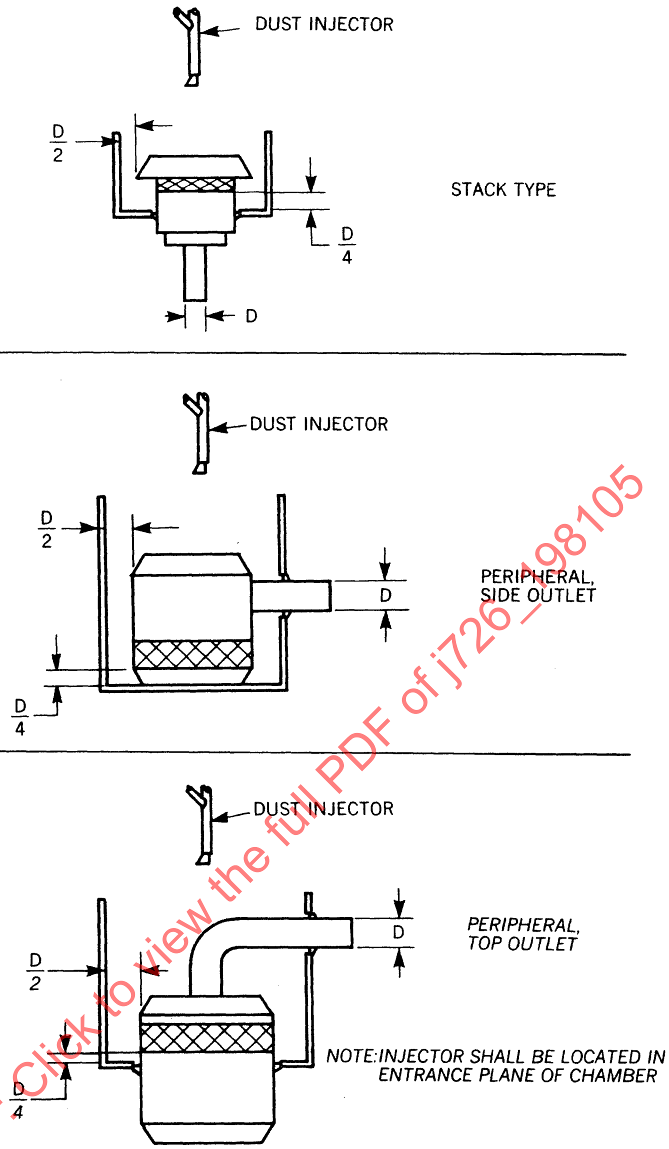



FIG. 3B—NON-TUBULAR INLET AIR CLEANER TEST CHAMBER ASSEMBLIES

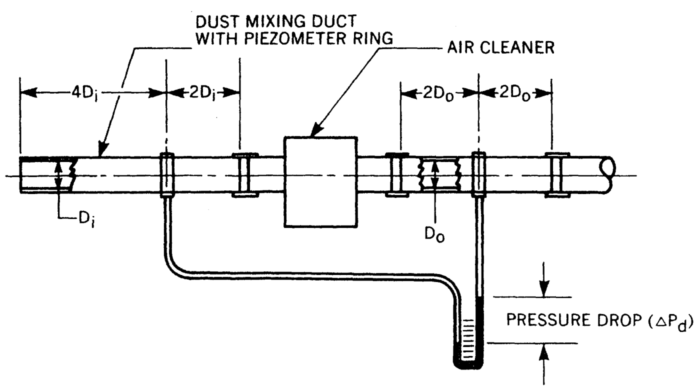



FIG. 3C—PRESSURE DROP TEST SET-UP

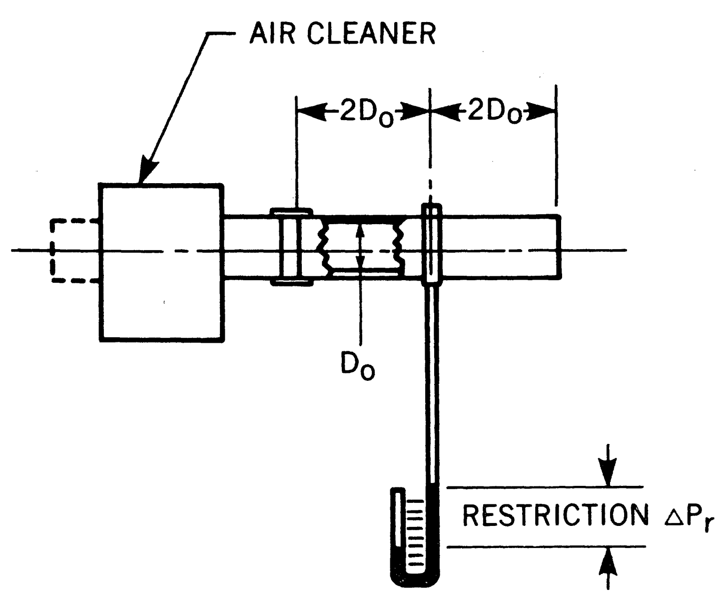



FIG. 3D—RESTRICTION TEST SET-UP

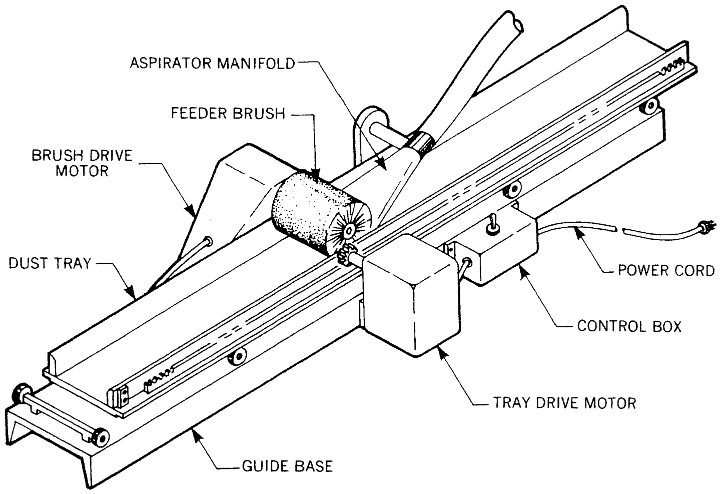



FIG. 3E—DUST FEEDER (DETAIL DRAWING AVAILABLE FROM SAE TEST CODE SUB-COMMITTEE)

170 $m^3/h$ (100 cfm) or less, use the dust injector configuration from Part 2, Fig. 2B.

3.2.3 Upstream Dust Mixing Duct

3.2.3.1 *Tubular Air Cleaner Inlet*—The cross-sectional area of the dust mixing duct and upstream piezometer tube shall be the same as the air cleaner inlet. The overall length shall be 6 diameters with the piezometer ring placed 4 diameters from the duct inlet. (See Fig. 3A).

3.2.3.2 *Rectangular or Open Face Inlet*—Same as paragraph 3.2.3.1, except the overall length and placement of the piezometer shall be 6 and 4 times the hydraulic radius respectively. (Hydraulic radius = area ÷ perimeter.)

3.2.3.3 *Peripheral Air Inlet or Stack Type Pre-Cleaners*—Air cleaners of the type shall be tested in an open top chamber, as shown in Fig. 3B.

3.2.4 Downstream Piezometer—The inside diameter of downstream piezometer shall be the same as the air cleaner outlet tube. (See Fig. 3A.)

3.2.5 Absolute Filter—The absolute filter shall contain the material specified in paragraph 1.6.3.

3.2.6 Airflow Meter—The airflow meter shall be calibrated annually to assure a known accuracy of ±2%, by using a flow meter conforming to the construction set forth in ASME Fluid Meters, Sixth Edition.

**3.3 Airflow Restriction and Pressure Drop Test**

3.3.1 Airflow restriction or pressure drop (see paragraph 1.4 Definitions) is measured with a clean filter element, or elements, at five equally spaced airflows between 50 and 150% of rated airflow. This data is presented in curve form to permit the easy determination of restriction, or pressure drop at any given airflow.

3.3.2 Airflow Restriction ($\Delta P_r$)

3.3.2.1 Set up air cleaner per Fig. 3D.

3.3.2.2 Record the downstream static gauge pressure at 50, 75, 100, 125, and 150% of rated airflow.

3.3.2.3 Record ambient temperature, pressure, and relative humidity.

3.3.2.4 Correct recorded restriction values to standard conditions per Appendix A and plot as shown in Fig. 3H, indicating restriction on ordinate.

3.3.3 Pressure Drop ($\Delta P_d$)

3.3.3.1 Set up air cleaner per Fig. 3C.

3.3.3.2 Record the difference in static pressure measured upstream and downstream of the air cleaner at 50, 75, 100, 125, and 150% of rated airflow.

3.3.3.3 Record ambient temperature, pressure, and relative humidity.

3.3.3.4 Correct recorded pressure drop values to standard conditions, per Appendix A, and plot as shown in Fig. 3H, indicating pressure drop on ordinate.

**3.4 Initial Efficiency**

3.4.1 Air cleaners covered within the scope of this test code exhibit a collection efficiency that is substantially independent of airflow, increases with dust load on the filter element, and decreases with dust particle size.

Two efficiency determinations are thus made; an initial efficiency test, and an accumulative efficiency conducted during the dust capacity test.

3.4.2 Procedure

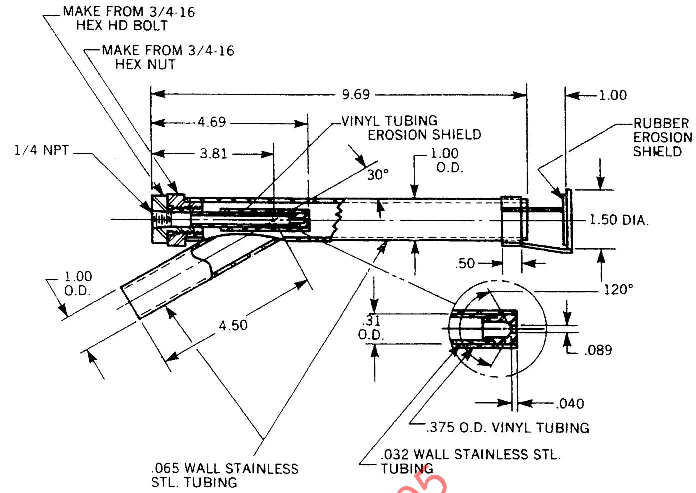
3.4.2.1 Set up air cleaner using clean filter element per Fig. 3A or 3B.

3.4.2.2 Weigh the absolute filter per paragraph 1.6.4.

3.4.2.3 Set and maintain air cleaner airflow at test flow ±2%.

3.4.2.4 Feed a quantity of fine test dust equal to 11 $g/m^2$ (1.0 $g/ft^2$) of primary element media area at a continuous rate for 30 min.

3.4.2.5 Reweigh the absolute filter per paragraph 1.6.4 and compute air cleaner efficiency based on the total dust fed to the air cleaner. Record on Fig. 3J.




| CONVERSION TABLE | |
|---|---|
| INCHES | mm |
| .032 | 0.81 |
| .040 | 1.02 |
| .065 | 1.65 |
| .089 | 2.26 |
| .310 | 7.87 |
| .375 | 9.53 |
| .500 | 12.70 |
| 1.000 | 25.40 |
| 1.500 | 38.10 |
| 3.810 | 96.77 |
| 4.500 | 114.30 |
| 4.690 | 119.12 |
| 9.690 | 246.13 |

FIG. 3F—DUST INJECTOR

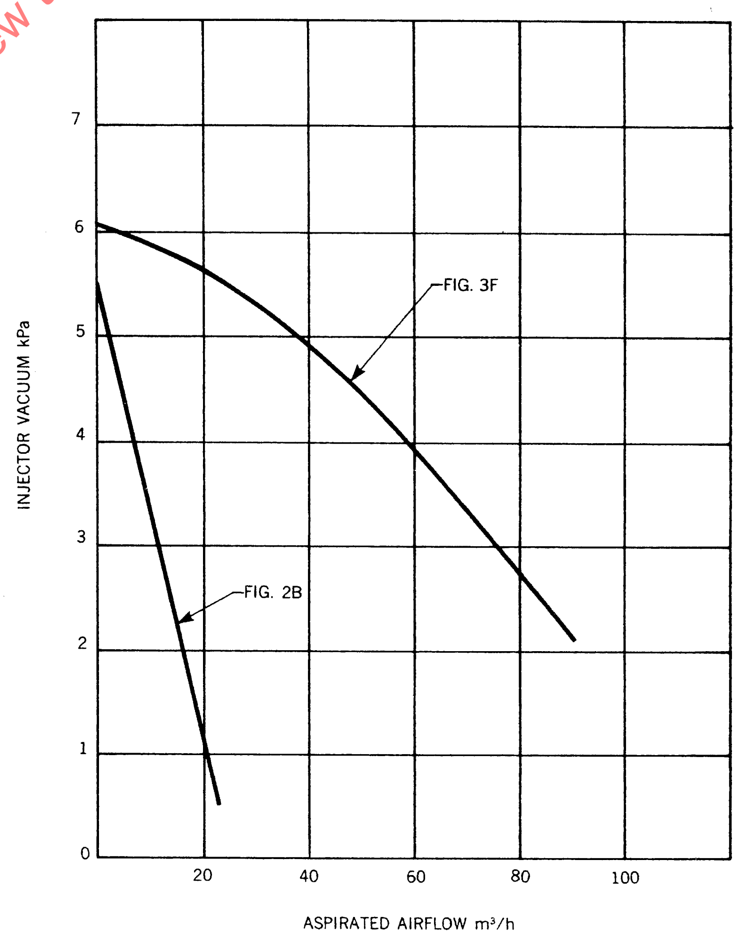



FIG. 3G—DUST INJECTOR PERFORMANCE