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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE STANDARD

SAE J2045

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Submitted for recognition as an American National Standard

TUBE/HOSE ASSEMBLIES

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1. ***Scope***—This SAE Standard encompasses the minimum functional requirements for fuel tubing and nonmetallic and nonrubber hose assemblies to be used in gasoline fuel injection systems. It utilizes information from the tubing standard SAE J2043, fittings and connectors SAE J2044, and protective covers SAE J2027. It is not intended to cover assemblies that operate below 30 °C (-22 °F) or above 115 °C (239 °F). In addition, this document is applicable for gasoline F.I. systems up to 5 bar (approximately 75 psig) operating pressure. It should be noted that temperatures can affect assemblies in various manners and every effort must be made to determine the operating temperature to which a specific assembly will be exposed, and design accordingly.

   This document does not make recommendations as to which assemblies are appropriate for different ranges of operating temperatures. The SAE specifications J2027, J2043, and J2044 for tubings, connectors, and protective covering should be referenced when designing any assembly.

2. ***References***

2.1 Applicable Documents—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J2027—Protective Covers for Nonmetallic Gasoline Fuel Injection Tubing
SAE J2043—Nonmetallic Tubing for Gasoline Fuel Injection and Fuel Supply Systems
SAE J2044—Fluid Coupling for Gasoline Fuel Injection Fuel Supply Systems
SAE Cooperative Research Report, Sept. 90, Gasoline/Methanol Mixtures for Materials Testing

3. ***Internal Cleanliness of Fuel Tube Assemblies***

3.1 Standards Referenced

Ford VES-E8AC-9327-AA, B5
B3 and GM 9080-P, 4.2

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3.2 Equipment and Supplies Required

Side arm suction flask (1 L) attached to vacuum pump
Solvent dispenser and filter (screen & 1 μ filter)
Whatman GF/B (or equivalent) glass microfilters 42 mm dia., retaining 1 μ
Filter holder with 200 mL minimum capacity
Analytical balance capable of weighing 0.0001 g
Stoddard solvent (solvent should be reagent grade or verify purity by running a blank test through the apparatus)
forceps
Petri dishes (50 mm diameter)
drying oven

3.3 Sample Preparation and Test Conditions

Test completed assemblies after removing retainers, covers, etc.
Conduct test under normal lab conditions with good ventilation.
Test assemblies in groups of at least five for best results.

3.4 Procedures

a. Weigh filter and place in filter holder, using forceps.
b. Set up apparatus as shown in Figure 1.
c. Turn on vacuum pump at maximum vacuum.
d. Pour an amount (equivalent to at least the volume of the assembly) of solvent through filter into open end of fuel assembly while holding it at least 2 ft above flask.
e. Collect solvent in vacuum flask after it passes through preweighed 1 μ filter.
f. Turn off pump and remove filter, checking filtrate for water separation from solvent. If none present, record "No Water"; if present, determine the amount in millimeters using a graduate.
g. Determine weight of dirt collected (in grams) by subtracting the original weight from the final weight (dirt = wt.g−wt.a). Total solvent insolubles shall not exceed 150 gm/m^2 of tubing surface area.
h. Assemblies should be sealed during shipment so as to prevent any contaminants entering the system.

3.5 Data to Record—Record dirt in grams per tube and record milliliters of water per tube.

3.6 CAUTION!!! WEAR GLOVES. SOLVENT REMOVES OILS FROM SKIN!!!!!!!!

3.7 Retention/Disposal of Samples—Dispose of daily—Do not recycle.

4. Chemical Resistance—The fuel line assembly must also be exposed to various automotive fluids to demonstrate chemical resistance as in Table 1. All tests at 23 °C ± 2 °C (73 °F ± 4 °F).

5. Fuel Supply Tube/Hose Assembly—SAE J2045 Durability—Fuel Supply/Tube Hose Assembly shall meet the following performance tests.

5.1 Fire/Heat Resistance

a. Flammability of the assembly shall be the flammability requirements of the individual components of the assembly.
b. Burn through the assembly shall be no less than the burn test referenced in SAE J2027.
c. Insulating ability of the assembly can be altered or modified per SAE J2027.

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5.2 Life Cycle Performance shall meet the requirements of SAE J2044, Section 5.3. Assembly shall be modified to fit the Life Cycle Test fixture with respect to the space restrictions of the fixture.

TABLE 1—EXTERNAL CHEMICAL AND ENVIRONMENTAL RESISTANCE

Fluid or Medium	Exposure Time	Procedure	Sample Size
ATF	30 day	Soak	
Brake Fluid	30 day	Soak	
Ethylene Glycol (Coolant)	30 day	Soak	
Ozone	144 h	ASTM D 1171-68	
Ultraviolet Rays	30 day	ASTM G 23	
Zinc Chloride	400 h	Soak	6
Diesel Fuels	30 day	Soak	
Motor Oil	30 day	Soak	
Windshield Washer Fluid	30 day	Soak	
Battery Acid (Sulfuric Acid—40% Wt.)	70 h	Soak @40 °C	
Lacquer Thinner—Used in Assembly Plants	30 day	Soak	
Car Wash Detergent	30 day	Soak	
Engine Degreasers	30 day	Soak	
Zn Cl—Flex Test - Initial Stress Bends See J2043—Section 6.3			
Vehicle Undercoating	30 day	Soak	

Upon exposing six fuel line assemblies to each fluid or medium, leak test at 23 °C ± 2 °C and report results. Disassemble and inspect for internal and external damage.

NOTE—200 h in 50% aqueous solution and 200 h in air at 23 °C ± 2 °C (73 °F ± 4 °F).

Fluids such as motor oil, detergent, etc., shall be considered generic and those that are common to the industry.

5.3 Routing Recommendations—When installed in a vehicle this assembly shall be routed and supported so as to:

a. Prevent chafing, abrasion, kinking, or other mechanical damage.
b. Minimize fatigue conditions.
c. Be protected against road hazards or provided with adequate shielding when located in vulnerable locations.
d. Be protected where temperatures exceed the limits -30 to +115 °C by the addition of adequate insulation.
e. Appropriate retainers and clips must be designed and incorporated into production or specific applications to assure maintenance of design intent routings of fuel lines. This requirement is intended to assure proper assembly and subsequent vehicle service operation, maintaining interfaces for temperature and environmental control for durability.

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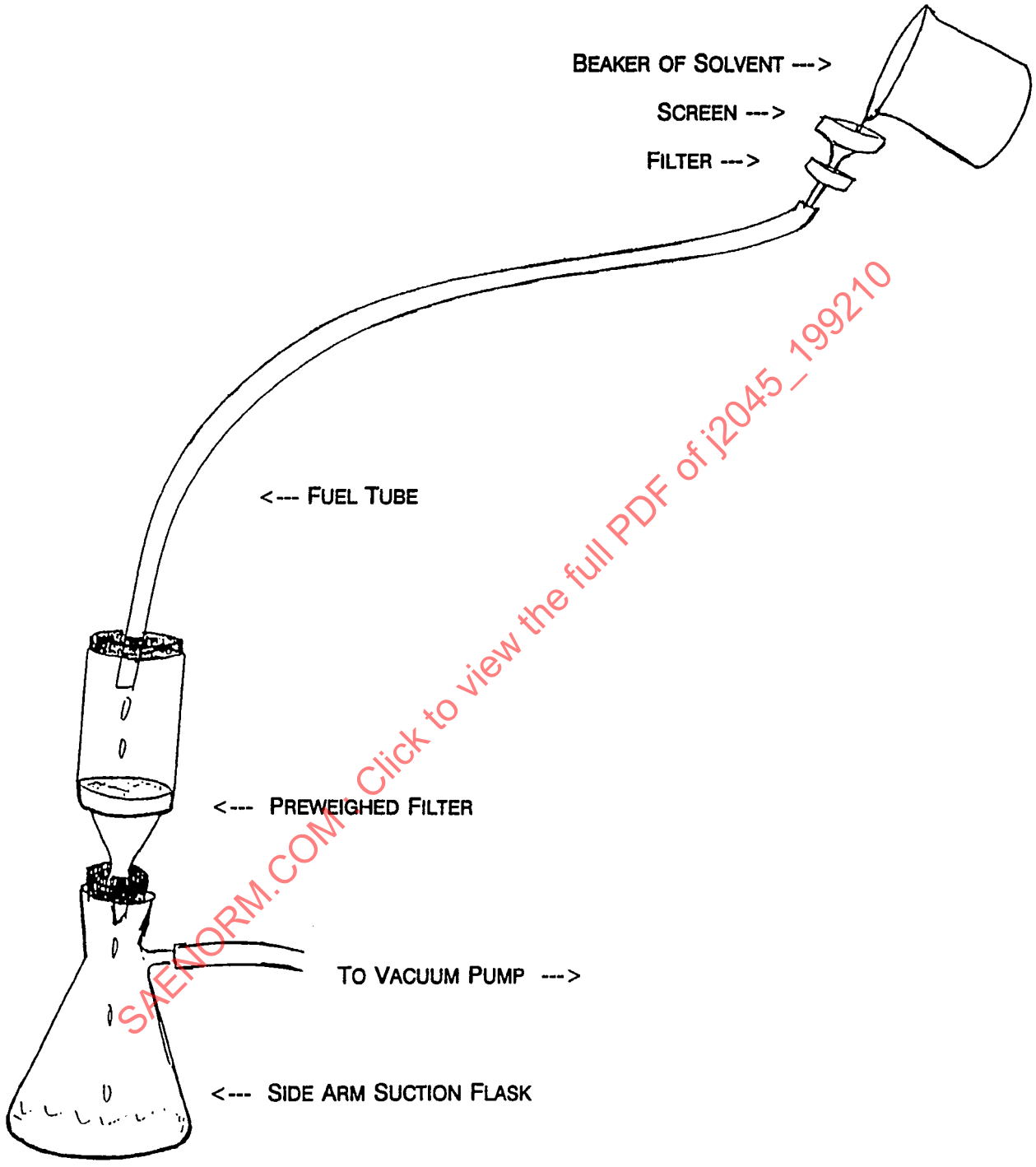

FIGURE 1—LABORATORY PROCEDURE

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6. Internal Fuel Resistance Test—See Table 2.

6.1 Reference

Ford FS-E9TA-9327-AA Sections A6 and A8
GM GM6264M Section 4.10 and 4.11
SAE Cooperative Research Report, Sept. 90, Gasoline/Methanol Mixtures for Materials Testing

TABLE 2—FUEL RESISTANCE TEST TABLE

	Temp.	Time	Sample Length	Peroxide	Length Change
Sour Gas Fuel °C	40°	6 Weeks	1800 mm	50	2-3%
Methanol M15	60°	6 Weeks	1800 mm	N/A	4-5%

NOTE — Length change is dependent upon the type of material selected. Care should be taken to choose a material that is consistent within the previous ranges.

Tests are to be performed on full assemblies using a recirculating test apparatus. These procedures are followed by measuring the change in length, then leak and burst tests.

Caution is advised when heating fuels and a suitable means for safely heating should always be adopted when performing these tests.

7. Pressure Drop Flow Test Fuel Line Assemblies—This specification covers the maximum amount of ΔP pressure variation permissible in a fuel line assembly when tested with air.

7.1 Test Equipment

7.1.1 PRESSURE PROOF TESTER—A device capable of applying an internal pressure of 1035 kPa ± 35 kPa (150 psi ± 5 psi) using air, with the capability of detecting a pressure drop in the assembly to 3.5 kPa (0.5 psi) increments.

7.1.2 Matched fittings that duplicate assembly to the vehicle for which it was designed.

7.2 Sample Preparation

7.2.1 All tests are conducted at 23 °C ± 2 °C (73 °F ± 4 °F).

7.3 Procedure

7.3.1 Attach tube assemblies to the test fixture.

7.3.2 Apply air at 1035 kPa ± 35 kPa (150 psi ± 5 psi) at one end of the assembly, (allow flow to reach a steady state) then measure pressure drop across assembly.

7.3.3 After test, remove assembly from test fixture and examine for cracking, deformation, or damage to connectors.

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7.4 Acceptance Criteria

7.4.1 Maximum pressure loss allowed is 13.8 kPa (2 psi) across the whole assembly.

7.4.2 No visible damage to connector or tubing.

8. Leak Resistance of Fuel Line Assemblies—This specification covers the maximum amount of leakage permissible in a fuel line assembly when tested with air.

8.1 Test Equipment

8.1.1 PRESSURE PROOF LEAK TESTER—A device capable of applying an internal pressure of 1035 kPa ± 35 kPa (150 psi ± 5 psi) using air, with the capability of detecting a leak in the assembly to 1.0 cm^3/min increments.

8.1.2 Matched fittings that duplicate assembly to the vehicle for which it was designed.

8.2 Sample Preparation

8.2.1 All tests are conducted at 23 °C ± 2 °C (73 °F ± 4 °F).

8.3 Procedure

8.3.1 Attach tube assemblies to the test fixture.

8.3.2 Pressurize assembly with air to 1035 kPa ± 35 kPa (150 psi ± 5 psi) allowing sufficient time for system to stabilize before determining leak rate. Leak rate to be measured in cubic centimeters per min.

8.3.3 After test, remove assembly from test fixture and examine for cracking, deformation, or damage to connectors.

8.4 Acceptance Criteria

8.4.1 Maximum leak rate allowed is 8 cm^3/min at 1035 kPa ± 35 kPa (150 psi ± 5 psi).

8.4.2 No visible damage to connector or tubing.

8.5 Using same procedures as above, pressure test assembly at 69 kPa ± 7 kPa (10 psi ± 1 psi).

9. Flow Restriction of Fuel Line Assemblies—This method is intended for use in determining the flow capability of an extruded tube after it has been bent to form and connector assembled.

9.1 Test Equipment

9.1.1 One ball half the size of the nominal tube ID.

9.2 Sample Preparation

9.2.1 This test is to be performed at 23 °C ± 2 °C (73 °F ± 4 °F) and 50% relative humidity.

9.3 Procedure

9.3.1 Bend tube samples to applicable form and insert connectors using production methods.

9.3.2 Pass ball through the assembly.

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9.4 Acceptance Criteria

9.4.1 A ball size of one half the nominal tube ID must pass through the tube.

10. High-Temperature Burst Strength of Fuel Line Assemblies—This method is intended for use in determining the burst strength of fuel line assemblies at elevated temperatures 121 °C (250 °F).

10.1 Test Equipment

10.1.1 BURST TESTER—A test apparatus capable of applying a pulse-free hydrostatic pressure at a uniform rate of increase of 7000 kPa/min (1000 psi/min), see Figure 2.

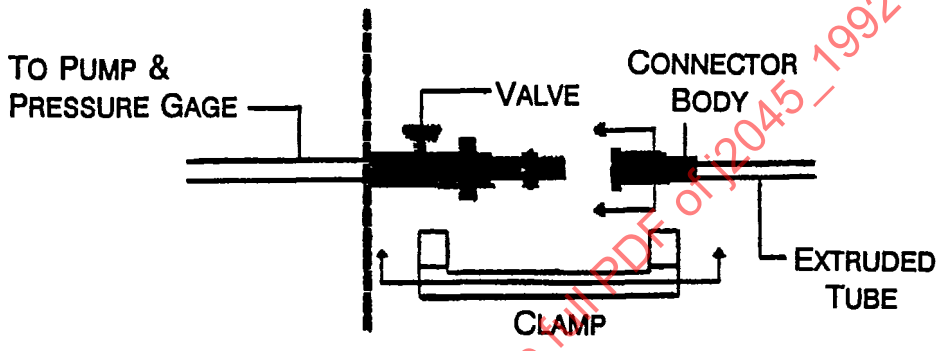

FIGURE 2—BURST TEST APPARATUS

10.1.2 PRESSURE GAUGE OR MONITOR

10.1.3 ENVIRONMENTAL BATH CHAMBER—Capable of holding temperatures to ±3 °C (±5 °F) uniformly throughout bath.

10.1.4 HIGH-TEMPERATURE BURST FLUID—The fluid for this test shall be capable of withstanding temperatures of 121 °C without serious degradation or safety hazards. Polyglycol E400 is one type of fluid.

10.1.5 SUITABLE FITTINGS OR CONNECTORS

10.2 Sample Preparation

10.2.1 Samples are cut to length 31 to 46 cm (12 to 18 in) and assembled with their proper connectors.

10.2.2 Samples are then conditioned for 24 h at 23 °C ± 2 °C (73 °F ± 4 °F) and 50% ± 5% relative humidity.

10.3 Procedure

10.3.1 Fill burst apparatus with burst fluid.

10.3.2 Fill bath chamber with burst fluid and heat to 121 °C.

10.3.3 Secure the test sample to the apparatus and bleed air from the tubing through a valve or petcock provided for that purpose.

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