SAE International™

SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J2044

REV. SEP2002

Issued 1992-06
Revised 2002-09

Superseding J2044 DEC1997

Quick Connect Coupling Specification for Liquid Fuel and Vapor/Emissions Systems

TABLE OF CONTENTS

TO PLACE A DOCUMENT ORDER:
Tel: 877-606-7323 (inside USA and Canada)
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: custsvc@sae.org
SAE WEB ADDRESS: http://www.sae.org

1. ***Scope—***This SAE Recommended Practice defines standard tube end form dimensions so as to guarantee interchangeability between all connector designs of the same size and the standard end form. This document also defines the minimum functional requirements for quick connect couplings between flexible tubing or hose and rigid tubing or tubular fittings used in supply, return, and vapor/emissions in fuel systems. This document applies to automotive and light truck applications under the following conditions:

a. Gasoline and diesel fuel delivery systems or their vapor venting or evaporative emission control systems.
b. Operating pressure up to 500 kPa, 5 bar, (72 psig).
c. Operating vacuum down to –50 kPa, –0.5 bar (–7.2 psi).
d. Operating temperatures from –40 °C (–40 °F) to 115 °C (239 °F).

Quick connect couplings function by joining the connector to a mating tube end form then pulling back to assure a complete connection. The requirements stated in this document apply to new connectors in assembly operations unless otherwise indicated. For service operations, the mating tube should be lubricated with SAE 30-weight oil before re-connecting.

NOTE— New connector designs using the same materials as previously tested connectors may use the original results as surrogate data for 7.1, 7.2, 7.3, and 7.4.

Vehicle OEM fuel system specifications may impose additional requirements beyond the scope of this general SAE document. In those cases, the OEM specification takes precedence over this document.

2. ***References***

2.1 **Applicable Publications—**The following publications form a part of this specification to the extent specified herein. Unless otherwise specified, the latest issue of SAE publications shall apply.

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

SAE J1645—Fuel System—Electrostatic Charge
SAE J1681—Gasoline, Alcohol, and Diesel Fuel Surrogates for Materials Testing
SAEJ1737—Test Procedure to Determine the Hydrocarbon Losses from Fuel Tubes, Hoses, Fittings, and Fuel Line Assemblies by Recirculation
SAE J2045—Performance Requirements for Fuel System Tubing Assemblies

2.1.2 ASTM PUBLICATION—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM B 117—Method of Salt Spray (Fog) Testing

2.2 **Related Publication—**The following publication is provided for information purposes only and is not a required part of this specification.

2.2.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J30—Fuel and Oil Hoses

3. ***Definitions***

3.1 **Unexposed coupling—**One that has not been used or deteriorated since manufacture.

3.2 **Lot—**A group of couplings that can be traced to a single assembly set-up or material lot. No more than one week production in a lot.

4. ***Size Designation—***The following system of size designations apply to the tube end and connector portions of quick connect couplings. The connector size designation consists of two numbers. The first number designates the OD of the mating tube end. The second number designates the tubing size suited for the stem.

EXAMPLE—9.5 mm x 8 mm connector fits a 9.5 mm male and 8 mm flexible tubing or hose. The mating tube end size designations refers to the nominal OD of the sealing surface. Refer to Figure 1 for an illustration of this Coupling Nomenclature.

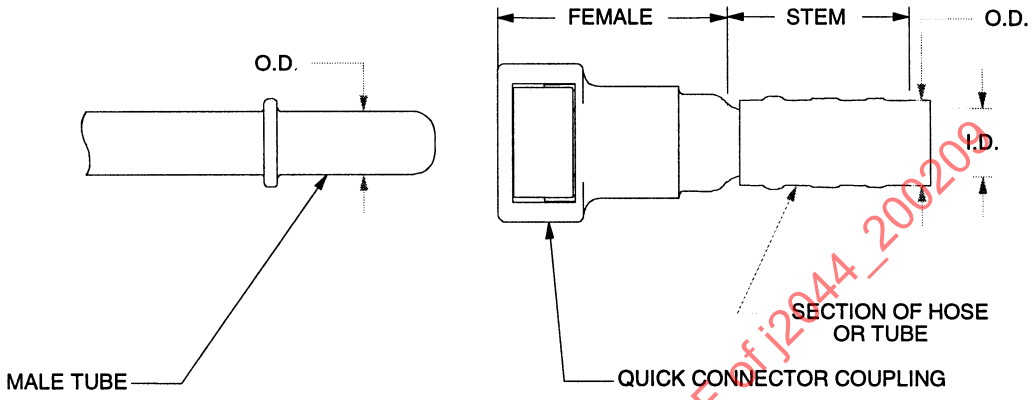


FIGURE 1—CONNECTOR NOMENCLATURE

Details for standard coupling sizes and dimensions for standard tube end forms are shown on Figure 2.

NOTE— On metal or nonmetallic tubing, the OD is used to designate size and on flexible hose and tubing, the ID is used to designate size.

5. ***Test Temperatures—***Unless otherwise specified, all tests will be performed at room temperature 23 °C ± 2 °C (73.4 °F ± 4 °F).

6. ***Functional Requirements—***This section defines the minimum functional requirements for quick connector couplings used in flexible tubing fuel systems.

6.1 **Leak Test—**In order to provide a production compatible process, all leak testing should be performed using compressed air in a manner that insures the connectors will not leak liquid fuel or vapor.

6.1.1 TEST PROCEDURE (LOW PRESSURE)

a. Insert leak test pin, shown in Figure 3, into the connector.
b. Pressurize between the seals with suitable air leak test equipment to 69 kPa ± 7 kPa, 0.69 bar ± 0.07bar (10 psig ± 1 psig).

NOTE— For single seal connectors, the stem must be capped or sealed.

6.1.2 ACCEPTANCE CRITERIA (LOW PRESSURE)—Maximum leak rate 2 cc/min at stabilization.

6.1.3 TEST PROCEDURE (HIGH PRESSURE)

a. Insert leak test pin, shown in Figure 3, into the connector.
b. For liquid fuel quick connector couplings, pressurize between the seals with suitable air leak test equipment to 1034 kPa ± 35 kPa, 10.34 bar ± 0.35 bar (150 psig ± 5 psig).
c. For vapor/emission quick connector couplings, pressurize between the seals with suitable air leak test equipment to 138 kPa ± 10 kPa, 1.38 bar ± 0.10 bar (20 psig ± 2 psig).

SAE J2044 Male Tube Endforms

Nominal Coupling Size & Tube Diameter	A Seal Diameter	B Bead Diameter	C Length	D[1] Bead Width	E Minimum I.D.	F[2] Clearance	G Gauge Diameter
6.35 mm (1/4")	6.30 ± 0.06	8.75 ± 0.15	19.31 ± 0.25	1.6 ± 0.33	3.6	9.5	7.75
PA coated							
6.35 mm (1/4")	6.30 ± 0.06	8.75 ± 0.15	19.31 ± 0.25	2.0 ± 0.33	3.6	9.5	7.75
8 mm (5/16")	7.89 ± 0.06	10.98 ± 0.15	19.52 ± 0.25	1.6 ± 0.33	4.7	12	9.39
PA coated							
8 mm (5/16")	7.89 ± 0.06	10.98 ± 0.15	19.52 ± 0.25	2.0 ± 0.33	4.7	12	9.39
9.5 mm (3/8")	9.49 ± 0.06	12.94 ± 0.21	19.52 ± 0.25	1.6 ± 0.33	6.3	14.3	10.92
PA coated							
9.5 mm (3/8")	9.49 ± 0.06	12.94 ± 0.21	19.52 ± 0.25	2.0 ± 0.33	6.3	14.3	10.92
10 mm (7/16")	9.89 ± 0.06	13.42 ± 0.21	22.24 ± 0.25	2.5 ± 0.33	6.6	15	TBD
11.1 mm	11.05 ± 0.10	14.80 ± 0.25	24.12 ± 0.50	2.5 ± 0.33	7.0	16.5	TBD
12 mm	11.80 ± 0.10	16.51 ± 0.25	24.12 ± 0.50	2.5 ± 0.33	7.5	18	14.10
12.7 mm (1/2")	12.61 ± 0.10	16.51 ± 0.25	24.12 ± 0.50	2.5 ± 0.33	7.5	18	14.10
16 mm (5/8")	15.82 ± 0.10	19.18 ± 0.25	24.12 ± 0.50	2.5 ± 0.33	11.3	24	TBD
19 mm (3/4")	18.90 ± 0.10	22.33 ± 0.25	24.12 ± 0.50	2.5 ± 0.33	13.2	28.5	TBD
23 mm (7/8)	22.70 ± 0.15	25.70 ± 0.50	27.00 ± 0.50	2.5 ± 0.33	16.0	33	TBD
25.4 mm (1")	25.50 ± 0.15	28.20 ± 0.50	27.00 ± 0.50	2.5 ± 0.33	19.0	38	TBD
28.5 mm (1 1/8")	28.42 ± 0.15	32.30 ± 0.50	40.00 ± 0.50	2.5 ± 0.33	22.7	43	TBD

For metal tubes D = 2 X wall thickness recommended.

[1]Measure at "G" diameter; Caution, not compatible with all connectors.

[2]Allow clearance for release tool if required.

See Appendix A for end form template examples

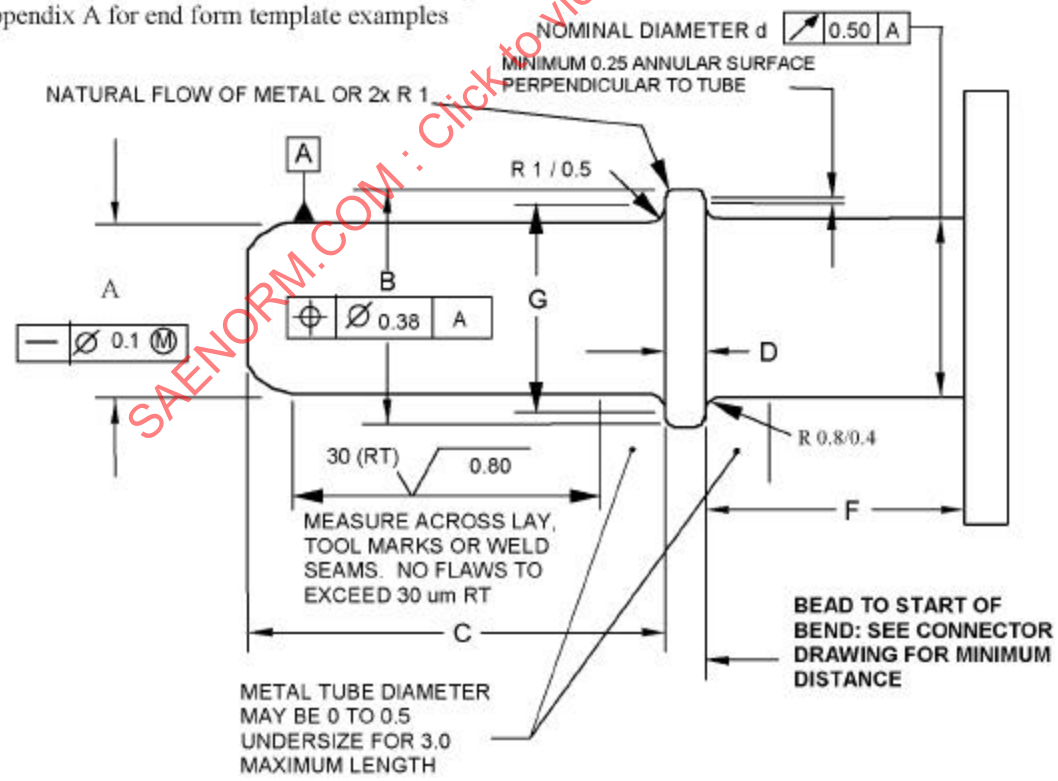


FIGURE 2—MATING TUBE FORM

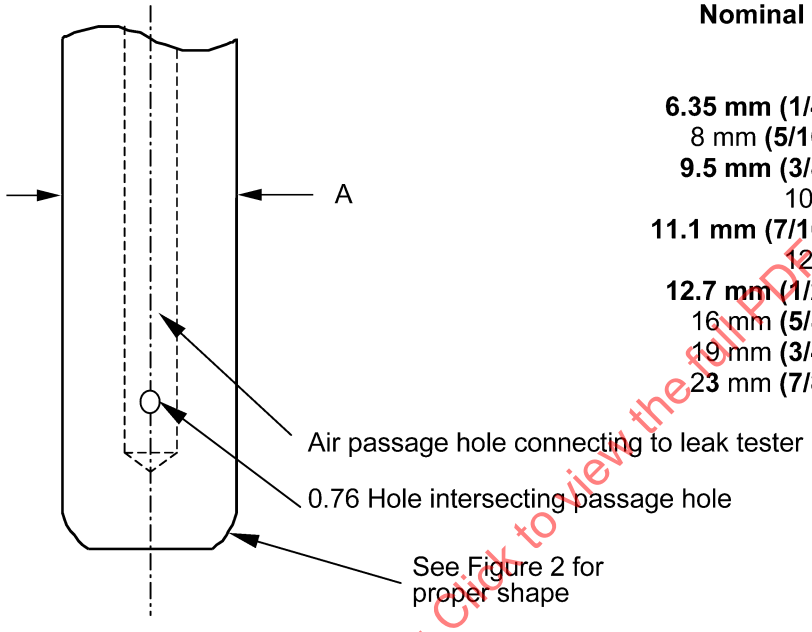
6.1.4 ACCEPTANCE CRITERIA (HIGH PRESSURE)—Maximum leak rate 5 cc/min at stabilization.

NOTE 1—For single seal connectors, the stem must be capped or sealed.
NOTE 2—Appropriate safety precautions should be taken when testing with high-pressure air.

6.1.5 TEST PROCEDURE (VACUUM)

a. Insert leak test pin shown in Figure 3 into connector.
b. Apply a vacuum of 7 kPa with suitable vacuum leak test equipment.

6.1.6 ACCEPTANCE CRITERIA (VACUUM)—Maximum leak rate 2 cc/min at stabilization.



Nominal Size	"A" Maximum	"A" Minimum
6.35 mm (1/4 in)	**6.24**	**6.22**
8 mm **(5/16 in)**	7.83	7.81
9.5 mm (3/8 in)	**9.43**	**9.41**
10 mm	9.83	9.81
11.1 mm (7/16 in)	**10.97**	**10.95**
12 mm	11.72	11.70
12.7 mm (1/2 in)	**12.51**	**12.49**
16 mm **(5/8 in)**	15.70	15.68
19 mm **(3/4 in)**	18.80	18.78
23 mm **(7/8 in)**	22.55	22.53

FIGURE 3—LEAK TEST PIN

6.2 Assembly Effort—Quick connect coupling assembly effort is the peak force required to fully assemble (latch or retain) the mating tube end into the connector. Use a suitable tensile/compression tester to verify conformance to this document.

6.2.1 TEST PROCEDURE (NEW PARTS)

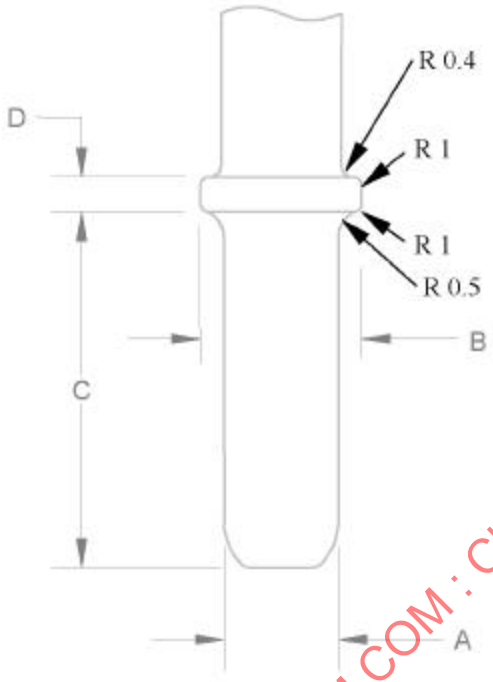
a. Test a minimum of 10 couplings.
b. Test the quick connect coupling as supplied. Do not add additional lubrication to the quick connect coupling or test pin.
c. Attach quick connect coupling to a suitable test fixture.
d. Wipe the test pins, before each test, with a clean lint-free cloth to prevent an accumulation of lubrication.
e. Insert assembly test pin, shown in Figure 4, into the quick connect coupling at a rate of 51 mm/min ± 5 mm/min (2 in/min ± 0.2 in/min) and measure assembly effort. (Simulated maximum tube end form)

6.2.2 TEST PROCEDURE—Connectors after Section 7 exposure.

a. Allow samples to dry 48 h before insertion testing.
b. Lubricate test pin with SAE 30-weight oil by dipping the end in oil up to the retaining bead.
c. Insert assembly test pin, shown in Figure 4, into the quick connector at a rate of 51 mm/min ± 5 mm/min (2 in/min ± 0.2 in/min) and measure assembly effort.

6.2.3 ACCEPTANCE CRITERIA

a. Maximum first time assembly effort must not exceed 67 N (15 lb) for sizes <11 mm male tubes, and 111 N (25 lb) for sizes ≥11 mm male tubes.
b. Maximum assembly effort after Section 7 exposures must not exceed 111 N (25 lb) for <11 mm male tubes and 156 N (35 lb) for ≥11 mm male tubes.



	A	B	C	D
+	0	0	0	0
-	0.01	0.01	0.05	0.02
6.35 mm (1/4")	6.36	8.90	19.56	1.93
6.35 mm (1/4") PA	6.36	8.90	19.56	2.33
8mm (5/16")	7.95	11.13	19.77	1.93
8mm (5/16") PA	7.95	11.13	19.77	2.33
9.5 mm (3/8")	9.55	13.15	19.77	1.93
9.5 mm(3/8") PA	9.55	13.15	19.77	2.33
10 mm	9.95	13.63	22.49	2.83
11.1 mm (7/16")	11.15	15.05	24.62	2.83
12 mm	11.90	16.05	24.62	2.83
12.7 (1/2")	12.71	16.76	24.62	2.83
16 mm (5/8")	15.92	19.43	24.62	2.83
19 mm (3/4")	19.00	22.58	24.62	2.83
23 mm (7/8")	22.85	26.20	27.50	2.83

FIGURE 4—ASSEMBLY TEST PIN

6.3 Pull-Apart Effort—Quick connect coupling pull-apart effort is the peak force required to pull the mating tube end out of the quick connect coupling. Use a suitable tensile tester to verify conformance to this document. For hose pull-off, see SAE J2045.

6.3.1 TEST PROCEDURE

a. Attach the quick connector body stem to a fixture suitable for pulling axially through the centerline of the quick connector.
b. Use the pull-apart test pin shown in Figure 5. (Simulated minimum mating end form)
c. Apply a tensile load, at a rate of 51 mm/min ± 5 mm/min (2 in/min ± 0.2 in/min), until complete separation occurs.

6.3.2 ACCEPTANCE CRITERIA

a. Minimum Force P required to separate the test pin from the fuel quick connector should be, P = 56d up to a maximum of 600 N (135 lb) or for unexposed connectors and P = 37d up to a maximum of 400 N (90 lb) after Section 7 exposure where P = Force in Newtons and d = Nominal Tube Diameter in millimeters.

b. Minimum Force P required to separate the test pin from the vapor/emissions quick connector should be P = 16d up to a maximum of 400 N (90 lb) for unexposed connectors, P = 12d up to a maximum of 300 N (67 lb) after Section 7 exposure.

	A	B	C	d	D
	+0.01 -0	+0.02 -0	+0.50 -0	+0.50 -0	+0.50 -0
6.35 (1/4 in)	6.27	8.60	19.06	6.35	1.47
8mm (5/16 in)	7.83	10.83	19.27	8.00	1.47
9.5 mm (3/8 in)	9.43	12.73	19.27	9.50	1.47
10 mm	9.83	13.21	21.99	10.00	2.17
11.1 mm (7/16 in)	10.95	14.55	23.62	11.10	2.17
12 mm	11.70	16.26	23.62	12.00	2.17
12.7 mm (1/2 in)	12.51	16.26	23.62	12.70	2.17
16 mm (5/8 in)	15.72	18.93	23.62	15.90	2.17
19 mm (3/4 in)	18.80	22.08	23.62	19.05	2.17
23 mm (7/8 in)	22.55	25.20	26.50	23.00	2.17

FIGURE 5—PULL APART PIN

6.4 Side Load Capability—Quick connect couplings must be able to withstand side loads typical of what might be imposed by hose routing in a vehicle application as well as from having the hose pushed aside to reach other objects on the vehicle during service procedures. The connector side load capability is measured using a side load leak test and a side load fracture test. All connector designs and all tube end forms on metal or plastic molded parts must meet the requirements of this procedure.

6.4.1 TEST PROCEDURE

a. Insert quick connector into a length of design intent flexible tubing or hose with the opposite end sealed.
b. Attach the quick connector to a suitable side load leak fixture or the plastic molded part, shown in Figure 6. (Simulated minimum end form)
c. For liquid fuel quick connect couplings, pressurize the assembly with 1034 kPa ± 35 kPa, 10.34 bar ± 0.35 bar (150 psig ± 5 psig) air pressure.
d. For vapor/emission quick connect couplings, pressurize the assembly with 69 kPa ± 14 kPa, 0.69 bar ± 0.14 bar (10 psig ± 2 psig) air pressure.
e. Side load the hose or tube center point with the required load specified and perform the leak test.
f. Mount a sample in the fracture fixture or plastic molded part, side load quick connector, at a rate of 12.7 mm/min ± 5 mm/min (0.5 in/min ± 0.2 in/min), until the specified force is applied or fracture of the quick connector occurs. Kinking of design intent hose is permitted.

6.4.2 ACCEPTANCE CRITERIA (SIDE LOAD LEAK TEST)

a. No leaks, fracture, or rupture of the quick connector or its components or the plastic molded tube end permitted below the minimum F = 19d up to maximum of 225 N (50 lb), where F = Side Load in Newtons and d = nominal tube diameter in millimeters.
b. Maximum leak rate is 8 cc/min at stabilization with 10.34 bar ± 0.34 bar (150 psig ± 5 psig) applied pressure for liquid connectors or 69 kPa ± 14 kPa, 0.69 bar ± 0.14 bar (10 psig ± 2 psig) applied pressure for vapor connectors.

6.4.3 TEST REQUIREMENT (SIDE LOAD FRACTURE TEST)—Push above the end of the stem.

6.4.4 ACCEPTANCE CRITERIA—No fracture, rupture, or yield of the quick connector or its components or the plastic molded tube end permitted, below the minimum of F = 28d up to a maximum of 400 N (90 lb), where F = Side Load in Newtons and d = nominal tube diameter in millimeters

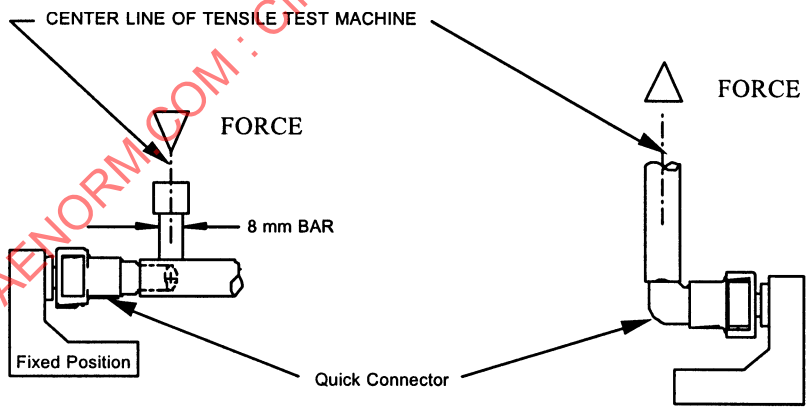


FIGURE 6—SIDE LOAD TEST FIXTURE

6.5 Resistance to Evaporative Emissions—Fuel line couplings are an integral part of the fuel system barrier to evaporative emissions. They are viewed as potential leak sites in the system. This method is to be used to determine hydrocarbon losses from permeation or micro leaks that are characteristic of each connector design.

6.5.1 TEST PROCEDURE

a. Because the losses from a single coupling are normally too small to measure accurately, it is recommended that a test specimen be created consisting of 10 couplings. The value measured is then divided by the number of connectors in the test specimen to arrive at the per connector value.
b. Connector stem is to be inserted into the design intent flexible tubing or hose and a design intent tube end inserted into the connector. The flexible tubing or hose should have its permeation properties measured independently using the same test fluid, preconditioning time and temperature, test temperature and measurement technique. The value measure in this test is then corrected by subtracting the permeation contribution from the flexible tubing.
c. For the purpose of making the correction described in b. (previously) measure the length of flexible tubing in the test specimen that will be exposed to fuel during the test. For each section of flexible tubing this should be measured from a point half way up the stem on one connector to the same point on the next connector in line.
d. Precondition the test specimen per SAE J1737 until steady state permeation/leak measurements are obtained. Use Test Fluid C per SAE J1681. Precondition at 40 °C and 60 °C for separate tests at each of those temperatures.
e. Measure the hydrocarbon losses using a suitable SAE test method (i.e., SAE J1737, Mini-SHED, weight loss, etc) providing it is sufficiently accurate and the flexible tubing has been permeation tested using the same method. Test at steady state temperatures of 40 °C and 60 °C.
f. Correct the measured value for the multi-coupling test specimen by first subtracting the permeation value attributed to the flexible tubing then dividing that value by the number of couplings in the test specimen.

6.5.2 ACCEPTANCE CRITERIA—None. Report value for each size and material combination only.

6.6 Electrical Resistance—If required by the OEM, all connectors used in fuel system applications involving flowing liquid fuel must be sufficiently conductive and capable of creating an electrical connection with the flexible tubing into which they are inserted and with the tube end form that is inserted into them in order to prevent the buildup of harmful electrostatic charges.

6.6.1 TEST PROCEDURE

a. Test specimen is to consist of a coupling representative of the design as it will be installed in a vehicle application. The coupling is to be in the middle of the specimen. The length of both the flexible tubing or hose and rigid tubing must be 250 mm.
b. Expose the specimens in accordance with 7.4 of this document then dry the exterior thoroughly.
c. Measure electrical resistance per SAE J1645 between the inner surfaces at each end of the specimen.

CAUTION—Measurement device may produce hazardous electrical charge, handle components with insulated means.

d. With the measurement system in place and recording, using insulated tongs or grasping device, move the connector both axially and tangentially with respect to the installed tube end.

6.6.2 ACCEPTANCE CRITERIA

a. Measured resistance must be less than 10^6 Ω (at 500 V).
b. Electrical continuity must be maintained in all orientations of the connector relative to the tube end.
c. Maintain material certification log to show in-process capability.

7. Design Verification/Validation Testing

7.1 Corrosion—The corrosion test is performed to assure that the quick connector components will meet the functional requirements of the fuel system after exposure to the corrosion test.

7.1.1 TEST PROCEDURE

a. Insert design intent mating tube ends, shown in Figure 2, into the quick connect couplings.
b. Cap the mating tube ends and the stem ends of the quick connect couplings, so internal surfaces remain free of water and corrosion.
c. Perform salt spray test per ASTM B 117.

7.1.2 ACCEPTANCE CRITERIA—The quick connect couplings shall be capable of meeting the functional requirements of 6.1, 6.2, and 6.3 after 500 h salt spray. Appearance is not a functional requirement.

7.2 Zinc Chloride Resistance—Zinc chloride is an environmental stress-cracking agent to which some hygroscopic polymers are sensitive. This test is performed to assure that the quick connect couplings meets their functional requirements after exposure to zinc chloride.

7.2.1 TEST PROCEDURE

a. Insert mating tube ends, shown in Figure 2, into the quick connect couplings.
b. Cap the mating tube ends and stem ends of the quick connect couplings, so internal surfaces remain free of water and corrosion.
c. Immerse the couplings in a 50% aqueous solution (by weight) of zinc chloride for 200 h at 23°C (room temperature). Cover or cap the container to prevent the solution from changing concentration significantly during the exposure. When in doubt, measure the concentration of ZnCl at the completion of the test.
d. When the exposure is complete, remove the quick connect couplings from the zinc chloride solution, do not rinse or clean.
e. The quick connect couplings must then be held at room temperature for 24 h.
f. Quick connect couplings are to be inspected after each exposure sequence for any evidence of cracking.

7.2.2 ACCEPTANCE CRITERIA

a. No cracks or fractures of the quick connector or its components permitted.
b. The quick connect couplings shall be capable of meeting the functional requirements of 6.1, 6.2, and 6.3 after exposure to zinc chloride.

7.3 External Chemical and Environmental Resistance—Quick connect couplings may be exposed to a range of chemicals typical of the automotive environment. This chemical resistance test is performed to assure that the quick connect couplings will meet their functional after exposure to typical automotive fluids.

7.3.1 TEST PROCEDURE

a. Insert mating tube ends, shown in Figure 2, into the quick connect couplings.
b. Cap mating tube ends and stem ends of the quick connect couplings.
c. Submerge the quick connect coupling assemblies completely.
d. At the end of 60 days, dry connectors at room temperature for 48 h.

7.3.2 FLUID OR MEDIUM—See Table 1.

7.3.3 ACCEPTANCE CRITERIA—The quick connect couplings shall be capable of meeting the functional requirements of 6.1, 6.2, and 6.3 upon completion of the external chemical and environmental testing.

NOTE— New connector sizes using the same materials and architectural design as previously tested connectors may use the original results as surrogate data.

TABLE 1—FLUID OR MEDIUM(1)

Fluid or Medium	Exposure Time	Procedure
Automatic Transmission Fluid	60 Days	Soak @ room temp
Motor Oil	60 Days	Soak @ room temp
Brake Fluid (Dot 3)	60 Days	Soak @ room temp
Ethylene Glycol (50% Water)	60 Days	Soak @ room temp
Propylene Glycol (50% Water)	60 Days	Soak @ room temp
Diesel Fuel	60 Days	Soak @ room temp
Engine Degreaser	60 Days	Soak @ room temp

1. The fluids in Table 2 shall be considered generic or those that are common to the industry.

7.4 Fuel Compatibility—The fuel compatibility test is performed to assure that the quick connector will meet the functional requirements of the fuel system after exposure to specific fuel blends.

NOTE— The intention of the document is that all couplings be fully interchangeable. As such couplings must be qualified to operate with all available fuels. Connectors made of materials that are not suitable for use in some fuels must be clearly labeled to identify their limitations.

7.4.1 TEST PROCEDURE

a. Insert mating tube ends, shown in Figure 2, into the connectors.
b. The samples shall have fuel contact surfaces exposed to the fuels specified in 7.4.2, see Table 2.
c. Replace the fuel every 7 days.
d. New samples must be used for each test.

7.4.2 TEST FUELS—Reference SAE J1681 and Table 2.

7.4.3 TEST REQUIREMENT—One-half the samples shall be tested immediately after removal from the test fuel and the remaining samples shall be tested after a 48-h dry-out period.

7.4.4 ACCEPTANCE CRITERIA—The quick connect coupling shall meet the functional requirements of 6.1, 6.2, and 6.3 after the completion of the fuel compatibility test.

NOTE— New connector sizes using the same materials and architectural design as previously tested connectors may use the original results as surrogate data.

TABLE 2—TEST FLUIDS

Test Fluid (Per SAE J1681)	Exposure Time	Procedure
ASTM Reference Fuel C	60 Days	Soak @ 40 °C
SAE CE10 (Fuel C Plus 10% Ethyl Alcohol)	60 Days	Soak @ 40 °C
SAE CM30 (Fuel C Plus 30% Methyl Alcohol)	60 Days	Soak @ 40 °C
SAE CME15 (Fuel C Plus 15% MTBE)	60 Days	Soak @ 40 °C
SAE CP (Auto-Oxidized Fuel)	60 Days	Soak @ 40 °C

7.5 Life Cycle—The life cycle test is performed to assure that the quick connector will meet the functional requirements of the fuel system when exposed to pressure, vibration, and temperature cycles typical of severe duty in automotive applications.

7.5.1 TEST PROCEDURE

a. Insert a connector in each end of a 500 mm (19.69 in) length of suitable flexible tubing.
b. Leak test the assembly per 6.1, except use mating tube end shown in Figure 2.
c. Connect the assembly to a test fixture, shown in Figure 7 using production intent tubes.
d. Test fluid (liquid fuel quick connect couplings)—Mobil Arctic 155 refrigerant oil or equivalent.
e. Test fluid (vapor/emission quick connect couplings)—Air.

NOTE— Use of flammable materials is not recommended. However, tests in fuel or fuel surrogates can produce better results at low temperatures.

7.5.2 VIBRATION FREQUENCY—Continuously sweep the frequency from 7 Hz to 200 Hz, with 3 sweeps per hour.

7.5.3 ACCELERATION—See Table 3.

TABLE 3—ACCELERATION(1)

Maintain Acceleration Load	From	To
18 m/s^2 (2 G)	7 Hz	25 Hz
90 (10 G)	25	50
182 (20 G)	50	75
163 (18 G)	75	100
145 (16 G)	100	125
127 (14 G)	125	150
109 (12 G)	150	175
90 (10 G)	175	200

1. This test may be interrupted or shut down for weekends at the end of any section.

7.5.4 VIBRATION DURATION—Maintain vibration as specified in 7.5.8 (Test Cycles).

7.5.5 FLUID PRESSURE

a. For liquid fuel quick connect couplings during pressure portions of the test, alternate pressure between 0 and 1034 kPa ± 35 kPa, 10.34 bar ± 0.35 bar (150 psig ± 5 psig). Alternate pressure one time per minute (i.e., 1 min at each pressure).
b. For vapor/emission quick connect couplings during pressure portions of the test, alternate pressure between 0 and 69 kPa ± 2 kPa, 0.69 bar ± 0.02 bar (10 psig ± 0.3 psig). Alternate pressure one time minute (i.e., 1 min at each pressure).

NOTE— Pressure transition rate is to be as close to a square wave as practical but not so abrupt that pressure overshoot occurs. This may require up to 3 s.

7.5.6 FLUID FLOW (LIQUID FUEL QUICK CONNECT COUPLINGS ONLY)—Flow rate during the specified test cycle is 1.33 Lpm ± 0.2 Lpm (0.46 gpm ± 0.07 gpm) through each quick connect coupling.

7.5.7 TEST DURATION—336 h (14 test cycles) (14 days)

7.5.8 TEST CYCLES—The test cycle consists of five sections to simulate hot operation, hot soak, hot operation after hot soak, cold soak, and cold operation. See Table 4.

NOTE—Included at the beginning of the hot and cold test sections are temperature transitions times of 1h maximum.

7.5.8.1 Hot Operation Test

a. Length of Time—7 h
b. Chamber Temperature—125 °C ± 5 °C (257 °F ± 9 °F)
c. Fluid Temperature (liquid fuel quick connect couplings only)—66 °C ± 5 °C (151 °F ± 9 °F)
d. Fluid Pressure—yes
e. Fluid Flow—yes
f. Vibration—yes

7.5.8.2 Hot Soak

a. Length of Time—2 h
b. Chamber Temperature—125 °C ± 5 °C (257 °F ± 9 °F)
c. Fluid Temperature (liquid fuel quick connect couplings only)—Heat to chamber temperature
d. Fluid Pressure—yes
e. Fluid Flow—no
f. Vibration—no

7.5.8.3 Hot Operation after Hot Soak

a. Length of Time—7 h
b. Chamber Temperature—125 °C ± 5 °C (257 °F ± 9 °F)
c. Fluid Temperature (liquid fuel quick connect couplings only)—66 °C ± 5 °C (151 °F ± 9 °F)
d. Fluid Pressure—yes
e. Fluid Flow—yes
f. Vibration—yes

7.5.8.4 Cold Soak

a. Length of Time—7 h
b. Chamber Temperature— –40 °C (-40 °F)
c. Fluid Temperature (liquid fuel quick connect couplings only)—Cool to chamber temperature
d. Fluid Pressure—yes
e. Fluid Flow—no
f. Vibration—no

7.5.8.5 Cold Operation

a. Length of Time—1 h
b. Chamber Temperature— –40 °C (–40 °F)
c. Fluid Temperature (liquid fuel quick connect couplings only)—Cool to chamber temperature
d. Fluid Pressure—yes
e. Fluid Flow—yes
f. Vibration—yes

7.5.9 ACCEPTANCE CRITERIA

a. No fluid leaks permitted during or at completion of test, for Vapor connector couplings, air leak test per 6.1.
b. The connector shall meet the functional requirements of 6.1, 6.2, and 6.3 after the completion of the life cycle test.
c. Perform visual inspection of connector and its components. No fractures, cracks, or unusual wear permitted.

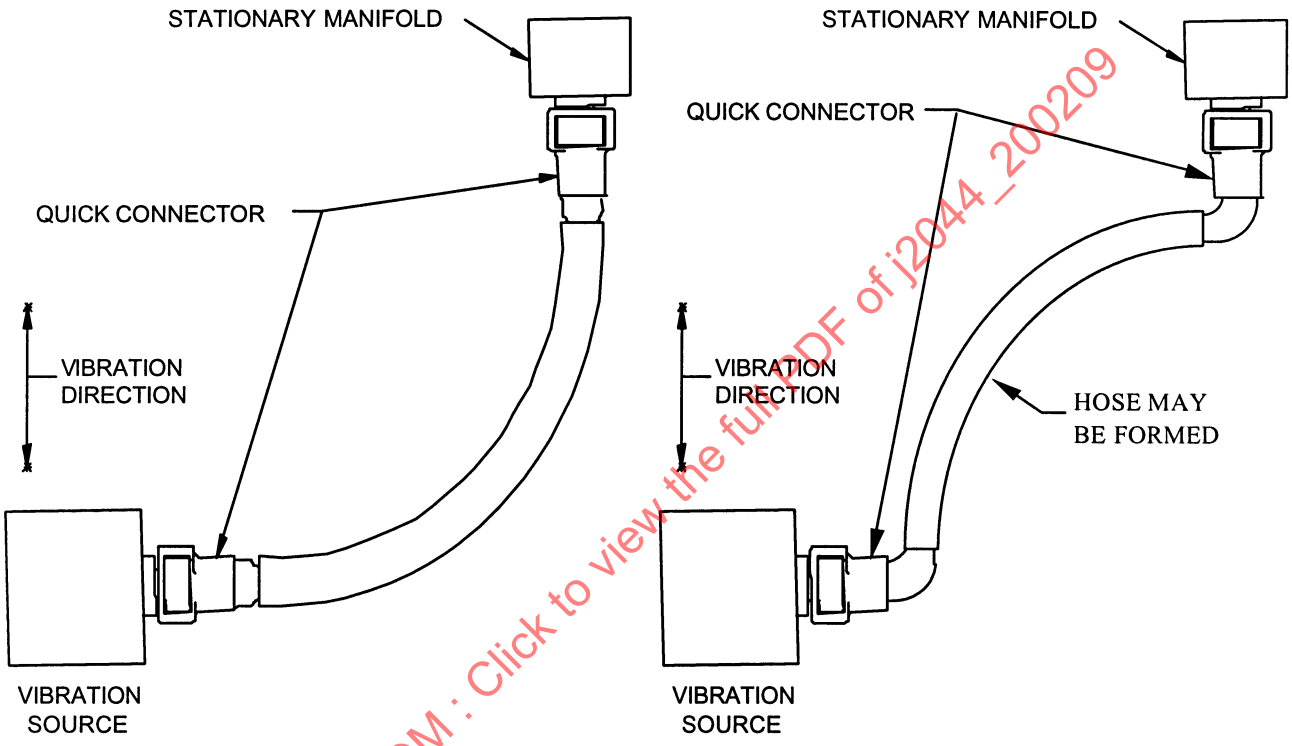


FIGURE 7—LIFE CYCLE TEST SET UP

TABLE 4—LIFE CYCLE TEST SCHEDULE

Section	Hour	Chamber Temperature	Fluid Temperature	Fluid Pressure	Fluid Flow	Vibration
7.5.8.1	1	125 °C(1)	125 °C(1)	Yes	Yes	Yes
	2	125°	66°	Yes	Yes	Yes
	3	125°	66°	Yes	Yes	Yes
	4	125°	66°	Yes	Yes	Yes
	5	125°	66°	Yes	Yes	Yes
	6	125°	66°	Yes	Yes	Yes
	7	125°	66°	Yes	Yes	Yes
7.5.8.2	8	125°	125°(1)	Yes	No	No
	9	125°	125°	Yes	No	No
7.5.8.3	10	125°	66°(1)	Yes	Yes	Yes
	11	125°	66°	Yes	Yes	Yes
	12	125°	66°	Yes	Yes	Yes
	13	125°	66°	Yes	Yes	Yes
	14	125°	66°	Yes	Yes	Yes
	15	125°	66°	Yes	Yes	Yes
	16	125°	66°	Yes	Yes	Yes
7.5.8.4	17	–40 °C(1)	–40°(1)	Yes	No	No
	18	–40°	–40°	Yes	No	No
	19	–40°	–40°	Yes	No	No
	20	–40°	–40°	Yes	No	No
	21	–40°	–40°	Yes	No	No
	22	–40°	–40°	Yes	No	No
	23	–40°	–40°	Yes	No	No
7.5.8.5	24	–40°	–40°	Yes	Yes	Yes

1. Temperature may be in transition.

7.6 Flow Restriction—Quick connect couplings shall be designed to provide minimal flow restriction.

7.6.1 TEST PROCEDURE

a. Insert connector into its intended flexible tubing.
b. Connect the flexible tubing to a source for controlled flow of water.
c. Measure the pressure required to create 120 L/h flow through each connector design.

7.6.2 ACCEPTANCE CRITERIA—None. Measure and report value.

7.7 Elevated Temperature Burst—The elevated temperature burst test is performed to assure that the quick connect coupling will withstand the pressure requirements of the fuel system at the maximum operating temperature. This test can be performed as part of the tube and hose assembly requirements of SAE J2045 or as follows.

7.7.1 TEST PROCEDURE

a. Insert a quick connector in each end of a 500 mm (19.69 in) length of tubing or reinforced fuel hose. Secure each end with a hose clamp if required, to prevent failure of the stem to hose interface.
b. Insert male tube ends, shown in Figure 2, into the quick connect couplings.
c. Attach assembly to a suitable, air or hydraulic, burst pressure source.
d. Place the assembly in a suitable environmental chamber and soak at 115 °C (239 °F) for 1 h.
e. Perform burst by pressurizing the hose assembly at a rate of 3450 kPa/min (500 psig/min) until burst or rupture occurs.