

PROCEDURE FOR QUALIFYING QUICK - CONNECTOR FITTINGS FOR VAPOR FUEL LINE GM9676P

1 SCOPE. This procedure defines the minimum requirements for quick connectors in low pressure, vacuum, and vent lines for flexible tubing systems. The specification applies to automotive and light truck gasoline and diesel systems, with operating pressures and vacuums generally of 70 kPa (10 psi) with the lines and connectors routed such that the continuous operating temperature exposure is less than 100°C (212°F). Other documents which describes the performance and dimensional requirements of the assemblies utilizing these quick connectors are specification GM6406M and GM6264M.

1.1 RESTRICTED AND REPORTABLE CHEMICALS (GM1000M). All materials supplied to this specification must comply with the requirements listed in GM1000M, "Restricted and Reportable Chemicals."

2 REFERENCED STANDARDS.

GM1000M
GM6264M

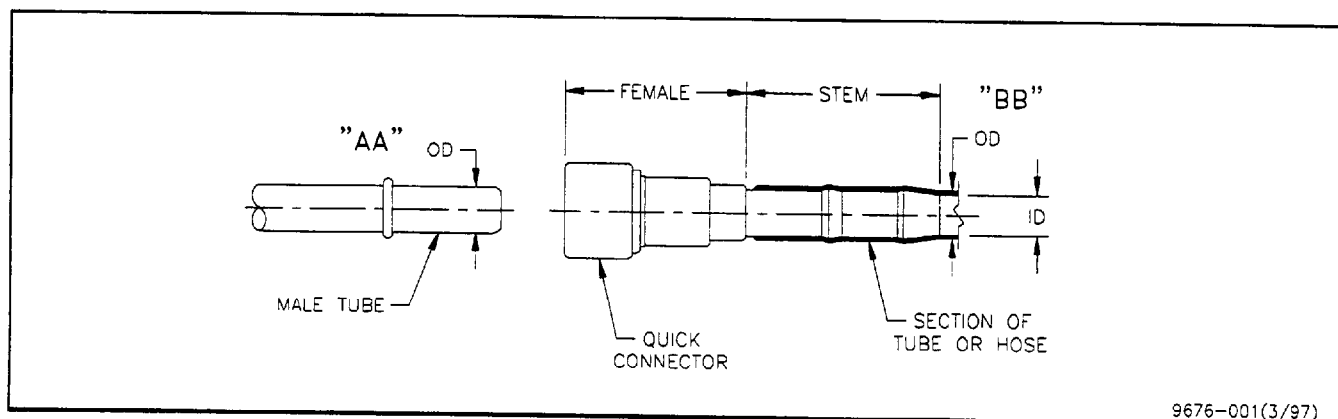
GM6268M
GM6406M

ASTM B117
SAE CM15

3 MATERIAL REQUIREMENTS AND SIZE DESIGNATION.

3.1 Information on the quick connector body material and the O-rings used must be provided by the vapor line assembly supplier to the GM Materials Engineer issuing the approval. The O-ring used in the quick connector must have been used in all quick connectors tested and approved to this specification. GM6268M should be used as a guide for material selection of O-rings. The engineering source approval will be specific for the connector body material and O-ring tested will be listed in MATSPC.

3.2 The quick-connector size designation consists of numbers. The first number, AA, designates the OD of the male tube end and the second number BB, designates the tubing size suited at the stem (See Figure 1).



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FIGURE 1 - SIZE DESIGNATION

4 TESTS.

4.1 Unless otherwise specified test shall be performed @ $23 \pm 2^\circ\text{C}$.

4.2 Quick connectors must be tested for conformance to all the tests detailed in Sections 5 and 6.

4.3 ENGINEERING SOURCE APPROVAL. The vapor line assembly supplier is responsible for the testing of each quick connector part number to the requirements of Sections 5 and 6 for engineering source approval. A minimum of 5 samples from 2 lots must be tested to these requirements. All samples must pass the requirements as tested in each environment.

All samples must pass the requirements as tested in each environment. Engineering source approvals generated through testing to prove compliance to this specification are specific

for size, design, construction, supplier specifications and manufacturing procedures, and all materials incorporated into the quick connector. The engineering source approval is also specific to the type and source of GM6406M tubing used for test to the Life Cycle Test of Section 6.6.

5 FUNCTIONAL REQUIREMENTS. This section defines the minimum functional requirements for low pressure and vacuum quick connectors used in flexible tubing systems.

5.1 LEAK TEST. Low pressure and vacuum quick connectors shall meet leak test requirements of this specification.

5.1.1 Test Procedures. Insert test pin as shown in Figure 2A or 2B to the quick-connector and pressurize with air. The test pin must meet any applicable finish requirements as called-out on the nylon fuel system drawing. The test pin OD dimensions

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which effect sealing must be the minimum values allowed by the tolerances as specified in Figure 2A or 2B. The connector barbed end must be suitably sealed during testing. The quick-connector shall be evaluated for leakage at a pressure of 70 ± 14 kPa and a vacuum of 70 ± 14 kPa.

5.1.2 Acceptance Criteria:

At 70 ± 14 kPa pressure: Leakage shall be less than 2 cc/minute

At 70 ± 14 kPa vacuum: Leakage shall be less than 2 cc/minute

5.1.2.1 Maximum increase in pressure per unit of time measured in (kPa / min) shall be $200/v$. (where v is the internal volume of the hose in cubic centimeters).

5.2 CONNECTOR ASSEMBLY EFFORT. Connector assembly effort is the force required to fully insert the male tube into the quick connector.

5.2.1 Test Procedure.

5.2.1.1 New Parts:

1. Attach the quick connector fitting to a suitable test fixture.
2. Insert test pin as shown in Figure 2A or 2B into the connector at a rate of 51 ± 5 mm/minute and measure assembly effort. The test pin OD dimensions must be the maximum values allowed by the tolerances specified by Figure 2A or 2B.

5.2.1.2 For Connectors After Exposure to Section 6.

1. Dry out time 48 h before insertion test.
2. Lubricate the pin with SAE 30 oil.
3. Insert test pin as shown in Figure 2A or 2B into the connector at a rate of 51 ± 5 mm/minute and measure assembly effort. The test pin OD dimensions must be the maximum values allowed by the tolerances specified by Figure 2A or 2B.

5.2.2 Acceptance Criteria:

1. As-received assembly effort must not exceed 67 N.
2. The assembly effort must not exceed 100 N after exposure to the requirements of 6.1, 6.2, 6.3, 6.4, 6.5, and 6.6.

5.3 CONNECTOR PULL-APART EFFORT. Connector pull-apart is the force required to pull the mating tube end out of the connector, or the tube from the barbed end of the connector.

5.3.1 Test Procedure:

1. Attach the tubing which is attached to the barbed end of the connector to a fixture which is suitable for pulling axially through the center line of the end being tested.

2. Insert the test pin as defined in Figure 2A or 2B into the connector and remove. Repeat for a total of 5 times. The test pin OD dimensions must be the maximum permitted by the tolerances as indicated in Figure 2A or 2B.
3. Insert the test pin as defined in Figure 2A or 2B into the connector and attach the assembly to the fixture. The test pin OD dimensions must be the minimum permitted by the tolerances as indicated in Figure 2A or 2B.
4. Apply a pull-apart load at a speed of 51 ± 2 mm/minute until separation occurs.
5. Perform step 4 @ 23 ± 2 and $60 \pm 2^\circ\text{C}$.

5.3.2 Acceptance Criteria:

1. The force required to separate the connector from the test pin or from the tube at the barbed end, @ $23 \pm 2^\circ\text{C}$, must exceed 134 N.
2. The force required to separate the connector from the test pin or from the tube at the barbed end, @ $23 \pm 2^\circ\text{C}$, after exposure to the requirements of 6.4 and 6.5, must exceed 50 N.
3. The force required to separate the connector from the test pin or from the tube at the barbed end, @ $60 \pm 2^\circ\text{C}$, must exceed 134 N.

5.4 CONNECTOR SIDE-LOAD CAPABILITY. Connector side load capability consists of a side load leak test.

5.4.1 Test Procedure:

1. Insert fitting barbed end of connector into a 200 mm length of design intent tube with the opposite end sealed.
2. Attach the connector to a suitable fixture as shown in Figure 4.
3. Pressurize the assembly with 70 ± 7 kPa air pressure.
4. Side load the connector at a rate of 12.7 ± 5 mm/minute to a force of 44.5 N while measuring leakage.

5.4.2 Acceptance Criteria: Leakage rate shall be less than 2 cc/minute.

6 DESIGN VERIFICATION/VALIDATION TESTING.

6.1 ZINC CHLORIDE RESISTANCE. The zinc chloride resistance is performed to assure the quick connector meets the functional requirements of the system after exposure to zinc chloride.

6.1.1 Test Procedure:

1. Insert assembly test pin as shown in Figure 2A or 2B into the connector. The test pin OD dimensions must be the maximum permitted by the tolerances shown in Figure 2A or 2B.

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2. Cap the barbed end of the connector so that the internal surfaces remain free of water and contamination.
3. Immerse the connector in a 50% aqueous solution (by weight) of Zinc Chloride.
4. Allow the connectors to remain for 200 h in a heated solution @ 23°C.
5. Inspect the connectors after each exposure sequence and record any evidence of cracking.

6.1.2 Acceptance Criteria:

1. No cracks or fractures of any connector surface are permitted.
2. The connector shall be capable of meeting the functional requirements of Section 5 after exposure to zinc chloride.

6.2 CALCIUM CHLORIDE RESISTANCE. The calcium chloride resistance is performed to assure the quick connector meets the functional requirements of the system after exposure to calcium chloride.

6.2.1 Test Procedure:

1. Insert assembly test pin as shown in Figure 2A or 2B into the connector. The test pin OD dimensions must be maximum permitted by the tolerances shown in Figure 2A or 2B.
2. Cap the barbed end of the connector so that the internal surfaces remain free of water and contamination.
3. Immerse the connector in a 50% aqueous solution (by weight) of Calcium Chloride.
4. Allow the connectors to remain for 200 h in a heated solution @ 60°C.
5. Remove the connectors from the solution - do not rinse or clean.
6. Allow the connectors to remain for 200 h in heated air @ 60°C.
7. Inspect the connectors after each exposure sequence and record any evidence of cracking.

6.2.2 Acceptance Criteria:

1. No cracks or fractures of any connectors surface are permitted.
2. The connector shall be capable of meeting the functional requirements of Section 5 after exposure to calcium chloride.

6.3 CORROSION TEST. The corrosion resistance is performed to assure the quick connector meets the functional requirements of the system after exposure to salt spray and is required only if metal components are used in the connector.

6.3.1 Test Procedure:

1. Insert assembly test pin as shown in Figure 2A or 2B into the connector. The test pin OD dimensions must be the maximum permitted by the tolerances shown in Figure 2A or 2B.

2. Cap the barbed end of the connector so that the internal surfaces remain free of water and contamination.
3. Perform salt spray testing per ASTM B117.

6.3.2 Acceptance Criteria:

1. There shall be no red rust on the connector after 192 h exposure.
2. The connector shall be capable of meeting the functional requirements of Section 5 after 500 h of salt exposure. Appearance is not a functional requirement.

6.4 EXTERNAL CHEMICAL RESISTANCE. The external chemical resistance is performed to assure the quick connector meets the functional requirements of the system after exposure.

6.4.1 Test Procedure:

1. Insert assembly test pin as shown in Figure 2A or 2B into the connector. The test pin OD dimensions must be the maximum permitted by the tolerances shown in Figure 2A or 2B.
2. Cap the barbed end of the connector so that the internal surfaces remain free of water and contamination.
3. Immerse the connector in the fluids in 6.4.2. All soaks are at room temperature unless specified.
4. Perform the functional tests after exposure as specified in Section 5.

6.4.2 Fluids.

Fluids	Exposure Time
Automatic Transmission Fluid	30 days
Brake fluid	30 days
Ethylene Glycol	30 days
Motor Oil	30 days
Windshield Washer Solvent	30 days

NOTE: Fluids shall be considered generic and those that are common to the automotive industry. New samples are required for each test.

6.4.3 Acceptance Criteria: The connector must be capable of meeting the functional requirements of Section 5 after completion of external chemical testing.

6.5 FUEL COMPATIBILITY. The fuel compatibility test is performed to assure the quick connector will meet the functional requirements of the system after exposure to the specified fuel.

6.5.1 Test Procedure:

1. Insert test pin as shown in Figure 2A or 2B into the quick connector. The test pin OD dimensions must be the minimum permitted by the tolerances shown in Figure 2A or 2B.

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2. Immerse connectors in each of the fuels as indicated in 6.5.2. Exposure temperature is $23 \pm 2^\circ\text{C}$. Exposure time is 30 days. Fuel used for immersion is to be changed every 7 days. New fuel samples are to be used for each test.
3. Perform the functional test after exposure as specified in Section 5. Half the samples should be tested immediately and half tested after 48 h dryout.

6.5.2 Test Fuels:

1. ASTM Reference Fuel C.
2. SAE CM15 (ASTM Reference Fuel C plus 15% methanol).
3. TF1 (10% ethanol).
4. TF2 (5% methanol, 2.5% ethanol).
5. Sour gas (Inodiene HO-III T-Butyl Hydroperoxide mixture) at a peroxide number of 50.

6.5.3 Acceptance Criteria: The quick connector shall meet the functional requirements of 5 after completion of the fuel compatibility test.

6.6 LIFE CYCLE TEST. The life cycle test is performed to assure the connector will meet the functional requirements of the system after exposed to vacuum/vibration/temperature cycles.

6.6.1 Test Procedure: Mount the samples in an environmental chamber capable of temperature control from -30 to 100°C as indicated in Figures 3A, 3B, or 3C, dependent on configuration of quick-connector, as indicated. Type and source of GM6406M tubing used to manufacture the test assemblies described in Figures 3A, 3B and 3C must be identified. The engineering source approval generated for a quick-connector to GM9676P is specific to the type and source of GM6406M tubing used in this test. Subject the test assemblies to repetitive 24 h test schedules as indicated in Table 1. The test duration is fourteen 24 h test schedules.

TABLE 1 - LIFE CYCLE TEST

Time	Chamber Temperature ($^\circ\text{C}$)	Air Pressure/Vacuum* (kPa)	Vibration Frequency (Hz)	Vibration Amplitude (mm)
Start-up	Ambient	0	0	0
8 A.M.	100	± 69	30 - 60	± 1.5
9 A.M.	100	± 69	30 - 60	± 1.5
10 A.M.	100	± 69	30 - 60	± 1.5
11 A.M.	100	± 69	30 - 60	± 1.5
12 P.M.	100	± 69	30 - 60	± 1.5
1 P.M.	100	± 69	30 - 60	± 1.5
2 P.M.	100	± 69	30 - 60	± 1.5
3 P.M.	100	± 69	0	0
4 P.M.	100	± 69	0	0
5 P.M.	100	± 69	30 - 60	± 1.5
6 P.M.	100	± 69	30 - 60	± 1.5
7 P.M.	100	± 69	30 - 60	± 1.5
8 P.M.	100	± 69	30 - 60	± 1.5
9 P.M.	100	± 69	30 - 60	± 1.5
10 P.M.	100	± 69	30 - 60	± 1.5
11 P.M.	100	± 69	30 - 60	± 1.5
12 A.M. - 7:15 A.M.	-30	0	0	0
7:15 A.M. - 8 A.M.	-30	± 69	10	± 1.5
8 A.M.	In Transition to 100	± 69	30 - 60	± 1.5

*Pulse Once/Minute Minimum