

PROCEDURE FOR QUALIFYING NYLON HOSE COUPLING

GM9080P

1 SCOPE. This specification covers qualification tests for nylon fuel system assemblies with quick connector assemblies intended for use in conducting liquid fuels or fuel vapor. Other documents which describe the performance and dimensional requirements of the assemblies and the assembly components are specifications GM6264M, GM9060P, GM6268M, GM6269M, and CPC Chart #10093203.

1.1 This specification also defines the performance requirements for those assemblies containing direct metal or nylon male tubing to nylon female tubing connections used for conducting liquid fuel or fuel vapor. The specification requirements contained therein are to be used for both the Engineering Source Approval generation through the testing of the standard assembly samples described in 4.1.1, and for the testing and approval of production fuel assemblies.

1.2 For those fuel vapor assemblies which do not contain either quick connectors or direct metal or nylon male tubing to nylon female tubing connections, the only sections of this specification to which these assemblies must be tested are 5.2, 5.8 and 5.9, if applicable.

1.3 **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	GM6269M	9985257
GM6264M	GM4298P	ASTM D380
GM6268M	GM9060P	

3 FUEL SYSTEM ASSEMBLY CONSTRUCTION.

3.1 The nylon line must meet the applicable nylon line specification as called out on the fuel system assembly drawing.

3.2 The quick connector assemblies used in the fuel system assembly must meet the applicable quick connector specification(s) as called out on the fuel system assembly drawing.

4 TESTS.

4.1 FUEL SYSTEM ASSEMBLY REQUIRED TESTS.

Nylon fuel or fuel vapor system assemblies with quick connector assemblies and with male tubing-nylon female tubing connections shall be tested for conformance with the following sections:

Section	Test
5.1	Leak
5.2	Internal Cleanliness
5.3	Burst
5.4	Pressure Cycling, Leak, Burst
5.5	Fitting Pull-Off
5.6	Pressure, Temperature, Vibration Cycling
5.7	Corrosion, Leak Test, Burst
5.8	Sleeve Displacement
5.9	Ovality (formed parts only)

4.1.1 **Engineering Source Approval.** Engineering source approvals generated through testing to prove compliance to this specification are specific for combinations of the following factors: raw material source, raw material compound number, tubing extruder, tubing extruder manufacturing process and site, assembly manufacturing process and site, size of tubing, any specific manufacturing processes to preform the tubing, and type of tubing interconnection.

The type of tubing interconnection is dependent on the specific dimensions of the tubing, and on the component to which the tubing is joined.

The component is defined by the dimensions, material, design, source, and source manufacturing site of the component.

Upon the successful testing of one part number to the requirements of the specification, the Engineering Source Approval for this part number can be extended to other part numbers with identical material, design, and manufacturing content, as defined above.

Actual part number samples may be required by the GM Release Engineer to be tested for Engineering Source Approval to this specification except for test procedures 5.6 and 5.7, which require the testing of standard test samples. These standard test samples shall have an exposed nylon tube of length of 500 ± 10 mm (except as noted in Figures 3 and 5), and the tubing interconnections for the test samples shall be representative connections for the part number(s) for which approval is sought.

Standard samples, or other samples deemed representative of production fuel line assemblies may be tested for Engineering Source Approval to this specification for sections other than 5.6 and 5.7, with GM Engineering Approval, for both formed and nonformed parts. In this case the standard test samples must be identical to those part numbers for which the approval is sought, with the exception of sample length.

Each sample must be tagged with the following information: GM specification number and date.

4.1.1.1 For Engineering Source Approval, data for the testing of 10 samples to each test procedure must be provided, with all samples passing the Acceptance Determination require-

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ments. The 10 samples shall consist of 5 samples from 2 lots of assemblies.

Test samples prepared may be used to qualify two different types of nylon tubing interconnections by the incorporation of each of these two nylon tubing interconnections on opposite ends of one test sample assembly. Test of 10 sample assemblies prepared in such a manner to the Burst Test (5.3) for example, would qualify two types of nylon tubing interconnections to the requirements of this test.

4.1.1.2 Unless otherwise noted, all test temperatures shall be held to $\pm 2^\circ\text{C}$ and all test pressures to $\pm 35\text{ kPa}$.

5 TEST REQUIREMENTS.

5.1 LEAK TEST.

5.1.1 Test Procedure. Attach nylon fuel system assembly to a suitable fixture which has mating fittings identical to those used on the vehicle. This fixture must engage the barbs of the quick connector such that the connector is being held in place by itself, without the aid of added fixturing. The outer diameter of the fitting must be the minimum allowed by the design of the vehicle fuel system. Pressurize the system with air to $1035 \pm 35\text{ kPa}$ and then determine leakage.

5.1.2 Acceptance Determination. Leakage during the test is to be less than 8 cc air/minute (no leakage of fuel). The equipment and procedures used must be capable of detecting leakage of 8 standard cc of air/minute at the specified air pressure. Specific test procedures and equipment for each supplier must have GM Engineering approval.

5.2 INTERNAL CLEANLINESS.

5.2.1 Test Procedure. Visual Inspection. After disassembly, visually inspect the assemblies for evidence of internal foreign substances and contamination of internal surfaces.

5.2.2 Contamination Collection. Bend the nylon fuel system assembly into a U shape and fill with reagent-grade Stoddard Solvent. Agitate the assembly and pour the Stoddard Solvent into a clean beaker and cover. After 15 minutes, visually inspect for free water (small globules). Collect insoluble contaminant by filtering the liquid through a 60 mesh screen (240 μm screen hole size), then through a 30 mL fritted glass, grade fine filtering crucible of known weight. Alternate solvents may be used with GM Engineering approval.

5.2.3 To ascertain the cleanliness of the Stoddard Solvent being used in this test, run a blank containing Stoddard Solvent equivalent to the amount held in the nylon fuel system assembly. The final weighing of the frittered crucible shall show no contaminants (weight increase = $< 0.0004\text{ g}$).

5.2.4 Acceptance Determination. There shall be no internal surface contamination present in the assemblies. In addition, no foreign material shall be collected on the 60 mesh screen and not more material than 0.15 g/m of interior surface shall be collected on the crucible (after drying @ 65°C for 1.5 h). If

the assembly is a nylon and steel tube assembly, the limit for material collected shall be 0.26 g/m.

5.3 BURST.

5.3.1 Test Procedure. The burst test shall be in accordance with ASTM D380.

5.3.2 Acceptance Determination. The minimum burst pressure shall be 3100 kPa.

5.4 PRESSURE CYCLING, LEAK TEST, BURST.

5.4.1 Test Procedure. Attach nylon fuel system assembly to a fixture which has mating fittings identical to those on the vehicle. The outer diameter of the fitting must be the minimum allowed by the vehicle fuel system design. Subject the hose to 15 000 cycles of the pressure profile tabulated below (10 s per cycle). A hydraulic pressure system, utilizing GM Part 9985257 or other GM Engineering approved fluid as the test fluid, is to be used:

Time, s	Pressure, kPa
< 0	0
0 – 2	350
2 – 3	1050
3 – 5	350
5 – 10	0

5.4.2 Acceptance Determination. Any loss of pressure during the test procedure described in 5.4.1 shall constitute failure of the test sample.

5.4.3 Leak Test. Following the test procedure of 5.4.1, the Leak test, described in 5.1, shall be performed on the same test samples. Acceptance determination shall be as described in 5.1.

5.4.4 Burst Test. Following the test procedure of 5.4.3, the Burst test, described in 5.3, shall be performed on the same test samples. Acceptance determination shall be as described in 5.3.2.

5.5 FITTING PULL-OFF.

5.5.1 Test Procedure. The integrity of the quick connector on each end of the nylon fuel system assembly, and the integrity of the metal or nylon male tubing-nylon female tubing connection, shall be tested. A mating fitting identical to that used on the vehicle shall be connected to the quick connector. The free end of the mating fitting shall be mounted in the upper jaws of the tensile tester. The lower jaws of the tensile tester will clamp the nylon fuel line assembly at least 15 cm below the end of the nylon tube as it connects to the quick connector. Apply a tensile load along the tube and connector axis, until the tubing or the tube connector joint ruptures. The load will be applied at a rate of 50.8 mm/minute. The same procedure is to be used for the testing of metal or nylon male tubing-nylon

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female tubing connections, except that the male tubing may be clamped directly in the tensile tester, with the appropriate internal support given to prevent distortion of the male tubing, when clamped.

5.5.2 Acceptance Determination. The connection tested shall withstand a force of 450 N.

5.6 PRESSURE, TEMPERATURE, VIBRATION CYCLING.

5.6.1 Test Procedure. Mount the samples in an environmental chamber capable of temperature control from -30 to 125°C as indicated in Figure 1. For the testing of test samples containing filters, the sample is to be mounted as indicated in Figure 3. For the testing of test samples containing 90° quick-connectors, or other nylon tubing interconnection component using a 90° stem, the sample is to be mounted as indicated in Figure 4. For the testing of test samples containing 45° quick-connectors, or other nylon tubing interconnection using a 45° stem, the sample is to be mounted as indicated in Figure 5. Subject test assemblies to repetitive 24 h test schedules as indicated in Figure 2. For test times indicated between 8 a.m. and 2 p.m., and between 5 p.m. and 11 p.m., the vibration frequency is to vary in a roughly equally distributed manner between 30 and 60 Hz, with an average frequency between 40 and 50 Hz. Oil to be used for the test is Mobil Gargoyle Arctic Oil 155 (Part Number 9985257). A dye sensitive to ultraviolet light must be added to the oil at a maximum concentration of 1%, and the assemblies monitored during the test with a ultraviolet light source to determine if leakage is occurring. Oil temperature in the nylon line and oil pressure are minimum values at the inlet to the environmental test chamber. Test duration to be fourteen 24 h test schedules. Alternate requirements for the frequencies, amplitude, and sample configuration may be specified for the test samples at the discretion of the GM Release Engineer.

5.6.2 Acceptance Determination. Any loss of pressure or leakage during the test procedure described in 5.6.1 shall constitute failure of the test sample.

5.6.3 Leak Test. Following the test procedure of 5.6.1, the Leak test, described in 5.1, shall be performed on the same test samples. Acceptance determination shall be as described in 5.1.2.

5.6.4 Burst Test. Following the test procedure of 5.6.3, the Burst test, described in 5.3, shall be performed on the same test samples. Acceptance determination shall be as described in 5.3.2.

5.7 CORROSION, LEAK TEST, BURST.

5.7.1 Test Procedure. Bend the sample to its minimum bend radius as specified in GM6264M. Subject the test specimen for 336 h to salt spray exposure per GM4298P. Test specimen must be bent to minimum radius and secured in that position for the duration of the test. NOTE: Cap the ends so that the quick connectors will remain functional at the completion of

the corrosion test.

5.7.2 Leak test per 5.1.

5.7.3 Perform the Burst test per 5.3.

5.7.4 Acceptance Determination. The nylon fuel system assembly shall meet all requirements of the Leak tests and Burst test as described in 5.1 and 5.3, respectively.

5.8 SLEEVE DISPLACEMENT. Samples of production hose tested which have protective sleeving placed over the nylon tubing which is held in place by tape must use a tape which will hold the sleeve securely without degradation to either the nylon tubing or the protective sleeving material.

5.9 OVALITY. This test procedure is to be performed on production assemblies having formed nylon tubes only. The preformed samples are to be tested by the cutting of any end fittings or male tube-nylon female tubing connections which interfere in the test. For production parts with protective sleeving, if the production process forms the tubes with the covers in place, the covers must remain on the assembly for the test.

5.9.1 Test Procedure. Select the appropriately sized ball from the table of 5.9.2, insert it into one end of the preformed tube and pass it through the entire length of the tube.

Tubing ID, mm	Test Ball dia, mm
8.05 ± 0.10	6.00
6.35 ± 0.10	4.75
4.02 ± 0.10	3.00

5.9.2 Acceptance Determination. The test ball must pass freely through the entire length of the tube.

6 INSPECTION AND REJECTION. Shipments of material or part under contract or purchase order quoting this specification shall be equivalent in every respect to samples approved by purchaser. No changes or revisions in material, dimensions, construction or processing practices are permitted without prior written agreement from purchaser. The reuse of quick connectors salvaged from assemblies rejected for shipment at the supplier location is prohibited. The use of tubing kinked in any manner during manufacture of the tubing or assembly is prohibited. While samples may be taken from incoming shipments and checked according to this specification, the supplier shall accept the responsibility for shipments without dependence upon the purchaser's inspection.

7 SOURCE APPROVAL. Final approval, granted to suppliers of Nylon Fuel Line Assemblies which have satisfactorily met the requirements of this specification, will be listed in the GM Corporate Material File.

8 ASSEMBLY MARKING. The assembly shall be legibly marked according to the requirements of Chart #10093203, Figure 7 and Figure 8.