

SAE J1403 has a different test procedure in which a straight length of hose is subjected to a vacuum and conditioned at 257 degrees F for 96 hours. After temperature conditioning, the hose is cooled and bent around a test cylinder, then visibly inspected for degradation. The hose is then subjected to a proof pressure test of 175 psi for one minute. Required performance measures include: not more than 10 percent collapse of the outside diameter (OD) for heavy-wall hose and not more than 15 percent collapse of the OD for light-wall hose after the hot aging test; no visible internal or external embrittlement or degradation; and no leakage during the high-pressure test.

While FMVSS No. 106 specifies test cylinder radii for given sizes of hose (Table V), SAE J1403 simply specifies a test cylinder that is five times the OD of the hose. These test cylinder dimensions cannot be compared based on information in the standards because FMVSS No. 106 does not indicate the OD of the hose.

Nevertheless, the high temperature resistance requirements in SAE J1403 appear to be more rigorous than those in FMVSS No. 106 given that standard's post-test dimensional and burst test specifications. Accordingly, NHTSA proposes to incorporate SAE J1403's high temperature resistance requirements/specifications for vacuum brake hose into FMVSS No. 106.

3. Low Temperature Resistance

Paragraph S9.2.3, *Low temperature resistance*, of FMVSS No. 106 specifies conditioning vacuum brake hose, in a straight configuration, at minus 40 degrees F for 70 hours and then, while still cold, bending the hose 180 degrees around a test cylinder with a radius specified in Table V. After performing this test, S9.2.3 specifies visual inspection of the hose. No visible cracks on the hose are permitted. SAE J1403 has similar provisions, except that after the cold bending test is performed, SAE J1403 specifies subjecting the hose to a 175-psi pressure test at room temperature with no leakage permitted. SAE J1403's low temperature resistance requirements are more rigorous due to the addition of this pressure test. Accordingly, NHTSA proposes to incorporate SAE J1403's pressure test procedure into FMVSS No. 106.

4. Ozone Resistance

Paragraph S9.2.4, *Ozone resistance*, of FMVSS No. 106 specifies subjecting vacuum brake hose to an ozone concentration of 50 ppm for 70 hours. After performing the test, the hose, when visually inspected under 7 power

magnification, must reveal no visible cracks. The ozone resistance specifications in SAE J1403 are similar but SAE J1403 specifies an ozone concentration of 100 ppm rather than 50 ppm. The agency tentatively concludes it is appropriate to update the ozone resistance specifications for vacuum brake hose, as it proposes to do for other types of brake hoses. Accordingly, NHTSA proposes to incorporate SAE J1403's 100-ppm ozone concentration specification into FMVSS No. 106.

5. Burst Strength

The burst strength requirements in FMVSS No. 106 and SAE J1403 are nearly identical. Both standards specify a hydrostatic burst test at 350 psi with no hose rupturing allowed under FMVSS No. 106 and no leakage or bursting allowed under SAE J1403. Given the similarities in the two standards, NHTSA does not propose any changes to the vacuum brake hose burst strength requirements/procedures in FMVSS No. 106.

6. Vacuum Deformation

Paragraph S9.2.6, *Vacuum*, of FMVSS No. 106 requires that a vacuum brake hose, when subjected to 26 inches of Hg. for 5 minutes, not collapse more than $\frac{1}{16}$ -inch as measured on the hose's outside diameter. SAE J1403 does not contain a corresponding, stand-alone test specification, although the collapse of hose as a percentage of OD is measured after performing the high temperature vacuum aging test described above. NHTSA does not propose any changes to the vacuum deformation requirements/procedures in FMVSS No. 106.

7. Bend Test

FMVSS No. 106 requires that a specified length of hose be bent until the ends are touching, with a maximum permissible outside diameter (OD) collapse specified in fractional inches. SAE J1403 has a similar requirement, although the maximum permissible collapse is specified as a percentage of the un-bent OD (e.g., 20 percent, 30 percent). It is difficult to compare the two requirements/procedures because the values presented in Standard No. 106 are not expressed in terms of OD measurement and, therefore, a percentage calculation cannot be made. One difference between the two standards is that SAE J1403 excludes preformed hoses molded to fit specific applications in which no significant additional bending occurs when the hose is installed on a vehicle. Based on the information provided in each standard, it does not appear that either

set of requirements/procedures is more stringent than the other. Accordingly, NHTSA does not propose any changes to the bending requirements/procedures in FMVSS No. 106. The agency does propose, however, to incorporate SAE J1403's exclusion of preformed hose and welcomes public comments on this issue.

8. Swell (Fuel Resistance)

FMVSS No. 106 specifies that a brake hose specimen be filled with ASTM Reference Fuel A and conditioned for 48 hours, after which the inside diameter (ID) of the hose is required to be at least 75 percent of nominal ID for heavy-duty hose and 70 percent of nominal ID for light-duty hose. Standard No. 106 specifies use of a plug gauge to measure the hose's inside diameter. Following the swell test, FMVSS No. 106 specifies subjecting the hose to 26 inches of Hg. for ten minutes. The hose must then be examined to determine that no leakage or separation of the inner tube from the fabric reinforcement of the hose has occurred.

SAE J1403's swell test requirements/procedures are similar, but not identical. First, SAE J1403 specifies use of Reference Fuel B rather than Reference Fuel A. Second, SAE J1403 specifies that the hose's inside diameter be measured with a drop ball rather than a plug gauge. Third, SAE J1403 specifies a 10-minute vacuum test, followed by a layer adhesion test with an 8 pounds-per-inch minimum separation specification. In contrast, FMVSS No. 106 specifies that the hose show no leakage or separation of the inner tube from the fabric reinforcement of the hose while the 10-minute vacuum test is being performed.

With respect to the difference in specified fuels, as described in ASTM D471-98e1, *Standard Test Method for Rubber Property—Effect of Liquids*, Reference Fuel A is composed of 100 percent isooctane and Reference Fuel B is composed of 70 percent isooctane and 30 percent toluene by volume. Note 2 in the test method states that:

The ASTM reference fuels in Table 3 have been selected to provide the maximum and minimum swelling effects produced by commercial gasolines. Reference Fuel A has a mild action on rubber vulcanizates and produces results of the same order as low swelling gasolines of the highly paraffinic, straight run type. Reference Fuels B, C [isooctane 50 percent, toluene 50 percent], and D [isooctane 60 percent, toluene 40 percent] simulate the swelling behaviour of the majority of commercial gasolines, with Reference Fuel C producing the highest swelling which is typical of highly aromatic premium grades of automotive gasoline.