

NHTSA proposes that Reference Fuel B as specified in SAE J1403 be used for the swell test in FMVSS No. 106. While this fuel would increase the severity of the test, it would not be so severe as using one of the other reference fuels that contain higher concentrations of toluene, nor as severe as some of the other reference fuels that represent ethanol or methanol blends of gasoline (gasohol).

With respect to the difference in measuring instruments used to determine the hose's inside diameter, NHTSA favors use of a plug gauge because plug gauges are somewhat less susceptible to friction than steel drop-balls. Accordingly, NHTSA proposes that the plug gauge method be kept in place in TP-106 for swell testing of vacuum brake hoses, but welcomes comments on the merits of each constriction test procedure as it applies to vacuum brake hose.

Regarding the differences in adhesion testing between the NHTSA and SAE standards during or after the vacuum test, NHTSA tentatively concludes that each standard has its benefits and drawbacks. While the visual check for hose collapse in FMVSS No. 106 is valid for cases in which the entire hose integrity has been compromised during the fuel soak, it is not clear that this visual check would be able to detect separation of multi-layer hose materials if collapse occurs only on the inside tube or layer. On the other hand, the SAE J1403 layer adhesion test does not include a specification that the hose not visibly collapse during the vacuum test. Visible collapse of the hose during the vacuum test indicates a loss of hose integrity, even if the hose layers remain well bonded.

NHTSA proposes that the specifications of these two standards be combined as follows. Following the fuel

conditioning using Reference Fuel B and the constriction test, each vacuum hose would be subjected to a vacuum of 26 inches of Hg for ten minutes, with no visible collapse or leakage of the hose permitted (as currently specified by FMVSS No. 106). Then, for hoses constructed of two layers or more, a layer adhesion test would be conducted with a specified performance of 8 pounds-per-inch minimum separation force (as specified by SAE J1403). NHTSA proposes that this adhesion test only be applied to multi-layer hoses for two reasons. First, the agency tentatively concludes that single layer hose cannot be tested easily. Second, NHTSA tentatively concludes that single layer hose that have lost mechanical integrity would not be able to pass the visual collapse or no leakage specification during the vacuum test and, as such, failure would already be detected prior to completion of the vacuum test.

In addition to the foregoing changes to FMVSS No. 106's swell test requirements/procedures, NHTSA also proposes to update the ASTM test procedure referenced in S10.7 for the swell test to the current revision, D471-98e1.

9. Adhesion

FMVSS No. 106 requires that vacuum brake hose, other than wire-reinforced hose, have a minimum layer separation strength of 8 pounds per inch. There are no specifications for wire-reinforced hose. There is a similar, 8-pound-per-inch adhesion requirement in SAE J1403, although the SAE standard specifically identifies the layers as "the tube from the plies" and "the cover from the plies." NHTSA tentatively concludes that there are no substantial differences between these two standards. Because NHTSA is proposing

to combine the adhesion test with the swell test, however, the agency proposes to delete the stand-alone adhesion test specifications for vacuum brake hose from FMVSS No. 106.

10. Deformation

Paragraph S9.2.10, *Deformation*, of FMVSS No. 106 specifies testing short lengths of hose by compressing (flattening or collapsing) the hose to a specified dimension and then releasing the compression force. After five cycles, the minimum outside diameter (OD) of the hose must be at least a specified percentage of the original OD. SAE J1403 does not contain a similar set of deformation testing specifications. NHTSA does not propose any changes to the vacuum brake hose deformation requirements/specifications in FMVSS No. 106.

11. End Fitting Corrosion Resistance

Paragraph S9.2.11, *End fitting corrosion resistance*, of FMVSS No. 106 requires that vacuum brake hose end fittings show no surface base metal corrosion after being exposed to salt spray for 24 hours. Standard No. 106 provides an exception for that portion of the end fitting where crimping or the application of labeling information has caused displacement of the end fitting's protective coating. SAE J1403 does not contain any corresponding requirements. NHTSA does not propose any changes to Standard No. 106's end fitting corrosion resistance requirements.

The table below summarizes the differences between the vacuum brake hose requirements/procedures of FMVSS No. 106 and SAE J1403 and indicates which requirements/procedures NHTSA proposes incorporating into the standard.

TABLE 3.—COMPARISON OF VACUUM BRAKE HOSE REQUIREMENTS/PROCEDURES IN FMVSS NO. 106 AND SAE J1403

Requirement/Procedure		Existing FMVSS No. 106		SAE J1403
Vacuum Brake Hoses				
"X" Indicates Requirements/Procedures Proposed To Be Included in FMVSS No. 106				
Constriction Test	x	Specifications for constriction at end fittings		No corresponding specifications
High Temperature Resistance		Hose bent and exposed to elevated temperature, less severe than J1403.	x	High temperature conditioning, bend test, pressure test
Low Temperature Resistance		Similar, but does not include pressure test	x	Similar, but also specifies 175 psi pressure test
Ozone Resistance		Similar, 50 ppm ozone concentration	x	Similar, 100 ppm ozone concentration
Burst Strength	x	Same		Same
Vacuum Deformation	x	Limit 1/16 in. collapse of hose OD under vacuum.		No corresponding, stand-alone specification; high temperature test has specifications
Bend Test	x	Similar test, different measurement		Similar test, different measurement
Swell (Fuel Resistance)	1	Similar test, Reference Fuel A, no collapse or leakage permitted.	1	Similar test, Reference Fuel B, layer adhesion test specified
Adhesion		Similar, but is a stand-alone test	x	Similar, but is conducted after swell test fuel soak