

Materials, rather than the one specified in ASTM G53 because ASTM G154-00 is an updated version of ASTM G53. NHTSA also proposes to reference two additional ASTM standards: ASTM D4329-99, *Standard Practice for Fluorescent UV Exposure of Plastics*, which is currently referenced in SAE J844, and ASTM G151-97, *Standard Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources*, which is not currently referenced in SAE J844, but may provide useful guidance for conducting UV testing.

7. Cold Temperature Flexibility

SAE J844 specifies tubing to be conditioned at 230 degrees F for 24 hours. Within 30 minutes of removal from the oven, the tubing is placed in a cold chamber at minus 40 degrees F and conditioned for 4 hours. A test cylinder with a radius equal to 6 times the nominal OD of the tubing is also conditioned at minus 40 degrees F for 4 hours. The tubing and test cylinder are removed from the cold chamber and the tubing is bent 180 degrees around the test cylinder within a period of 4 to 8 seconds. The tubing must show no signs of fracture.

FMVSS No. 106 also contains a low temperature resistance test procedure. The FMVSS No. 106 procedure differs in that the hose is bent around the test cylinder prior to being conditioned in the cold chamber; the cold conditioning is for 70 hours; and there is no high-temperature preconditioning. The table in paragraph S7 (Table IV) includes dimensions for the test cylinder radius for each nominal size of hose. Table IV references hose size by nominal diameter, and does not differentiate between hose, which is sized by inside diameter, and tubing, which is sized by outside diameter. Applying the test cylinder radii in Table IV to the nominal outside diameter of tubing, and then comparing these values to the test cylinder radii in SAE J844, reveals that the test cylinder radii in SAE J844 are smaller and, therefore, SAE J844 provides a more stringent test condition in terms of bend radius than does FMVSS No. 106.

The test conditions of "cold temperature flexibility" in SAE J844 do not correspond to the "low temperature resistance" test in FMVSS No. 106. SAE J844 is a test to evaluate the crack resistance of tubing, subjected to bending while in a cold state, while the FMVSS No. 106 test condition is an evaluation of pre-bent tubing's resistance to cracking when subjected to cold temperatures. Because SAE J844 is more rigorous, NHTSA proposes

substituting it for the current test in FMVSS No. 106. NHTSA tentatively concludes that the time period of 4 to 8 seconds to accomplish the bending of the tubing is appropriate for this test because the bending is done by hand and is therefore subject to some variability. Specifying the 4 to 8 second time period will preclude the need for specialized bending apparatus that can meet a specific timing specification.

8. Heat Aging

SAE J844 includes three different heat aging tests, which specify use of three separate samples of the same tubing. A tubing sample is subjected to one of the aging tests described below, then subjected to the burst test at room temperature, with a minimum burst strength of 80 percent of a specified value.

The first test is to bend a section of tubing 180 degrees around a test cylinder with a diameter equal to two times the tubing's minimum bend radius, as specified in the standard. The tubing and test cylinder are conditioned for 72 hours at 230 degrees F and then removed to cool at 75 degrees F. Within 30 minutes after stabilizing at 75 degrees F, the tubing is straightened within a time period of four seconds. The tubing is then bent 180 degrees in the opposite direction within a time period of 4 to 8 seconds.

The second test is to condition the tubing at 230 degrees F for 72 hours, then remove and cool the tubing to 75 degrees F. Within 30 minutes after stabilizing at 75 degrees F, the tubing is subjected to an impact test as specified in the standard.

The third test involves conditioning the tubing by immersing it in boiling water for 2 hours, then removing and cooling it to 75 degrees F. Within 30 minutes after stabilizing at 75 degrees F, the tubing is subjected to an impact test as specified in the standard.

FMVSS No. 106 does not have corresponding test procedures. The high temperature resistance test (S8.1) evaluates a hose for resistance to visible cracking after being conditioned at 212 degrees F for 70 hours and then straightened. There is no burst (pressure) strength requirement. NHTSA proposes incorporating the SAE J844 test procedures for plastic air brake tubing into FMVSS No. 106.

9. Zinc Chloride Resistance

SAE J844 specifies that tubing be bent around a test cylinder and immersed in a 50 percent by weight (specific gravity of 1.576 or a Baume rating of 53 degrees at 60 degrees F) aqueous solution of zinc chloride for 200 hours at 75 degrees F.

After removal from the solution, the tubing must show no evidence of cracking on the outside diameter. FMVSS No. 106 specifies that a hose assembly be immersed in a 50 percent zinc chloride aqueous solution for 200 hours, with no visible cracks permitted when viewed with 7-power magnification. SAE J844's zinc chloride test procedures are more rigorous due to the bending of the tubing during the conditioning. Accordingly, NHTSA proposes to incorporate the zinc chloride resistance performance requirements and test procedures from SAE J844 into FMVSS No. 106.

10. Resistance to Methyl Alcohol Resistance

SAE J844 specifies that the tubing be bent around a test cylinder and then immersed in 95 percent methyl alcohol for 200 hours at 75 degrees F. After removal from the solution, the tubing must show no evidence of cracking. This test ensures that air brake tubing is not susceptible to damage from alcohol that is sometimes introduced into air brake systems during extreme cold weather conditions, or from windshield washer fluid containing alcohol that may spill onto brake tubing. There is no corresponding test procedure/performance requirement in FMVSS No. 106, and NHTSA proposes to incorporate the one specified in SAE J844. NHTSA also welcomes comments on the suitability of adopting this test procedure/performance requirement for rubber air brake hoses, since they are also susceptible to alcohol exposure for the same reasons.

11. Stiffness

SAE J844 specifies that an 11-inch long sample of tubing be slipped over a rod to maintain the hose in a straight position within plus or minus 1/8 inch. The tubing and rod are conditioned at 230 degrees F for 24 hours, then removed and cooled to 75 degrees F. Within 30 minutes after stabilizing at 75 degrees F, the rod is removed and tubing is subjected to a stiffness test as outlined in the standard. The tubing must require no more than the specified amount of force to deflect 2 inches. This test ensures that the flexibility of the tubing is not reduced when the tubing is subjected to elevated temperatures. An increase in stiffness after exposure to elevated temperatures indicates that the tubing is susceptible to kinking or embrittlement under this condition. Because Standard No. 106 does not contain a similar set of procedures/requirements, NHTSA proposes to incorporate the stiffness procedures/