

raised by commenters on the January 1993 NPRM. These included whether to measure test gas temperature during the 60-minute period following barrier impact, whether to specify an ambient test temperature, the accuracy of available pressure drop measurement technology, and the time period over which pressure drop is measured. These, along with commenters' concerns, presented complex, and, in some cases, competing issues to resolve. There were a variety of possible solutions, some more feasible than others, to the problem of measuring CNG fuel system leakage.

Contrary to the assertion made by Ford in its petition, the agency considered the information provided by AAMA about the effect of temperature on pressure. That information is specifically referenced in the preamble to the final rule (59 FR 19652). In addition, the agency noted in the preamble that several commenters, including AAMA, stated that temperature variations should be compensated for when conducting the crash test. However, neither AAMA nor other commenters suggested any method to correct for this. After reviewing the components, NHTSA decided not to specify an ambient test temperature, but to limit the amount of ambient temperature variation during the 60-minute test period to 5.6 °C (10 °F). A temperature variation exceeding this amount will invalidate the test results. The agency noted that, "Without such control, a large change in temperature could artificially affect the test results." NHTSA continues to believe that this test condition will sufficiently minimize changes in test gas temperature, as well as pressure drop measurement accuracy.

NHTSA appreciates the concerns expressed by Ford and Chrysler in their petitions. However, as noted above, under real world test conditions, any variation in test gas temperature will not significantly affect test results. The agency believes there are three leakage scenarios that could potentially occur during the 60-minute test period following barrier impact: No leak, a large leak, and a small or marginal leak condition. In the case of no leak, Ford and Chrysler stated in their petitions that a 5.6 °C (10 °F) drop in ambient temperature could result in a 60 psi pressure drop even though there is no leakage. However, since the allowable pressure drop established in the final rule is at least 1062 kPa (154 psi), a 60 psi pressure drop will not affect compliance test results since it is well below the amount allowed in the final rule. Similarly, in the case of a large

leak, any change in test gas temperature should not influence compliance test results, since all or most of the gas will leak out during the 60-minute test period, thereby making a non-compliance obvious. Based on supplemental information which the agency obtained by telephone from Ford and Blue Bird Body Company on the NPRM, the agency believes these two conditions, no leak or a large leak, will account for most of the leakage scenarios after real world CNG vehicle crash tests. However, in the event there is a slow leak, NHTSA believes that here, too, test gas temperature will remain relatively constant during testing, due to thermal contact between the test gas and fuel container walls. Any change in test gas temperature will tend to be offset by the temperature or thermal energy of the surrounding container walls, which along with the test gas have been stabilized to ambient temperature prior to testing.

NHTSA rejects Ford's recommendation that the final rule exclude pressure changes due to test gas temperature changes, because it would require that test gas temperature be measured. NHTSA believes that this would unnecessarily result in a more costly and complex test procedure. Further, it could make the fuel system more vulnerable to leakage in a crash, since an additional fuel system measurement fitting may be required. In its petition for reconsideration, Chrysler referred to this as "\* \* \* the added difficulty of measuring gas temperature within the high pressure fuel system, which is difficult, impracticable, and risks compromising the fuel system integrity." In addition, supplemental information which the agency obtained by telephone from Ford indicates that measuring gas temperature in a CNG fuel system is not always accurate.

NHTSA also rejects Chrysler's recommendation that an additional 60 psi be added to the allowable pressure drop in the final rule. In the case of an allowable pressure drop of 1062 kPa (154 psi), adopting Chrysler's request would have raised this level by approximately 40 percent. The agency believes that that addition could make the allowable pressure drop levels unsafe, since it would allow more fuel leakage. This would be clearly inconsistent with the agency's goal of establishing a minimum leakage requirement that is as close to a no leakage requirement as possible while still being readily measurable.

For the above reasons, NHTSA denies the requests of Ford and Chrysler regarding pressure drop.

### Fill Condition

As part of the test conditions prior to CNG vehicle crash testing, S7.1.1 of Standard No. 304 specifies that, "Each fuel storage container is filled to 100 percent of service pressure with nitrogen, N<sub>2</sub>." S4 states that, "Service pressure means the internal pressure of a CNG fuel container when filled to design capacity with CNG at 20° Celsius (68° Fahrenheit)."

In its petition, AAMA stated that since the final rule places no absolute limits on the ambient temperatures at which testing may be performed, but merely requires that ambient temperature not change more than 10 °F during the course of the test, fuel storage containers will not always be filled at and stabilized to a temperature of 20° Celsius (68° Fahrenheit). According to the petitioner, the fill pressure to be used for ambient temperatures other than 20° Celsius (68° Fahrenheit) is unclear and therefore not reasonable, practicable, or stated in objective terms. AAMA further stated that an appropriate corrective action would be to amend S7.1.1 of the Standard to state that, "Each fuel storage container is filled with nitrogen, N<sub>2</sub>, to 100 percent of service pressure *adjusted for ambient temperature.*" AAMA's suggested language is italicized.

After reviewing AAMA's petition for reconsideration about fill pressure, NHTSA has determined that that organization's requested modification to S7.1.1 would be inappropriate.

The agency's purpose in specifying that CNG containers be filled to 100 percent of service pressure in S7.1.1 is to provide a reference point for the fill condition from which crash tests are performed, e.g., 20,684 kPa (3000 psi) at 20 °C (68 °F). NHTSA recognizes that since the final rule does not specify an ambient temperature at which crash testing is performed, fuel containers will not always be filled and stabilized to 20 °C (68 °F). This will result in CNG container pressures which are different than if testing were performed at 20 °C (68 °F), because of the relationship between gas temperature and pressure. Thus, manufacturers may fill and stabilize the CNG containers prior to testing to a pressure that is adjusted for ambient temperature. The final rule does not prohibit this. However, that pressure, which is adjusted for ambient temperature, must be such that if ambient temperature were 20 °C (68 °F), pressure in the CNG containers would be equal to service pressure. Since the final rule does not prohibit this adjustment for ambient temperature prior to testing, NHTSA sees no need to