

**FOR FURTHER INFORMATION CONTACT:**

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**SUPPLEMENTARY INFORMATION:** On April 25, 1994, NHTSA published a new Federal motor vehicle safety standard (FMVSS) for the fuel system integrity of compressed natural gas (CNG) vehicles (59 FR 19648). The new standard, FMVSS No. 303, *Fuel System Integrity of Compressed Natural Gas Vehicles*, limits the amount of allowable CNG leakage after a crash test. This is done by placing a limit on the post-crash pressure drop of the fuel system. Vehicles with a gross vehicle weight rating (GVWR) of 10,000 pounds or less are subject to front, rear, and side impact crash tests. Schoolbuses with a GVWR greater than 10,000 pounds are subject to moving contoured barrier crash at any point and angle on the vehicle. The purpose of the new standard, which becomes effective September 1, 1995, is to reduce deaths and injuries caused by fires resulting from fuel leakage during and after crashes involving CNG vehicles.

Ford Motor Company (Ford), Chrysler Corporation (Chrysler), and the American Automobile Manufacturers Association (AAMA) submitted petitions for reconsideration of the final rule. The issues raised in the petitions include the post-crash pressure drop limit of the fuel system, and procedures and test conditions prior to crash testing. A discussion of each issue and the agency's response follows.

**Pressure Drop Limit**

The final rule, as specified in S5.2(a), sets the allowable pressure drop in the CNG fuel system one hour after any crash test as follows:

- (1) 1062 kPa (154 psi), or
- (2)  $895 (T/V_{FS})$ , whichever is higher.

T is the average temperature of the test gas in degrees Kelvin, stabilized to ambient temperature before testing. Average temperature T is determined by measuring ambient temperature at the start of the test, and then every 15 minutes until the test time of 60 minutes is completed. The sum of the five ambient temperatures is then divided by five to yield average temperature T. S7.1.7 of the final rule specifies that ambient temperature is not to vary more than 5.6 °C (10 °F) during the course of the test.  $V_{FS}$  is the internal volume of the high pressure portion of the vehicle fuel system.

The other allowable pressure drop, 1062 kPa (154 psi), represents the smallest pressure drop measurable using existing pressure drop measurement technology is test gas temperature varies no more than 5.6 °C (10 °F). The agency established this level based on comments from AAMA and others in response to the agency's January 21, 1993 notice of proposed rulemaking (NPRM) (58 FR 5323). In its comments on that notice, AAMA stated that using a state-of-the-art capacitance type pressure transducer could still result in pressure drop measurement error of  $\pm 106.1$  kPa ( $\pm 15.4$  psi) if test gas temperature varied no more than  $\pm 5.6$  °C ( $\pm 10$  °F). This is due to the cumulative errors attributable to pressure transducer accuracy, thermal zero shift, thermal coefficient sensitivity, and analogue-digital conversion. These factors, coupled with the accepted engineering practice that measurement error should not exceed ten percent of the value being measured, led to the conclusion that pressure drops less than 1062 kPa (154 psi) should not be measured.

The above pressure drop established in the final rule represents the maximum allowable CNG leakage, 895 (T/V<sub>FS</sub>), within the limits of current pressure drop measurement technology, 1062 kPa (154 psi).

Both Ford and Chrysler petitioned the agency for reconsideration of the above pressure drop limits in S5.2(a). Ford stated that it believes the agency erred by disregarding certain information provided by AAMA in its response to the January 1993 NPRM (58 FR 5323). Specifically, AAMA stated that " \* \* \* a 10 °F change in the temperature of the test gas would result in a 60 psi change in the pressure of the test gas." Noting that the final rule allows the ambient temperature to vary as much as 5.6 °C (10 °F) during the test, Ford stated that a 10 °F drop in temperature could result in a 60 psi pressure drop even with zero leakage. Thus, according to Ford, the pressure drop limits in the final rule are, in effect, reduced by 60 psi when the ambient temperature drops 10 °F and increased by 60 psi when the ambient temperature increases 10 °F during the test. Ford asserted that the pressure drop limits are, therefore, not reasonable, practicable, or stated in objective terms as required by statute, because they present arbitrary limits that vary depending on whether ambient temperature decreases or increases. Ford further stated that an appropriate corrective action would be to amend S5.2(a) so that it states, "For all vehicles, the pressure drop in the high pressure portion of the fuel system,

*excluding pressure changes due to changes in the temperature of the test gas, expressed in \* \* \*."* Ford's recommended language is underlined. Thus, Ford's alternative would eliminate that component of any pressure drop which is due to test gas temperature change.

Chrysler, in its petition, provided an almost identical rationale to that of Ford, stating that the pressure drop limits specified in the final rule do not accurately measure fuel leakage when the internal temperature of the gas causes change to the pressure within the fuel system. However, Chrysler's suggested corrective action differs from that of Ford. Chrysler requested that the agency amend the pressure drop limits in the final rule to incorporate the 60 psi adjustment needed to compensate for the possible change in gas temperature. Under Chrysler's request, the amended pressure drop limits in S5.2(a) would be:

- (1) 1476 kPa (214 psi), or
- (2)  $895 (T/V_{FS}) + 414$  kPa (60 psi), whichever is higher.

Chrysler stated that "[t]his would provide the needed compensation without the added difficulty of measuring gas temperature within the high pressure fuel system, which is difficult, impracticable, and risks compromising the fuel system integrity."

After reviewing Ford's and Chrysler's petitions for reconsideration about permissible pressure drop, NHTSA has determined that the requested modifications to S5.2(a) would be inappropriate. NHTSA continues to believe that the pressure drop limits and test procedure established in the final rule are the most appropriate and feasible, and that they provide a relatively simple and accurate method to determine CNG fuel leakage. The agency believes that under real world test conditions, any variation in test gas temperature will not significantly affect test results.

NHTSA notes that because CNG is a gas, and not a liquid, measuring a safe level of allowable leakage after a crash test is much more complex than measuring similar levels for liquid fuels. This is because of the relationship between the temperature and pressure of a gas. The two are directly proportional. A change in either, pressure or temperature, directly affects the other.

In arriving at the allowable pressure drop limit and test procedure established in the final rule, NHTSA addressed the issue of temperature and pressure, along with other related issues