

than warranted by safety considerations. They further stated that the higher safety factors will unduly increase the cost of carbon fiber containers and make them noncompetitive with other technologies. Some petitioners stated that NHTSA's safety factors are not harmonized with the Canadian Standards Association (CSA) standard (Canadian B51 Part II) or with the 1993 draft International Standards Organization (ISO) standard (ISO/TC 58/SC 3/WG 17), both of which specify a 2.25 safety factor for carbon fiber containers. On the other hand, only one commenter supported the 3.33 safety factor.

While the carbon fiber safety factors were the most controversial issue raised by petitioners, some petitioners requested changes to other aspects of the final rule. For example, some petitioners expressed concern that FMVSS No. 304 prohibits certain materials, such as new or different aluminum and steel alloys or other new materials. Some petitioners wanted FMVSS No. 304 to include additional safety requirements found in ANSI/NGV2. A number of petitioners requested the agency to delay or withdraw FMVSS No. 304 until the current revision of ANSI/NGV2 is completed. Petitioners also raised questions about the need for certain technical amendments to FMVSS No. 304.

NHTSA has responded to the petitions for reconsideration by issuing two different notices. The two-step approach to responding to the petitions was necessary to provide immediate regulatory relief by allowing the manufacture of carbon fiber containers, subject to a single safety factor of 2.25. This approach also provided NHTSA an opportunity to review and analyze all the information presented in the petitions for reconsideration.

III. December 1994 Final Rule Responding to Petitions for Reconsideration

In an initial notice responding to petitions for reconsideration published on December 28, 1994, the agency established a burst test safety factor of 2.25 for carbon fiber containers, and indicated that it would issue a final determination about the appropriate burst test safety factor pending completion of the reconsideration process. (59 FR 66773) That notice also responded to several other technical issues whose resolution did not necessitate extensive review or consideration. In today's notice, the agency sets forth a final determination about the safety factor for carbon fiber

containers and responds to the balance of the issues in the petitions for reconsideration.

IV. Further Response to Petitions for Reconsideration

A. Carbon Fiber Safety Factors

In the September 1994 final rule, NHTSA departed from ANSI/NGV2 and established higher safety factors for carbon fiber containers. The agency made this determination because at that time the agency was not aware that these containers were being used extensively in motor vehicle applications. The agency stated that adopting more stringent safety factors is consistent with the longstanding approach taken by the Research and Special Programs Administration (RSPA)² to initially adopt conservative requirements in response to the uncertain level of risk posed by new technologies and subsequently modify the requirements if further real-world safety data become available supporting less stringent regulations. The agency indicated that it would consider reducing the safety factors for carbon fiber containers if data supporting a reduction "are developed and become available on the use of carbon fiber containers in motor vehicle applications."

In response to the final rule, CNG container manufacturers and other petitioners have submitted new test data and information indicating that carbon fiber containers at the lower 2.25 safety factor can provide a level of performance equal to that of other materials built to higher safety factors. This information also indicated that implementing higher safety factors for carbon fiber would make carbon fiber containers noncompetitive because of the higher costs associated with adding additional material to meet the higher safety factors. The data include information on tests and analyses of carbon fiber containers, the number of containers in use in motor vehicle applications, and cost and weight information.

Several petitioners, particularly Brunswick Technical Group and EDO Corp., submitted test data which indicate that carbon fiber containers that comply with ANSI/NGV2 are safe. Brunswick stated that it has qualified 26 different configurations of its carbon fiber containers under ANSI/NGV2 requirements and has destructively tested 500 carbon/fiberglass CNG

containers.³ That manufacturer further stated that there is no information indicating that carbon fiber containers that comply with ANSI/NGV2 requirements have failed in the field or that test data would indicate the likelihood of such failure. To illustrate its claim, Brunswick provided the results of tests recently performed by British Gas on its containers.

EDO also provided extensive testing information and analyses about its carbon fiber containers built to the 2.25 safety factor. EDO submitted an analysis showing how its container meets the requirements of a draft industry-wide guideline for the performance of CNG containers used in a motor vehicle environment. The guideline, which was developed by General Motors (GM) following failures of CNG containers on two GM pickup trucks in 1994, includes requirements for performance relative to contaminants, corrosives, crashworthiness, leak integrity, fire resistance, reliability, dependability, and accelerated aging. The results of the analysis indicate that EDO's carbon fiber containers built to the 2.25 safety factor comply with these requirements.

EDO also provided a detailed analysis, known as a Failure Modes and Effects Analysis (FMEA),⁴ which it performed to determine the safety risks of its carbon fiber containers built to ANSI/NGV2 requirements. This analysis led EDO to conclude that no significant safety risk could be identified for the carbon fiber containers. Specifically, EDO cited the significantly long fatigue life and high resistance to stress rupture of carbon fiber, which are evaluated by the burst test. EDO also cited additional test data that it believes indicate that no further requirements are needed with respect to container strength.

Several petitioners supplied information favorably comparing the performance (under both real world and laboratory test conditions) of carbon fiber containers subject to the 2.25 safety factor with fiberglass containers. Based on an evaluation that Powertech conducted for Transport Canada, Powertech concluded that carbon fiber resists stress rupture, and

³ Brunswick's design uses carbon as the major load carrying fiber with a small layer of fiberglass outside.

⁴ A FMEA sets out in writing each failure mode that is possible with a product along with the potential cause for the failure and the design control in place to counter the failure. RSPA sometimes requires a FMEA to be submitted when it evaluates a manufacturer's particular container design. NHTSA believes that FMEA is a valid technique for assessing the adequacy of a particular design, provided that other supporting information is presented.

² RSPA is an administration within the United States Department of Transportation whose functions include regulating the transportation of hazardous materials.