Quantum Fuel Systems LLC June 19th, 2024

To Whom It May Concern,

The fuel storage engineering team at Quantum Fuel Systems LLC has reviewed the proposed FMVSS No. 307 and 308 standards created by the Department of Transportation. There are two main issues that we would like to address regarding these proposed standards.

The first issue is the omission of a deviation table. The FMVSS No. 307 and 308 standards refer to GTR 13 throughout multiple sections when describing various tank validation tests. GTR 13 is identical to another international standard called ECE 134. The only difference between GTR 13 and ECE 134 is that ECE 134 also includes a deviation table. A deviation table has been an effective tool in other standards such as HGV2, NGV2, ISO 11515, and EC 79. This allows for reduced tank validation testing when designing new tank variations. These tank variations are like the parent design but with minor design changes such as diameter, length, resin system used, etc. Real world applications involving tank design are not limited to only OEMs. Sometimes, tanks are sold as standalone items or included in smaller orders. A deviation table becomes vital in this situation. If a deviation table does not exist in the FMVSS No. 307 and 308 standards, then tank manufacturers will have to fully validate all parent and variant tank designs. Please see the deviation table below from ECE 134. Since the GTR 13 and ECE 134 standards are identical except for the deviation table found in ECE 134, we would like this to be added to the FMVSS No. 307 and 308 standards as well.

Annex 7, Table 1 and Notes, amend to read:

"Table 1
Change of Design

Changed Item		*Required Tests*
Metallic container or liner material		- Initial burst, Initial pressure cycle life - Sequential hydraulic tests - Fire test
Plastic liner material		- Initial pressure cycle life - Sequential hydraulic tests - Sequential pneumatic tests - Fire test
Fiber material [1]		- Initial burst, Initial pressure cycle life - Sequential hydraulic tests - Fire test
Resin material		- Initial burst, Initial pressure cycle life - Sequential hydraulic tests - Fire test
Diameter [2]	≤20%	- Initial burst, Initial pressure cycle life
	>20%	- Initial burst, Initial pressure cycle life - Sequential hydraulic tests - Fire test

Changed Item			*Required Tests*
Length		≤50%	- Initial burst, Initial pressure cycle life - Fire test [3]
		>50%	- Initial burst, Initial pressure cycle life - Sequential hydraulic tests - Fire test [3]
Coating			- Sequential hydraulic tests - Fire test [4]
Boss [5]	Material, geometry, opening size		- Initial burst, Initial pressure cycle life
	Sealing (liner and/or valve interface)		- Sequential pneumatic tests
Fire protection system			- Fire test
Valve change [6]			- Sequential pneumatic tests - Fire test [7]
Container attachment	Material, geometry		- Sequential hydraulic tests - Fire test [7]

Notes:

1. Change of fiber type, e.g., glass to carbon is not applicable. Change of design applies only to changes of materials properties or manufacturer within a fiber type.
2. Only when thickness change is proportional to diameter change.
3. Fire test is not required, provided safety relief devices or device configuration passed the required fire test on a container with equal or greater internal water volume.
4. Fire test required if coating affects fire performance.
5. Tests are not required if the stresses in the neck are equal to the original stresses or reduced by the design change (e.g., reducing the diameter of internal threads, or changing the boss length), the liner to boss interface is not affected, and the original materials are used for boss, liner, and seals.
6. Alternative valve shall be approved in accordance with part II.
7. Fire test not required if TPRD design has not been changed, and the mass of the changed valve is +/- 30 per cent of the original valve.

The second issue involves the extreme temperature pressure cycling test found on page 27517 of the FMVSS draft. Like GTR 13, the FMVSS draft indicates that a total of 11,000 cycles are required for heavy-duty vehicles to pass before leakage. The extreme temperature pressure cycle test requires 20 percent of the total number of cycles, which equates to 2,200 hot and 2,200 cold cycles. However, GTR 13 indicates 20% of the specified number of cycles determined in paragraph 5.1.1.2. This can be found on table 6, page 110 of the GTR 13 standard. In paragraph 5.1.1.2, it states that a total number of 22,000 cycles shall be completed without rupture. 20 percent of 22,000 cycles equates to 4,400 hot and 4,400 cold cycles. Quantum's interpretation of the GTR standard was that a total of 4,400 hot and 4,400 cold cycles were necessary to pass the GTR requirement. However, the test laboratory that we quoted interpreted that a total of 2,200 hot and 2,200 cold cycles were necessary to pass the GTR requirement. Quantum is asking for clarity on the parameters of this test to see if the total number of cycles required is 22,000 or 11,000 to establish the number of cycles required for the extreme temperature pressure cycling test.

We are proposing that table 6 (shown below) from GTR 13 be added to the FMVSS standard on page 27518. However, we would like to change the wording in the number of cycles section from "20 per cent the specified number of cycles determined in paragraph 5.1.1.2." to "20 percent of either 7,500 cycles for light-duty vehicles or 11,000 cycles for heavy-duty vehicles." This will ensure that there is no confusion regarding the parameters of the extreme temperature pressure cycling test.

5.1.1.2. **Baseline initial pressure cycle life**

Three (3) new containers randomly selected from the design qualification batch are hydraulically pressure cycled without rupture for 22,000 cycles or until a leak occurs in accordance with paragraph 6.2.2.2. The container attachments, if any, shall also be included in this test, unless the manufacturer can demonstrate that the container attachments do not affect the test results and are not affected by the test procedure. Leakage shall not occur within 7,500 or 11,000 cycles for light-duty vehicles, at the Contracting Parties' discretion and 11,000 cycles for heavy-duty vehicles.

Table 6
Pressure Cycles and Conditions - Extreme Temperature Pressure Cycling Test

Purpose	*Number of cycles*	*Target Pressure*	*Temperature*	*Rate*
Extreme cold test	20 percent of either 7,500 cycles for light-duty vehicles or 11,000 cycles for heavy-duty vehicles. ~~20 per cent the specified number of cycles determined in paragraph 5.1.1.2.~~	≥ 80 per cent NWP	Environment: ≤ -40 °C at the start of each test Hydraulic fluid and surface: ≤ -40 °C for duration of the cycling	≤ 10 cycles per minute
Extreme hot test	20 percent of either 7,500 cycles for light-duty vehicles or 11,000 cycles for heavy-duty vehicles. ~~20 per cent the specified number of cycles determined in paragraph 5.1.1.2.~~	≥ 125 per cent NWP	Environment: ≥ 85 °C and ≥ 80 per cent relative humidity Hydraulic fluid & surface: ≥ 85 °C for duration of the cycling	≤ 10 cycles per minute