Remote TPRD Supply Lines Proposal for GTR13 Amendment and PfR for FMVSS 308

OICA

21 January 2025

Summary

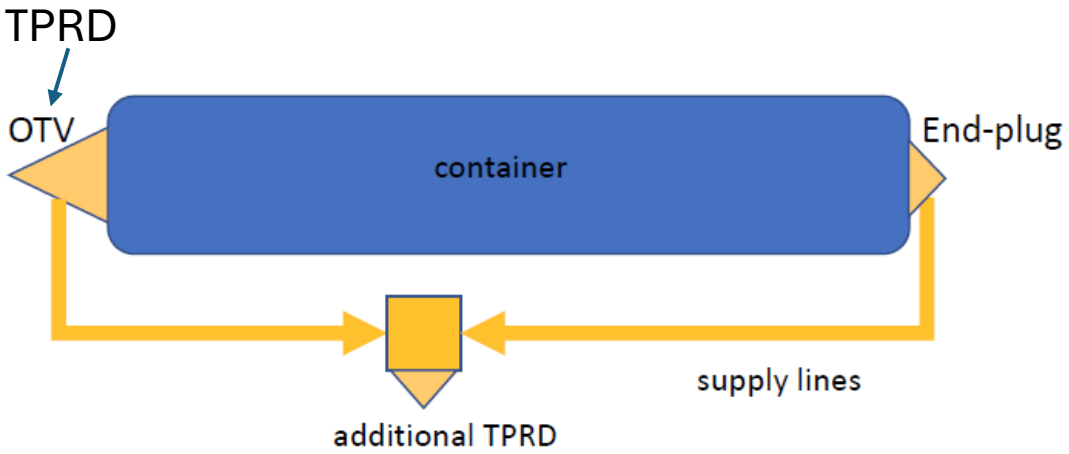
- GTR13 Amd 1 (2023) allows CP to determine installation location of primary closures
  - US, EC, Japan held differing opinions on remote TPRD
- UN R134 Taskforce held deep discussions about remote TPRD and their supply lines resulting in new language
  - UN R134 Series 03 – Exclude supply lines in drop test
  - GTR13 Amd1 – To harmonize Part 1 and Part 2
- NHTSA FMVSS 308 reflects GTR13 Amd1 language
- Industry/OICA requesting:
  - Proposal for Reconsideration for harmonizing with GTR13
  - Supporting NL proposal for amendment to GTR13 at next GRSP

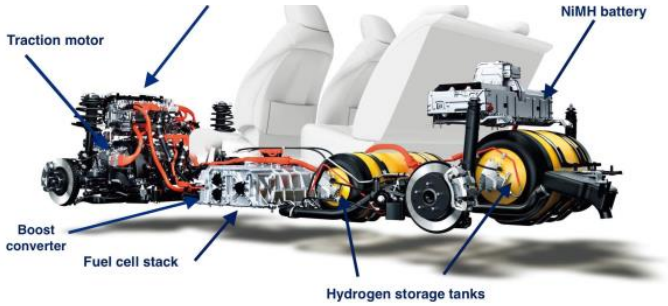
Background: Timeline of Remote TPRD Discussions for H2 Vehicles

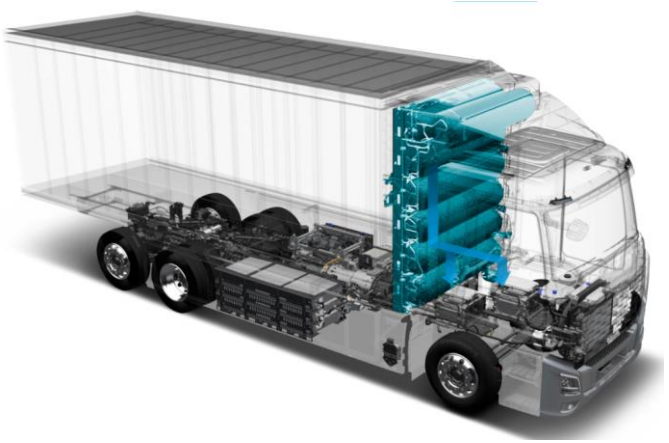
IWG 2022	GTR13 Amd 1 July 2023	R134 Transposition TF 2022-July 2024	R134 TF Mtg – Aug 2024	R134 TF Sep-Dec	GRSP-76 (Dec 2024)
CP's agree in Cosponsors Mtg of 13th IWG (Mar '22): (1) CP option for direct mounting of closures; (2) Remote TPRD in Part 1	CP option for primary closure installation, Para 51 added for remote TPRD option	Remote TPRD discussion continued to include specific wording on location and requirements	Agreement to: (1) Exclude supply lines from drop test; (2) Add Annex 9 for clarification of test article; (3) Add COD; (4) Add COP language	Prepared Series 02 draft with minor clarifications; Prepared 03 draft for supply line language Prepared proposal for change to GTR13 Amd1	Series 02 approved; Proposal for GTR13 Amd1 and Series 03 not presented after discussions with NHTSA/TC

TPRD comparisons

On-Tank Valve (OTV)







Supply Line Comparison: Container Definition

GTR13 Amd 1	§571.308 Standard No. 308; Compressed hydrogen storage system integrity.	Supplement 1 to the R134 Series 02
3.6. "Container" (for hydrogen storage) is the pressure-bearing component on the vehicle that stores the primary volume of hydrogen fuel in a single chamber or in multiple permanently interconnected chambers. ✓	Container means a pressure-bearing component of a compressed hydrogen storage system that stores a continuous volume of hydrogen fuel in a single chamber or in multiple permanently interconnected chambers. ✓	2.4. "Container" (for hydrogen storage) means the pressure-bearing component on the vehicle that stores the primary volume of hydrogen fuel in a single chamber or in multiple permanently interconnected chambers. ✓ Note: The high-pressure fuel lines interconnecting the multiple chambers and /or connecting to the primary closing device(s) are considered as part of the container as long as those parts hold the same pressure level as the chamber(s), and the permanent interconnections between the chambers are ensured. Such fuel lines are tested as integral elements of the container. Permanent interconnections are any physical solutions to pneumatically connect chambers, e.g. welded or screwed tubing, manifolds, etc. that are designed to not change their initial flow resistance during the entire CHSS service life. Any disassembly of chambers and / or interconnections after manufacturing shall be visually detectable, e.g. by use of seals, and result in permanent removal of the CHSS from service.
3.7. "Container Attachments" are non-pressure bearing parts attached to the container that provide additional support and/or protection to the container and that may be only temporarily removed for maintenance and/or inspection only with the use of tools. ✓ .	Container attachments mean non-pressure bearing parts attached to the container that provide additional support and/or protection to the container and that may be removed only with the use of tools for the specific purpose of maintenance and/or inspection. ✓	2.5. "Container Attachments" means non-pressure bearing parts attached to the container that provide additional support and/or protection to the container and that may be only temporarily removed for maintenance and/or inspection only with the use of tools. ✓ Note: The non-pressure bearing parts attached to the container that provide additional support and/or protection to additional TPRDs and supply lines are also considered as container attachments.

Supply Line Text Comparison: Non-Mandatory

GTR13 Amd 1	§571.308 Standard No. 308; Compressed hydrogen storage system integrity.	UN R134
51. Requirements for Compressed Hydrogen Storage System (CHSS) and its primary closures are defined in paragraph 5.1. The provision in paragraph 5.1.(b) allows Contracting Parties to require that primary closure devices be mounted directly on the container. If needed, manufacturers can choose to locate additional TPRDs in alternative locations on the container. However, any additional TPRDs should be connected directly to the containers by using supply lines that have demonstrated mechanical integrity and durability as part of qualification tests for CHSS (paragraphs 5.1.1. and 5.1.2.).	Background GTR No. 13 provided contracting parties with the discretion to require that the closure devices be mounted directly on or within each hydrogen fuel container. The relevant safety concern is that the high-pressure lines required to connect remotely located closure devices with the container could be susceptible to damage or leak. However, as discussed above, the definition of a container is sufficiently broad that it includes lines that are part of the continuous volume of stored hydrogen (as determined by the location of the shut-off valve or any other obstruction that "breaks'' or "interrupts'' the container's continuous volume). Thus, any lines that form part of the container's continuous volume are themselves part of the container and will be included in the container performance testing discussed below. If a container (which includes any lines that are part of the container's continuous volume) can successfully complete the performance testing in FMVSS No. 308, then the risk of failure of the lines has been addressed. As a result, NHTSA tentatively concluded that it is not necessary to specify that closure devices be mounted directly on or within each container. NHTSA sought comment on requiring closure devices to be mounted directly on or within each container.	N/A

Supply Line Comparison: CHSS Definition

GTR13 Amd 1	§571.308 Standard No. 308; Compressed hydrogen storage system integrity.	Supplement 1 to the R134 Series 02
3.8. "Compressed hydrogen storage system (CHSS)" is a system designed to store compressed hydrogen fuel for a hydrogen-fuelled vehicle, composed of a container, container attachments (if any), and all primary closure devices required to isolate the stored hydrogen from the remainder of the fuel system and the environment.	Compressed hydrogen storage system (CHSS) means a system that stores compressed hydrogen fuel for a hydrogen-fueled vehicle, composed of a container, container attachments (if any), and all closure devices required to isolate the stored hydrogen from the remainder of the fuel system and the environment.	2.3. "Compressed hydrogen storage system (CHSS)" means a system designed to store compressed hydrogen fuel for a hydrogen-fuelled vehicle and composed of a container, container attachments (if any), supply lines for additional Thermally activated Pressure Relief Device (TPRD) (if any), and all primary closure devices required to isolate the stored hydrogen from the remainder of the fuel system and the environment.

Supply Line Comparison: Primary closure

GTR13 Amd 1	§571.308 Standard No. 308; Compressed hydrogen storage system integrity.	Supplement 1 to the R134 Series 02
5.1.(b) Each Contracting Party may, at its discretion, require that the primary closure devices shall be mounted directly on or within each container;	NHTSA will not require closure devices to be mounted on or within each container. As discussed above, the definition of "container" in the final rule is sufficiently broad to include any lines that may form part of the container's continuous volume of pressurized hydrogen up to the closure device. [15] **Therefore, these lines must be included in the applicable performance testing as part of the container itself**. If a container, including all portions of the container's continuous volume, can successfully complete the performance testing in FMVSS No. 308, then the risk of failure of the lines has been sufficiently addressed. [15] In this context, "lines" refers to any pluming, piping, and/or connections where hydrogen fuel may be present	5.(b) The primary closure devices shall be mounted directly on or within each container. If needed, manufacturers may choose to locate additional TPRDs in alternative locations on the container. However, any high-pressure supply lines for such additional TPRDs shall have demonstrated mechanical integrity and durability as part of qualification tests for the container (verification tests for baseline metrics in paragraph 5.1., hydraulic sequential test in paragraph 5.2. **excluding the drop test**; see Annex 9 – Overview of applicability of component and system tests for supply lines for additional TPRDs).

Supply Line Comparison: Test Article

GTR13 Amd 1	§571.308 Standard No. 308; Compressed hydrogen storage system integrity.	Supplement 1 to the R134 Series 02, Proposed 03 Series of Amendments
Table 2 Requirement section: 5.1.2. Verification test for performance durability Test article: Container or container plus container attachments, as applicable	TABLE 2 TO § 571.308 S5.1 Requirement section S5.1.2. Test for performance durability ..... Test article Container. Container attachments designed to be removed shall be removed and container attachments that are not designed to be removed shall remain in place. Container attachments that are removed, shall not be reinstalled for the remainder of S5.1.2; container attachments that are not removed, shall remain in place for the remainder of S5.1.2.Container attachments designed to be removed shall be removed and container attachments that are not designed to be removed shall remain in place	Table 2 Requirement section: 5.1.2. Verification test for performance durability Test article: Container or container plus container attachments, as applicable[4] [4] For detailed requirements on supply lines for additional TPRDs see Annex 9 – Overview of applicability of component and system tests for supply lines for additional TPRDs.

Drop Test Requirements and Procedure

GTR13 Amd 1	§571.308 Standard No. 308; Compressed hydrogen storage system integrity.	Supplement 1 to the R134 Series 02, Proposed 03 Series of Amendments
5.1.2.2. Drop (impact) test The container with its container attachments (if any) is dropped once in one of the impact orientations specified in paragraph 6.2.3.2. 6.2.3.2. Drop (impact) test (unpressurized) The container and its container attachments (if any) is drop tested without internal pressurization or attached valves. The surface onto which the test article is dropped shall be a smooth, horizontal concrete pad or other flooring type with equivalent hardness. No attempt shall be made to prevent the test article from bouncing or falling over during a drop test, but the test article shall be prevented from falling over during the vertical drop test.	S5.1.2.1. Drop test. The container with its container attachments (if any) is dropped once in accordance with S6.2.3.2 of this standard in any one of the four orientations specified in that section S6.2.3.2. Drop impact test. The container is drop tested without internal pressurization or attached valves. The surface onto which the container is dropped shall be a smooth, horizontal, uniform, dry, concrete pad or other flooring type with equivalent hardness. No attempt shall be made to prevent the container from bouncing or falling over during a drop test, except for the vertical drop test, during which the test article shall be prevented from falling over. The container shall be dropped in any one of the following four orientations described below and illustrated in figure 2 to S6.2.3.2.	5.2.2. Drop (impact) test The container with its container attachments (if any) is dropped once in one of the impact orientations specified in Annex 3, paragraph 3.2. This test does not apply to supply lines for additional TPRDs. Note: The manufacturer applying for approval shall provide handling procedures to ensure that the supply lines for additional TPRDs will not suffer damage or contamination during handling. The handling procedure shall require the removal from service of supply lines that have unacceptable damage. Annex 3, para 3.2 3.2. Drop (impact) test (unpressurized) The container and its container attachments (if any) is drop tested without internal pressurization or attached valves or supply lines for additional TPRDs. The surface onto which the test article is dropped shall be a smooth, horizontal concrete pad or other flooring type with equivalent hardness. No attempt shall be made to prevent the test article from bouncing or falling over during a drop test, but the test article shall be prevented from falling over during the vertical drop test. The test article shall be dropped in any one of the following four orientations, the orientation chosen for the test shall be determined by the Technical Service in consultation with the manufacturers:

" [Annex 9

Hydraulic Testing

Overview of the Applicability of Tests for Supply Lines for Additional Thermally Activated Pressure Relief Device

Test no.	*Test title*	*CHSS*	*Container with attachments (if any)*	*Primary closure devices*	*Supply lines*	*Notes*
5.1.	Verification test for baseline metrics					
5.1.1.	Baseline initial burst pressure		x		x[1]	
5.1.2.	Baseline initial pressure cycle life		x		x[1]	
5.2.	Verification tests for performance durability (Hydraulic sequential tests)					At the discretion of the Technical Service and the Type-Approval Authority, for supply lines the worst-case approach may be applied, e.g. longest lines, largest diameter, smallest bend radius and highest number of fittings. The tests shall be conducted for each material separately.
5.2.1.	Proof pressure test		x		x[1]	
5.2.2.	Drop (impact) test		x			The manufacturer applying for approval shall provide handling procedures to ensure that the supply lines for additional TPRDs will not suffer damage during handling. It shall require the removal from service of supply lines that have unacceptable damage.
5.2.3.	Surface damage test		x			Not applicable to metallic supply lines for additional TPRDs
5.2.4.	Chemical exposure and ambient-temperature pressure cycling test		x		x[1]	
5.2.5.	High temperature static pressure test		x		x[1]	
5.2.6.	Extreme temperature pressure cycling test		x		x[1]	
5.2.7.	Residual proof pressure test		x		x[1]	
5.2.8.	Residual strength burst test		x		x[1]	

Pneumatic and Fire Testing

Test no.	*Test title*	*CHSS*	*Container with attachments (if any)*	*Primary closure devices*	*Supply lines*	*Notes*
5.3.	Verification test for expected on-road performance (Pneumatic sequential tests)					At the discretion of the Technical Service and the Type-Approval Authority, for such supply lines the worst-case approach may be applied, e.g. longest lines, largest diameter, smallest bend radius and highest number of fittings. The tests shall be conducted for each material separately.
5.3.1.	Proof pressure test	x	x	x	x	
5.3.2.	Ambient and extreme temperature gas pressure cycling test (pneumatic)	x	x	x	x	
5.3.3.	Extreme temperature static gas pressure leak or permeation test (pneumatic)	x	x	x	x	
5.3.4.	Residual proof pressure test (hydraulic)	x	x	x	x	
5.3.5.	Residual strength burst test (hydraulic)	x	x	x	x	
5.4.	Verification test for service terminating performance in fire	x	x	x	x	

Notes:
1. Supply lines for additional TPRDs (if any) through appropriate adaptors]"

Proposal for Reconsideration

§571.308 Standard No. 308; Compressed hydrogen storage system integrity. (CURRENT)	§571.308 Standard No. 308; Compressed hydrogen storage system integrity.	Rationale
NHTSA will not require closure devices to be mounted on or within each container. As discussed above, the definition of "container" in the final rule is sufficiently broad to include any lines that may form part of the container's continuous volume of pressurized hydrogen up to the closure device. [15] Therefore, these lines must be included in the applicable performance testing as part of the container itself. If a container, including all portions of the container's continuous volume, can successfully complete the performance testing in FMVSS No. 308, then the risk of failure of the lines has been sufficiently addressed. [15] In this context, "lines" refers to any pluming, piping, and/or connections where hydrogen fuel may be present	NHTSA will not require closure devices to be mounted on or within each container. As discussed above, the definition of "container" in the final rule is sufficiently broad to include any lines that may form part of the container's continuous volume of pressurized hydrogen up to the closure device. [15] **Therefore, these lines must be included in the applicable performance testing as part of the container itself, excluding the drop test.** If a container, including all portions of the container's continuous volume, can successfully complete the performance testing in FMVSS No. 308, then the risk of failure of the lines has been sufficiently addressed. [15] In this context, "lines" refers to any pluming, piping, and/or connections where hydrogen fuel may be present	Unlike light-duty vehicles, heavy duty vehicles with large CHSS can have a variety of storage configurations. It is essential to allow manufacturers to focus on the regulatory requirements of the container, ensuring a high degree of safety before the product enters the market. Properties of metallic supply lines are well-understood and flexibility is needed in testing the CHSS.

Proposal for Reconsideration

§571.308 Standard No. 308; Compressed hydrogen storage system integrity.	§571.308 Standard No. 308; Compressed hydrogen storage system integrity.	Rationale
S5.1.2.1. Drop test. The container with its container attachments (if any) is dropped once in accordance with S6.2.3.2 of this standard in any one of the four orientations specified in that section	S5.1.2.1. Drop test. The container with its container attachments (if any) is dropped once in accordance with S6.2.3.2 of this standard in any one of the four orientations specified in that section. This test does not apply to supply lines for additional TPRDs.	
S6.2.3.2. Drop impact test. The container is drop tested without internal pressurization or attached valves. The surface onto which the container is dropped shall be a smooth, horizontal, uniform, dry, concrete pad or other flooring type with equivalent hardness. No attempt shall be made to prevent the container from bouncing or falling over during a drop test, except for the vertical drop test, during which the test article shall be prevented from falling over. The container shall be dropped in any one of the following four orientations described below and illustrated in figure 2 to S6.2.3.2.	S6.2.3.2. Drop impact test. The container is drop tested without internal pressurization or attached valves or supply lines for additional TPRDs. . The surface onto which the container is dropped shall be a smooth, horizontal, uniform, dry, concrete pad or other flooring type with equivalent hardness. No attempt shall be made to prevent the container from bouncing or falling over during a drop test, except for the vertical drop test, during which the test article shall be prevented from falling over. The container shall be dropped in any one of the following four orientations described below and illustrated in figure 2 to S6.2.3.2.	