

LNG amendments to UN Regulation No. 110: Some background on specific issues

The text produced below has been prepared by the Chairman of the LNG Task Force (LNG TF) (Netherlands) to address issues and concerns about proposed amendments to R.110 (ECE-TRANS-WP.29-GRSG-2013-7e by the Delegate from France. At his request this informal document has been prepared to identify questions raised, answers provided by various LNG Task Force experts, and additional clarifications addressing further concerns and questions.

Where modifications have been made to the proposed amendments in the Formal Document ECE-TRANS-WP.29-GRSG-2013-7e, these are shown in the current text of the Regulation and marked in bold for new or strikethrough for deleted characters.

I. Questions

***Question 1a & B:** Section 8-13 provisions regarding components fitted to the LNG tank: to create FR: is in favor of: a) a mandatory filling limiter; and b) a mandatory fuel indicator.*

Answer 1a: Fill limiters. There is no need to have filling limiters in LNG tanks. When the tank is full it is full. Nevertheless, in deference to this concern we suggest using language provided in ISO 12991 that states, in section 4.7.7, “A system shall be provided for preventing the fuel tank from being overfilled. This system may work in conjunction with the refueling station.”

More detailed language will be in conflict with ISO 12991. All current automotive LNG tanks seen in the field address overfill with a ullage volume in the tank (as required in SAE J2343) and there haven't been any problems with that.

***Follow-up question/concern: Overfill protection:** Agree to insert the requirement from ISO 12991, but they need more technical explanations about what happens in reality when overfilling occurs (e.g. where does the gas go?). They would not agree on a system that would “just” vent gas to atmosphere without alerting the user when tank is full. Can it happen on existing systems?*

Answer: There are instances where the customer has mistakenly, completely filled a tank including the ullage space but the fuel tanks are not in danger of bursting. The only ‘result’ of a full tank is that there will be a rapid pressure drop when the vehicle is in use because there is no gas vapor in the tank and boil off is too slow to maintain pressure. Additionally, the pressure relief valves (PRVs) are cryogenic so could vent liquid if needed but pressure alone from the pumped fuel would not normally trigger the PRV.

Moreover, the locking-type design of the filling nozzles prevent any cryogenic fuel or vapor from escaping during fuelling so the when the tank is full no further fuel will enter the system. Nor would it result in spilled fuel, unlike a normal diesel or gasoline fuel system that is overfilled and spills on the side of the vehicle before pooling on the ground.

Proposed amendment (see separate document): Section 8-13 Provisions on components fitted to the LNG tank reference to ISO 12991 is added, (new) **18.13.4 A system shall be provided for preventing the fuel tank from being overfilled. This system may work in conjunction with the refueling station.**

Answer 1b: Mandatory fuel indicator. In 18.3.5.4 of the proposed amendment it is mentioned that an LNG level gauge on the tank is optional. Most of the tanks seen in the field have a level gauge system fitted to them, which is required by the customer on dedicated (gas only) natural gas vehicles. In this proposed regulation the fuel gauge on the fuel tank is, however, optional since typically there is a fuel gauge in the driver compartment of the vehicle. This is no different than a normal gasoline or diesel vehicle and anything more will be driven by the customer's expressed requirements.

Question 2: *8-14 à 8-??: provisions regarding other LNG components : to create FR : seems incomplete*

Answer 2: In a previous version of the amendments the component list started with 8-14 but the final version includes all the LNG components. We do not believe there are other components that are missing.

Follow-up question 2: *Consistency between paragraphs 8.4/8.21 (approval requirements for components) and paragraph 18.3.5. (components that may be installed in a LNG system). It seems that some components (e.g. level gauge) are mentioned in 18.3.5. but not in paragraph 8. As it is required that every component has to be type-approved, we need to have everything in paragraph 8. We should review this and add missing items if needed.*

Items listed in section 18.3 but that are not listed in section 8 include:

- 18.3.4.4: LNG venting system
- 18.3.4.8 LNG: fuel line
- 18.3.4.9: LNG couplings
- 18.3.4.11: LNG pressure indicator or fuel indicator
- 18.3.4.12: Electronic control unit
- 18.3.5.4: LNG level gauge

Mentioned in Section 8 but not in 18.3 are:

- 8.15: LNG filling receptacle
- 8.19: natural gas detector

Not all of these components are to be certified. For instance, the couplings and gas tight housing are not mentioned in the CNG part of R.110. Only the components with a separate annex are mentioned in the table 8.15 up to 8.21.

- a. **LNG venting system** is atmospheric and, therefore, is should not be required in this section.
- b. **LNG fuel line.** Ridged fuel line is not tested for CNG.
- c. **LNG couplings.** Couplings for CNG are also not possible to test and certify.
- d. **18.3.4.11 LNG pressure indicator or fuel indicator.** We did mention in 8.18 pressure and/or temperature sensor. We need to change the name in the document to be consistent.

- e. **ECU.** This needs to be updated in the table with 8.22. *A correcting amendment will be offered to cover this.*
- f. **LNG level gauge.** We do not have a test description for this due to the fact that it is a performance component. Therefore, this product need not be mentioned in the table.
- g. 18.3.4.5 needs to be updated from the current characterization as “LNG receptacle” to instead read, “LNG *filling* receptacle.”

The natural gas detector is included. see 18.3.4.13

Question 3: Part II. Section 18.13 Requirements for the installation of specific components for the use of compressed natural gas and/or liquefied natural gas in the propulsion system of a vehicle. The LNG system in category M vehicles **shall** be equipped with a natural gas detector and/or gas tight housing. The LNG system in category N vehicles **may be** equipped with a natural gas detector: *LNG is odorless. How can the absence of gas detector be justified? France is in favor of mandatory gas detector FR : See 18.13 mandatory for M, optional N. It should be mandatory if the LNG tank is installed in a closed area (such as a van).*

Answer 3: The LNG Task Force has discussed this at length and decided to mandate detectors for M category vehicles but not for N category vehicles. Added in (new) 18.3: “The LNG system in Category M vehicles shall be equipped with a natural gas detector and/or gas tight housing. The LNG system in Category N vehicles *may* be equipped with a natural gas detector.

Field experience has indicated that gas detectors in commercial practice have been generally unreliable (and are activated even when there is no gas leakage). Also, there is no ‘threshold’ for determining leakage. California code mandates gas leakage in LNG vehicles and defines percentage limits. The rest of the U.S. does not mandate it now but it will be mandated in 2014 in NFPA-52. Discussion point is raised about mandating gas detectors in passenger vehicles (Class M) but not (Class N).

Follow-up to Question 3: Gas detection: Differentiation between M and N is not sufficient. The wording should be modified so that LNG detector would be mandatory in any case where there is a risk of LNG entering driver/passenger compartment and/or cargo space.

Answer 3 (follow-up): The main concern with gas leaks is explosive risk of accumulation in enclosed areas. On heavy tractor-trailer-type trucks the only enclosed area is the cab and they are so well sealed it is inconceivable that enough gas from the exterior-mounted fuel tanks could escape into the cab to make a flammable mix (5 – 15% by vol). In such trucks there are no enclosed spaces under the cab. Furthermore, it is impractical to fit gas detectors outside the cab because the gas line from tank to engine would need several detectors for full coverage. Any gas would disperse anyway because the engine would be running and the vehicle moving. The mandated automatic valve after the vaporiser will be shut when stationary, so only a small quantity of gas downstream can escape and accumulate, but would not burn explosively as it is not contained.

For N vehicles that are uni-body or that have space where LNG tanks might be fit inside a cargo area the use of a gas detector would be appropriate and enhance safety. As such the LNG TF, in deference to these concerns recommends the following additional language

Section 18.13: The LNG system in category M vehicles shall be equipped with a natural gas detector and/or gas tight housing. The LNG system in category N vehicles may be equipped with a natural gas detector.

The following will be offered as a new amendment: The LNG system in category N vehicles may be equipped with a natural gas detector if the fuel storage tank and associated piping is mounted on the exterior of the vehicle without the possibility of gas trapping (as in 18.12). If the fuel storage tank is located inside the cargo area of a category vehicle then a natural gas detector and/or gas tight housing is mandatory.

Question 4: Point 18-6 Accessories fitted to the LNG tanks

Why not install "automatic valve" and "PRD temperature triggered for the LNG tank? FR: thinks that this comment has not been answered.

Answer 4: Unlike CNG tanks that are temperature-sensitive PRDs, are not applicable for LNG tanks and there is no danger of melting under fire. This is the same approach as taken in ISO CD 12991 (that there is no PRD on LNG tanks). All LNG tanks have pressure-triggered PRVs that close again when the tank pressure drops. These are much safer than thermal PRDs that release all the tank contents go once the system is opened. LNG tanks routinely vent if left unused, so an automatic valve does not have the same isolating effect as it does with CNG. Furthermore, automatic valves are not currently used because of availability and reliability problems in automotive applications.

A correcting amendment will be made(see separate proposal): “2.7 LNG fuel pump shall be provided with pressure relief ~~devi~~ **valve** to limit the pressure to the maximum safe working pressure of the pump.”

Question 5: Annex 3B, Section 2.6.3.2: What procedure is used to verify the minimum of 5 days? Why 5 days? FR: Reference should be made to the test done in Annex 3B Appendix A, A3

Answer 5: This has been discussed at length by the LNG Task Force and the requirements have been made in line with SAE J2343, which is the most severe requirement in the industry. Annex 3b, Appendix A.3 of the proposed amendments the hold time test is specified. Furthermore, this is not a safety issue but is considered more of an environmental issue. Therefore, the LNG TF feels comfortable that the provisions herein are satisfactory as drafted. Also with the 5 day hold time most of the venting issues will be solved.

Question 6: Annex 3B, Section 2-7: no provisions where is evacuated gas? etc FR: France believes that requirements are necessary. Indicate in the point 18-6-6

If 2.7 refers to Annex 4O, these are covered by 18.6.2 (PRV connected to pipe away) and 18.6.7 (venting management system) so requirements are in place.

Answer 6: Venting is mentioned in several places in the document. The answer to Question 3 is updating a part of the question. Paragraph 18.6.7 explains how the venting management system should be constructed and should prevent any dangerous situations.

Annex 3B paragraph 2.6 also describes that in case LNG tanks are located in enclosed spaces safety provisions should be taken.

Question 7: Venting Management System (18.6.7): FR thinks that some cases are missing. E.g. the vent stack should not send gas to the cooling systems installed on the bodywork or on the semi-trailers (see picture below)



Answer 7: Point taken on exhaust to other vehicle systems with air intake. Amendment provided below.

Section 18.6.7. Venting management system, amend to read (see separate document):
The primary pressure relief valve shall be piped to a vent stack which extends to a high level. The primary and secondary relief valve outlets shall be protected **from** fouling by dirt, debris, snow, ice and/or water. The vent stack shall be sized to prevent flow restriction due to pressure drop. Gas exiting the vent stack or secondary relieve valve shall not impinge on enclosed areas, other vehicles, **exterior-mounted systems with air intake (i.e. air-conditioning systems)**, engine intakes, or engine exhaust. In the case of dual tanks, the primary relief valve outlets piping for each tank may be manifold to a common stack.

Question 8: Annex 7 and 18-1-8 Why not extend identification mark for vehicles of category N FR: not solved

Answer 8: This is to be in line with the CNG. For CNG the identification mark is also only mandatory. Part 2. 18.1.8.1: addresses labeling of M2 and M3. The practice is identical to that for CNG.

Question/Comment 9: *Optional components: The wording of 18.3.5. should be amended to clearly express that only items mentioned in the following subparagraphs (18.3.5.1 to 18.3.5.7) can be installed in addition to mandatory components, so that any other component is forbidden. Example: if experts consider that temperature triggered PRD is not applicable to LNG, and that installation of these components is not suitable, then it should not be authorized to install such component on a LNG system.*

Answer 9: Since this section is specified for LNG only it should be clear that additional components ONLY designed for cryogenic LNG would be applicable. It is not the purpose of this section to make an exhaustive list of other components, such as PRDs suitable for CNG that are not appropriate to LNG. Furthermore, at this stage in the development of this regulation and the development of the industry it might be overly restrictive to forbid any components other than those on this list.

Question 10: Risks linked to empty tank: in case where the tank is completely empty, is there a risk to fill it in? If yes, what are the measures foreseen in R110?

Answer 10: No. The fuel connector on the vehicle cannot be compromised by any liquid fuelling system or nozzle. On dual-fuel engine systems the fuel storage tanks are isolated from each other until the point of entry into the engine so there is no chance of anything else than LNG entering to the fuel tank from either another vehicle system or at the fuel receptacle.

Question 11: Can we have a feedback from countries that already allow the LNG?

Answer 11: The opportunity for feedback from each member state country has been requested as part of the process to develop the LNG amendments starting with documents submitted for the two GRPE meetings in 2012. Furthermore, the members of the LNG-TF are a wide international representation of countries also using LNG in vehicles and whose views and expert advice have been incorporated into the LNG amendments.

Furthermore, Mr. Dijkhof, as part of the technical department working together with the RDW is happy to have a face to face meeting to discuss the Dutch experience with the 4 vehicle types with a national approval in the Netherlands.

Nevertheless, additional information has been gathered regarding specific case studies of heavy duty truck fleets in Europe and North American that have experience using LNG. These are provided in a 'companion' Informal Document for GRSG 104.

II. Justification

This informal document is in response to detailed questions by the French delegation to GRSG who requested that additional information be provided to assure that other GRSG members have an opportunity to consider the questions, comments and issues raised. The response to questions, based on continued dialogue and input from LNG experts, resulted in some new proposed amendments to various parts of the proposed amendment to Regulation No. 110, i.e. in ECE/TRANS/WP.29/GRSG/2013/7.
