

Proposed LNG Pump Requirements for Regulation 110

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For reference, this is the process I followed:

1)

Extract LPG pump requirements from regulation 67.

Using these requirements, draft the requirements for LNG pump for Rag 110.

2)

Verify other LNG codes for vehicle applications as well as storage and handling for requirements for LNG pumps:

- CSA Z276-07, Liquefied Natural Gas (LNG) – Production Storage and Handling
- NFPA 52-2010, Vehicular Gaseous Fuel Systems Code
- SAE J2343-2008, Recommended Practice for LNG Medium and Heavy-Duty Powered Vehicles
- AS/NZS 2739:2009, Natural gas (NG) fuel systems for vehicle engines (Australia and New Zealand)
- Code of Practice Liquefied Natural Gas Facilities, Nova Scotia, Canada, 2005
- Liquefied Natural Gas Regulations, Texas, USA, 2003

3)

Using these findings and Westport experience, write the section “General design rules for LNG pumps”

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Contents

Edit 1

Add:

Annex 4(Letter) – Provisions regarding the approval of LNG fuel pump

Definitions

Edit 2

Add to paragraph 2.2:

Reference paragraph 2.2

2.2. "Specific component" means:

- (a) container (or cylinder),
- (b) accessories fitted to the cylinder
- (c) pressure regulator,
- (d) automatic valve,
- (e) manual valve,
- (f) gas supply device,
- (g) gas flow adjuster,
- (h) flexible fuel line,
- (i) rigid fuel line,
- (j) filling unit or receptacle,
- (k) non-return valve or non-return valve,
- (l) pressure relief valve (discharge valve),
- (m) pressure relief device (temperature triggered),
- (n) filter,
- (o) pressure or temperature sensor / indicator,
- (p) excess flow valve,
- (q) service valve,
- (r) electronic control unit,
- (s) gas-tight housing,
- (t) fitting,
- (u) ventilation hose.
- (v) Pressure relief device (PRD)(pressure triggered).
- (w) vaporizer

(letter) LNG fuel pump

Edit 3

~~If a paragraph "Accessories fitted to the LNG tank" is intended == similar to 2.5~~

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Comment [mu1]: As discussed during the meeting, the paragraph will not be included in R110.

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Reference paragraph 2.5

~~2.5 "Accessories fitted to the container" means the following components (but not limited to them), either separate or combined, when fitted to the container:~~

- ~~2.5.1. Manual valve;~~
- ~~2.5.2. Pressure sensor/indicator;~~
- ~~2.5.3. Pressure relief valve (discharge valve);~~
- ~~2.5.4. Pressure relief device (temperature triggered);~~
- ~~2.5.5. Automatic cylinder valve;~~
- ~~2.5.6. Excess flow valve;~~
- ~~2.5.7. Gas tight housing.~~

Then add "LNG fuel pump" to the list.

Edit 4

Add to chapter 2 the following definition:

2.(number) "LNG fuel pump" means a device to establish the supply of LNG to the engine by increasing the pressure of the fluid (liquid or vapour).

2. (number) "LNG trapping" is containment of LNG in an enclosure of constant volume).

Markings

Edit 5

Add into paragraph 4.4

Reference paragraph 4.4

- 4.4. Every vessel shall also bear a marking plate with the following data clearly legible and indelible:
- (a) Manufacture
 - (b) serial number
 - (c) Volume in water
 - (d) the marking "LNG"
 - (e) ISO12991

(letter) The marking "PUMP INSIDE, Pump Delivery Pressure *** bar" if the LNG fuel pump is mounted on the tank.

Comment [mu2]: Add "pump delivery pressure, as discussed during the meeting

Where the *** is the value of the pump delivery pressure.

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~~Provisions regarding LNG tanks~~

Comment [mu3]: As discussed during the meeting , the paragraph will not be included in R110.

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~~Edit 6~~

~~(for reference see paragraph 6.2)~~

~~If such a paragraph will be introduced (for reference see paragraph 6.2),
than Add:~~

~~(number.number) The LNG tank may be equipped with a LNG fuel pump inside.~~

Provisions regarding (other) components

Edit 7

Add new paragraphs:

6-4 – 6-(number) Provisions regarding other CNG and LNG components

The components shown shall be type approved pursuant to the provisions laid down in the annex which can be determined from the table below:

Paragraph	Component	Annex
6.4.	Automatic valve Non-return valve or non-return valve Pressure relief valve Pressure relief device Excess flow valve	4A
6.5.	Flexible fuel line-hose	4B
6.6.	CNG filter	4C
6.7.	Pressure regulator	4D
6.8.	Pressure and temperature sensors	4E
6.9.	Filling unit or receptacle	4F
6.10.	Gas flow adjuster and gas/air mixer or injector	4G
6.11.	Electronic control unit	4H
6.(number)	LNG fuel pump	4(Letter)

General design rules regarding LNG fuel pump

Edit 8

!!! Need a location for insertion into Reg 110

#.1 LNG pump shall be constructed of materials suitable for the temperature and pressure conditions that might be encountered.

#.2 LNG pump shall be constructed in such a manner as to avoid LNG trapping.

~~*** (LNG trapping is containment of LNG in an enclosure of constant volume)~~

Comment [mu4]: Moved into the definition section

#.3 Means shall be provided for the LNG present in the pump at engine shut-off, to be safely processed without pressure increase above maximum safe working pressure.

#.4 LNG pump shall be provided with pressure control device to maintain the pressure within the operating pressure range.

#.4.1 The limitation of the power supplied by the actuating mechanism can be accepted in lieu of pressure control device.

#.4.2 An electronic control system can be accepted in lieu of pressure control device.

~~#.4.3 The pressure control device, is not allowed the vent natural gas to atmosphere during normal function.~~

Comment [mu5]: Added following the discussions during meeting

#.5 LNG pump shall be provided with pressure relief device to limit the pressure to the maximum safe working pressure of the pump.

#.5.1 The fuel system pressure relief device is acceptable in lieu of pump pressure relief device if by relieving system pressure it relieves the pump pressure.

#.6 The LNG pump is allowed to function before the engine is started to produce required pressure in the fuel system. This function shall be achieved without delivering fuel to the engine if the engine is not ~~spinning~~ running.

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The LNG system

Edit 9

Add to paragraph 17.3.4.7

...the LNG system may also contain the following components:

17.3.4.7.(number) LNG fuel pump

Description of component

Edit 10

Add to Annex 1A

(number.number...) LNG fuel pump(s): yes/no 1/

- (n.n...).1. Make(s):
- (n.n...).2. Type(s):
- (n.n...).3. Description:
- (n.n...).4. Working pressure(s): 2/ kPa
- (n.n...).5. Location inside/outside LNG tank 1/:
- (n.n...).6. Operating temperatures: 2/ °C

Description of the LNG system

Edit 11

Add to Annex 1B

(number.number...) LNG fuel pump(s): yes/no 1/

- (n.n...).1. Make(s):
- (n.n...).2. Type(s):
- (n.n...).3. Description:
- (n.n...).4. Working pressure(s): 2/ kPa
- (n.n...).5. Location inside/outside LNG tank 1/:
- (n.n...).6. Operating temperatures: 2/ °C

LNG fuel pump on the list of approved components

Edit 12

Add to Annex 2B

Paragraph 2

2 LNG component considered:

...

...

LNG fuel pump

Annex 4(Letter)

PROVISIONS REGARDING THE APPROVAL OF THE LNG FUEL PUMP

Edit 13

1 Definition: see paragraph 2.(number) of this Regulation.

2. Component classification (according to Figure 1-1): Class 5.

3. Applicable test procedures:

3.1. LNG fuel pump mounted inside the container:

Low temperature test	Annex 5P
CNG compatibility	Annex 5D
Resistance to dry heat	Annex 5F
Ozone ageing	Annex 5G

Not Applicable:
~~Internal leakage~~
~~Burst/destructive tests~~
~~Operating temperatures~~
~~Durability tests~~

Comment [mu6]: Added as discussed during the meeting.

3.2. LNG fuel pump mounted outside the container:

Overpressure or strength	Annex 5A
External leakage	Annex 5B
CNG compatibility	Annex 5D
Corrosion resistance	Annex 5E
Resistance to dry heat	Annex 5F
Ozone ageing	Annex 5G
Temperature cycle	Annex 5H
Vibration resistance	Annex 5N
Low temperature test	Annex 5P

~~Requirements impacting other components~~

Comment [mu7]: This is covered in other sections of the R110.

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~~Edit 14~~

~~?? Where to insert this into Reg 110??~~

~~The LNG fuel pump can be combined with other components into a multifunctional component.~~

~~The multifunctional (LNG fuel pump) component can be mounted inside or outside the tank.~~