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

Definitions

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
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.

Than 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).

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” if the LNG fuel pump is mounted on the tank.
**Provisions regarding LNG tanks**

**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 annexes which can be determined from the table below:

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<th>Paragraph</th>
<th>Component</th>
<th>Annex</th>
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<td>Automatic valve</td>
<td></td>
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<tr>
<td></td>
<td>Non-return valve or non-return valve</td>
<td>4A</td>
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<tr>
<td></td>
<td>Pressure relief valve</td>
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<td>Excess flow valve</td>
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<td>6.5.</td>
<td>Flexible fuel line-hose</td>
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<td>4D</td>
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<td>6.9.</td>
<td>Filling unit or receptacle</td>
<td>4F</td>
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<td>6.10.</td>
<td>Gas flow adjuster and gas/air mixer or injector</td>
<td>4G</td>
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<td>6.11.</td>
<td>Electronic control unit</td>
<td>4H</td>
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<tr>
<td>6.(number)</td>
<td>LNG fuel pump</td>
<td>4(Letter)</td>
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</table>
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)

#.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.

#.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.
The LNG system

…the LNG system may also contain the following components:

17.3.4.7.(number) LNG fuel pump

Description of component

Add to Annex 1A

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

(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

Add to Annex 1B

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

(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

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

Not Applicable:
- Internal leakage
- Burst/destructive tests
- Operating temperatures
- Durability tests
Requirements impacting other components

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.