The following information applies to factory-built medium and heavy natural gas trucks and buses.

WEIGHT IMPACT

A natural gas fuel system – whether for a liquefied (LNG) vehicle or for a compressed natural gas (CNG) vehicle - adds weight to the vehicle compared to a diesel fuel system. The weight difference for a natural gas vehicle will depend on two factors:

1. Amount of fuel stored on the vehicle
2. Type of exhaust aftertreatment used

The weight of a natural gas engine is similar to a comparable diesel engine, so this is not a major factor in comparing the weight impact relative to diesel.

FUEL STORAGE ON VEHICLE

CNG CYLINDERS - FOUR TYPES

- Typically store 15 or 25 US diesel gallon equivalent (DGE) of fuel per tank based on 3.7 litres per US gallon
- Fuel systems of 45, 60, 75 or 90 DGE are common
- Lightweight tanks using a metal or plastic liner have been developed and weigh less than half of what a traditional steel cylinder weighs

LNG TANKS – TWO TYPES

- Double-walled, insulated tanks that require warm (unsaturated) LNG unless equipped with a pressure booster allowing for the use of cold (unsaturated LNG); these tanks are available in 60 or 75 DGE sizes.
- Double-walled, insulated tanks that include a cryogenic pump inside the tank and can use warm (saturated) or cold (unsaturated) LNG; these tanks are available in sizes of 70, 100 or 120 DGE.
UNDERSTANDING LNG TANK VOLUMES

LNG needs almost twice as much space to store the same amount of energy as diesel.

LNG tanks are described by their “water volume” as this reflects the size of the outer wall of the tank. The actual available space for fuel storage is less because room is needed for the insulation inside the double-walled tank.

<table>
<thead>
<tr>
<th>Water volume of tank</th>
<th>70 gallon</th>
<th>100 gallon</th>
<th>120 gallon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usable volume for LNG</td>
<td>56 gallon</td>
<td>78 gallon</td>
<td>96 gallon</td>
</tr>
<tr>
<td>Usable volume in LNG gallons</td>
<td>32 DGE</td>
<td>44 DGE</td>
<td>54 DGE</td>
</tr>
<tr>
<td>Usable volume in LNG litres</td>
<td>118 DLE</td>
<td>163 DLE</td>
<td>200 DLE</td>
</tr>
<tr>
<td>Total weight (full of LNG, incl. brackets and piping)</td>
<td>+ 385 kg</td>
<td>+ 480 kg</td>
<td>+ 545 kg</td>
</tr>
</tbody>
</table>

There are 3.7 litres of LNG in a US gallon of LNG.

2. EXHAUST AFTERTREATMENT

The type of exhaust aftertreatment used also affects vehicle weight.

- Vehicles with Cummins Westport 8.9 or 12 litre engines use a passive three-way catalyst and do not require a diesel particulate filter (DPF) or selective catalytic reduction (SCR)

INCREASED WEIGHT ALLOWANCES

Industry is engaged with the Provinces to discuss changes to weight allowances, so that fleets that operate LNG highway tractors do not need to compromise payload to compensate for the added weight of an LNG fuel system.

British Columbia is the first province in Canada to provide an additional weight allowance for LNG highway tractors. An extra 1,500 kg is allowed on the steering axle and drive axle combined. The overall gross vehicle weight can be increased by the same amount and vehicles are limited to heavy haul highways.

DIMENSIONS

Depending on the type of vehicle, there are four potential locations where the natural gas fuel system can be installed:

1. Roof-mount – adds an estimated 22” to the height of the vehicle
2. Back-of-cab – requires about 22” of space on the frame rails behind cab
3. Side mount on frame rail – commonly used for natural gas highway tractors
4. Custom – may involve fuel system installation within the body of a truck

The location options for CNG cylinders or LNG tanks will vary depending on the type of vehicle. Consult your vehicle dealer to learn more about available options.

SCHOOL BUS WEIGHT EXAMPLE

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CNG cylinders</td>
<td>+ 660 kg</td>
</tr>
<tr>
<td>No DPF, SCR</td>
<td>- 180 kg</td>
</tr>
<tr>
<td>NET</td>
<td>+ 480 kg</td>
</tr>
</tbody>
</table>

Assumes same weight for fuel in tanks, whether CNG or diesel.

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