



SURFACE VEHICLE INFORMATION REPORT

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Liquefied Natural Gas (LNG) Vehicle Fuel

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FOREWORD

Liquefied natural gas (LNG) is a practical automotive fuel with advantages and disadvantages when compared to conventional liquid fuels. Large quantities of natural gas are produced in North America. It has a higher “octane” rating, provides lower exhaust emissions of criteria (and many other) pollutants, and can cost less on an equivalent energy basis than other fuels.

LNG is a cryogenic liquid, which is produced by removing heat from natural gas. As heat is removed, the vapor cools and condenses, resulting in a liquid product with a boiling point of about -162°C (-260°F) at atmospheric pressure. Liquefaction increases the energy density of natural gas, thereby reducing its on-board vehicle storage volume for a given range and payload.

Typical pipeline natural gas and compressed natural gas is chiefly methane (generally 88 to 96 mole percent) with the balance being a decreasing proportion of higher hydrocarbons such as ethane, propane, and butane. It can also contain nitrogen, water, carbon dioxide, oxygen, sulfur compounds and trace amounts of lubricating oil.

The composition of LNG is different from that of pipeline natural gas as a result of the liquefaction process. Most of the hydrocarbon constituents remain soluble in LNG. However, other components, such as water, carbon dioxide, sulfur compounds and trace amounts of lubricating oil are removed during the liquefaction process.

At present the only agency in North America which provides a minimum composition level of natural gas vehicles is CARB. This regulation is a Compressed Natural Gas standard and the reference to water, CO₂, sulfur, and lubricates which do not apply to LNG, the hydrocarbon components of natural gas do apply. The minimum level of methane and max levels of ethane, propane, butane, and nitrogen, provide important references for engine manufactures. These minimum and maximum levels of constituents in the fuel composition are crucial in the engine design.

When using LNG as a vehicle fuel, it is stored at some combination of cryogenic temperature and relatively low pressure. It is not uncommon for the fuel to go through several transfers as it is moved from production site storage, to a transport tank, transport tank to a local refueling station tank and then into the vehicle tank. During each transfer, and during periods of storage, heat transfers into the fuel, which if left to evaporate its composition will change.

In order to provide fuel to the engine that meets the minimum hydrocarbons requirement of CARB, the LNG vaporization must be controlled and LNG inventories must be managed. Therefore, this document includes the information required to calculate a “dispense by” date for LNG. With a fixed set of assumptions on evaporation rates, a known initial fuel composition, the future fuel composition can be calculated. While this document is based on CARB requirements, the same methodology can be used for different fuel composition targets were required.

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1. SCOPE

This SAE Information Report applies to liquefied natural gas used as vehicle fuel and requires LNG producers to provide the required information on the fuel composition and its “dispense by” date.

1.1 Purpose

The purpose of this document is to provide the fixed assumption and calculation so that LNG producers can provide the required product information data which fuel composition and its “dispense by” dates can be calculated. The “dispense by” date provides users the date when the fuel no longer meets the minimum hydrocarbon requirement of CARB, which may compromise the engine emission performance, warranty or reliability. The “dispense by” date provides users the time/date when the fuel meets the minimum hydrocarbon requirement of CARB. Beyond this date/time the fuel composition may compromise engine emission performance, warranty or reliability.

2. REFERENCES

2.1 Applicable Document

The following publication forms a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 State of California Publication

Available from website <http://ccr.oal.ca.gov/>.

Specifications for Compressed Natural Gas, California Air Resources Board, Title 13, Division 3, Chapter 5, Article 3, Section 2292.5 of the California Code of Regulations

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J2343 Recommended Practice for LNG Medium and Heavy-Duty Powered Vehicles

2.2.2 NFPA Publications

Available from the National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471, Tel: 800-344-3555, www.nfpa.org.

NFPA 52 2006 Vehicular Fuel System Code

NFPA 59A 2006 Standard for the Production, Storage, and Handling of Liquefied Natural Gas