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Air Resources Board

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Manufacturers Advisory Correspondence MAC #99-01

TO: -ALL PASSENGER CAR MANUFACTURERS
-ALL LIGHT-DUTY TRUCK MANUFACTURERS
-ALL MEDIUM-DUTY VEHICLE MANUFACTURERS
-ALL HEAVY-DUTY VEHICLE MANUFACTURERS
-ALL OTHER INTERESTED PARTIES

SUBJECT: Evaporative Testing Requirements for Dual-Fuel CNG/Gasoline and LPG/Gasoline Vehicles

This letter transmits the attached Manufacturers Advisory Correspondence (MAC) which clarifies the Air Resources Board's (ARB's) policy regarding evaporative emission testing requirements for dual-fuel compressed natural gas (CNG)/gasoline and liquefied petroleum gas (LPG)/gasoline vehicles.

Should you have any questions or comments, please contact Mr. Duc Nguyen, Manager, Certification Section, or Mr. Steven Hada, Air Resources Engineer, at (626) 575-6641.

Sincerely,

John Kowalski for

R. B. Summerfield, Chief
Mobile Source Operations Division

Attachment

State of California
AIR RESOURCES BOARD

SUBJECT: Evaporative Testing Requirements for Dual-Fuel CNG/Gasoline and LPG/Gasoline Vehicles

APPLICABILITY:

All 1999 model-year (MY) and subsequent dual-fuel CNG/gasoline or LPG/gasoline passenger cars (PCs), light-duty trucks (LDTs), medium-duty vehicles (MDVs) and heavy-duty vehicles (HDVs).

However, any dual-fuel vehicles that are unchanged from the previous MYs may, for the 1999 MY only, be certified using carry-over evaporative emission data from previous MYs.

DEFINITIONS:

For purposes of this MAC only, the following definitions shall apply.

Dual-Fuel Vehicle (DFV). A DFV means any motor vehicle that is designed and engineered to be capable of operating on either gasoline or an alternative fuel separately. A DFV has two separate on-board fuel systems, one for the alternative fuel and the other for gasoline. In operation, DFVs combust only one fuel at any time, principally the alternative fuel; gasoline is burnt only when the alternative fuel system is inoperable or when the alternative fuel is low.

(For comparison, a "bi-fuel vehicle" is a vehicle that is designed and engineered to be capable of operating on gasoline and an alternative fuel simultaneously. A bi-fuel vehicle also has two separate on-board fuel systems. In operation, a bi- fuel vehicle combusts both gasoline and the alternative fuel at the same time in various calibrated proportions. A bi-fuel vehicle is subject to evaporative emission testing similar to that for gasoline vehicles, and is not a subject of this MAC.)

Alternative Fuel. In this MAC, an alternative fuel is either compressed natural gas (CNG) or liquefied petroleum gas (LPG).

Liquefied natural gas (LNG) fuel systems with their low pressure and venting characteristics, and any evaporative emission control requirements for LNG vehicles, whether dedicated or LNG/gasoline dual-fueled, are not within the scope of this MAC.

REFERENCES:

1. Title 13, California Code of Regulations (CCR), section 1976, "Standards and Test Procedures for Motor Vehicle Fuel Evaporative Emissions."

2. "California Evaporative Emission Standards and Test Procedures for 1978 and Subsequent Model Motor Vehicles," as last amended October 16, 1997, incorporated by reference in title 13, CCR, section 1976(c) (the Evaporative Emission Test Procedures)

3. "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles," as last amended March 19, 1998, incorporated by reference in title 13, CCR, section 1960.1(k) (the Exhaust Emission Test Procedures)

BACKGROUND AND DISCUSSION:

Title 13, CCR, section 1976(b)(1) provides that the California evaporative emission standards apply to ". . . 1978 and subsequent model gasoline-fueled, 1983 and subsequent model liquefied petroleum gas-fueled, and 1993 and subsequent model alcohol-fueled motor vehicles and hybrid electric vehicles . . . , except petroleum-fueled diesel vehicles, compressed natural gas- fueled vehicles, hybrid electric vehicles that have sealed fuel systems which can be demonstrated to have no evaporative emissions, and motorcycles . . . ." The exception for CNG vehicles was established because CNG fuel systems are considered sealed due to their very high storage pressure.

The Evaporative Emission Test Procedures do not expressly address evaporative emission testing of DFVs. Since both gasoline-fueled and LPG-fueled vehicles are subject to the evaporative emission standards, it is clear that a LPG/gasoline DFV must be evaporative-emission tested when operating both on LPG and on gasoline. It is also clear that a CNG/gasoline DFV must be evaporative- emission tested when operated on gasoline, because the evaporative emission standards apply to the vehicle in that mode. As discussed below, it is necessary to measure the evaporative gasoline emissions of a CNG/gasoline DFV when operating on CNG as well as when operating on gasoline, in order to confirm compliance with the evaporative emission standards for gasoline vehicles.

Due to the presence of the gasoline fuel system, evaporated gasoline emissions are always associated with DFV operation, when the DFV is operated on CNG or LPG as well as when it is operated on gasoline. Regardless of which fuel

the DFV is running on, the gasoline vapor is routed to the carbon canister for storing and for purging later to the engine for combustion. Most DFVs have separate engine management calibrations and/or purge strategies for gasoline operation and for alternative fuel operation. Purging stored gasoline vapor for combustion in the engine can affect exhaust emissions.

Most DFVs are certified to low emission standards (e.g., "TLEV", "LEV", "ULEV" or "SULEV"), in which case the non-methane organic gases (NMOG) exhaust emission standard for alternative fuel operation is more stringent than the NMOG standard for gasoline operation. (Exhaust Emission Test Procedures, section 3.g. note (4)b.) Thus, it is likely that a DFV will have separate purge strategies for gasoline operation and for alternative fuel operation, and that demonstrating compliance with the evaporative emission standard when the test vehicle is run on gasoline is no sure proof of compliance with the evaporative emission standard when the test vehicle is run on the alternative fuel. Consequently, in order to ensure that the gasoline fuel system of a CNG/gasoline DFV complies with the evaporative emission standard for gasoline vehicles, the test vehicle must undergo separate evaporative emission tests on both fuels.

The complete evaporative test procedure must be run for each fuel. That is, for each test fuel, the test vehicle must undergo the 3-day diurnal plus hot soak (D+HS), the running loss (R/L), and the supplemental 2-day D+HS tests. During the evaporative emission tests with the alternative fuel, the gasoline fuel fill and gasoline fuel tank R/L temperature profile must follow the same procedure as when evaporative emission testing is conducted with gasoline. Section 9.a.13.(g)(1) of the Exhaust Emission Test Procedures expressly identifies the LPG test fuel specifications for exhaust and evaporative emission testing of dual-fueled vehicles which use LPG. Section 9.a.13.(g)(2) of the Exhaust Emission Test Procedures identifies the natural gas test fuel specifications for emission-testing of dual-fuel vehicles which use natural gas. Under Section 4.i. of the Evaporative Emission Test Procedures, the evaporative emission test fuel is to be the test fuel specified for exhaust emission testing, with an exception pertaining to Indolene.

A related issue for MDVs with two separate fuel systems (e.g., dual-fuel and bi- fuel MDVs) is the determination of the applicable 3-day and 2-day D+HS emission standards. The 3-day and 2-day D+HS emission standards for such MDVs can differ by 0.5 grams depending on whether the fuel tank capacity is less than 30 gallons or equal to/in excess of 30 gallons. For determining the applicable D+HS emission standard, the combined capacities of the gasoline fuel tank and CNG or LPG fuel tank will be considered.

POLICY:

1.a. All 1999 MY and subsequent CNG/gasoline or LPG/gasoline dual-fuel PCs, LDTs, and chassis dynamometer-certified MDVs shall demonstrate compliance with the 3-day D+HS and R/L and 2-day D+HS evaporative emission standards by undergoing separate emission tests pursuant to the test procedures while operating on gasoline and the alternative fuel. Exhaust emission data conducted in connection with the evaporative test (pursuant to section 4.g.vi. of the Evaporative Emission Test Procedures) shall be reported in the application for certification.

b. All 1999 MY and subsequent CNG/gasoline or LPG/gasoline dual-fuel HDVs or incomplete MDVs shall demonstrate compliance with the 3-day D+HS and R/L and 2-day D+HS evaporative emission standards in accordance with section 5. of the Evaporative Emission Test Procedures (i.e., by engineering evaluation and submitted data) while operating on gasoline and the alternative fuel separately.

c. Any dual-fuel vehicles that use the same engine management and/or purge strategy calibrations unchanged from previous MYs may, for the 1999 MY only, be certified using carry-over evaporative emission data from previous MYs.

2. When conducting the evaporative emission test with the alternative fuel, the gasoline fuel tank fill and gasoline fuel tank temperature profile shall be the same as those during the evaporative emission test with gasoline.

3. The applicable 3-day and 2-day D+HS emission standards for CNG/gasoline or LPG/gasoline dual-fuel MDVs shall be based on the combined capacities of the gasoline fuel tank and CNG or LPG fuel tank.