



Hydrogen Fuel Injection System

Technology Fact Sheet for Canadian Hydrogen Energy Company Ltd.

Performance Claim

Canadian Hydrogen Energy Company's Hydrogen Fuel Injection (HFI) System when installed on a 1992 Detroit diesel (60-series) heavy duty engine using low sulphur (< 15 ppm) diesel fuel and tested on a "go-Power" (Model DT-2000) heavy-duty engine dynamometer rated at 800 HP with the application of the AVL 8-Mode Heavy-Duty Cycle for engine testing displayed the following performance:

- (1) reduced fuel consumption by 4.44% ;
- (2) reduced THC emissions by 6.17%;
- (3) reduced CO emissions by 0.39%;
- (4) reduced NO_x emissions by 4.34%; and
- (5) reduced PM emissions by 7.0%.

Technology Application

While the test was performed on a diesel truck engine, the HFI technology is adaptable to a broad range of applications, including light trucks, buses, SUV's, stationary generators, trains, boats, off-road forestry and mining equipment, motor homes and emergency services vehicles.

Performance Conditions

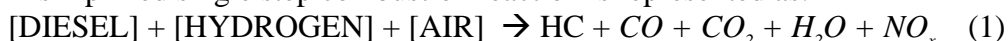
The performance claim evaluation was based on data and information provided by the Canadian Hydrogen Energy Company Ltd. regarding the HFI retrofit kit. The kit was installed and tested in a 1992 Detroit diesel heavy-duty engine (60-series) using low sulphur (< 15 ppm) diesel fuel and tested on a "go-Power" (Model DT-2000) heavy-duty dynamometer rated at 800 HP. The test was based on the widely used "AVL 8-Mode Heavy – Duty Cycle" for engine performance and emissions testing.

The AVL 8-mode test cycle runs at selected constant engine speeds. Measured data is applicable for on-road engine applications. The data provided by the Canadian Hydrogen Energy Company Ltd. is comprised of two test sets: (i) baseline performance (without HFI) and (ii) HFI performance (with hydrogen injection). The claim by the Canadian Hydrogen Energy Company Ltd. is based on the comparison of the baseline and HFI test results.

Technology Description

Through electrolysis, the Hydrogen Fuel Injection (HFI) kit generates hydrogen and oxygen, which are injected directly into the intake manifold. Published data show that hydrogen burns nearly one order of magnitude faster than petroleum fuels, thus approaching ideal thermodynamic cycle; and hydrogen has a shorter flame quench distance, allowing flames to travel closer to the cold zones, thus improving combustion. These hydrogen properties improve engine performance and emissions.

A simplified single step combustion reaction is represented as:



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Technology Description (cont'd)

For incomplete combustion, equation (1) above results in exhaust products, including unburned hydrocarbon (HC) and carbon monoxide (CO). The NO_x is formed mainly from the combustion air, and it is strongly temperature dependent.

For direct injection diesel engines, the Hydrogen Fuel Injection (HFI) kit injects the gases during intake so that it thoroughly mixes with intake air prior to diesel injection. The electrolysis cell of the HFI kit is constructed of seamless nickel tubing and the water chamber is made of seamless stainless steel. The Canadian Hydrogen Energy Company Ltd. indicated that the power for the electrolysis is supplied from the vehicle's engine battery and hydrogen is only produced, on demand, when the vehicle engine is operating.

Verification

The performance claim verification was based on the following data and information provided by Canadian Hydrogen Energy Company Ltd:

1. California Environmental Engineering Facility (CEE) Certification of emissions testing by California Air Resource Board (CARB)
2. Patent for the electrolysis kit to be used in internal combustion engines
3. Performance data from CEE laboratory

The data provided by Canadian Hydrogen Energy Company Ltd. comprised of two test sets:

1. "BASELINE" (without the HFI) to establish the baseline for engine emissions; and
2. "PRE-TURBO" with the HFI installed.

The claim is based on a comparison of the baseline test results to the "PRE-TURBO" test results. The verification was completed by Bodycote Material Testing Canada Inc. (BMTC) (Mississauga, Ontario) using ETV Canada's General Verification Protocol (March, 2000).

What is the ETV Program?

The Environmental Technology Verification (ETV) Program is a joint Environment Canada - Industry Canada initiative delivered by ETV Canada. The ETV Program is designed to support Canada's environment industry by providing credible and independent verification of technology performance claims.

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