Case Study
A PIT Group Technical Report

Performance Innovation Transport
An FPInnovations Group

Is ECM data accurate enough to use when making decisions about fuel saving technologies or operational practices?

Fuel consumption has always been an important component in transportation costs. It is also a very complicated element to measure, especially when it comes to diesel engines. With the advent of electronically controlled engines, many truck fleets have used data on fuel consumption from engine Electronic Control Modules (ECM). Engine ECMs record information about engine and vehicle performance, including fuel usage.

Original equipment manufacturers provide fuel consumption data via the ECM using comprehensive algorithms, which take into consideration parameters such as engine speed, road speed, distance, and fuel volume used, among other factors. However, because fuel consumption data in an ECM is derived from an algorithm and not from actual fuel flow, and does not account for fuel energy content, density or temperature, there is an inherent error with those calculations.

Despite extensive research, no report or technical information has been found containing engine manufacturers' statements regarding the accuracy or the precision of ECM fuel consumption data. In verbal communication, domestic engine manufacturers seem to concur on a +/-4% error, although no scientific evidence was ever provided confirming these statements.

The ability to measure fuel consumption accurately and precisely and defend the results is critical for writing vehicle specifications, for establishing effective maintenance practices, and for training drivers to operate vehicles as fuel efficiently as possible. Therefore, the PIT Group decided to carry out a study to compare engine ECM data with actual fuel consumption.

Testing Methodology

The PIT Group testing methodology evaluated fuel consumption data provided by ECMs using test track fuel consumption tests.

Test track fuel consumption evaluations conducted in the fall of 2014 on 14 different vehicles with engines from four manufacturers followed the Joint TMC/SAE Fuel Consumption Test Procedure Type II described in SAE J1321 [3]. The fuel measurement gravimetric method allows test accuracy within 1%.

The results of the gravimetric measurement, converted to fuel volume, were compared with the fuel consumption data provided by the ECM, which was retrieved using onboard computers or engine scan tools. Fuel specific gravity was measured with a hydrometer.

Results

These tests showed that engine ECMs presented different levels of precision and accuracy:

- Cummins (4 vehicles were tested for a total of 24 tests): accuracy from -5.4 % to -6.2%, precision from 0.18 to 0.81%
- Detroit Diesel (7 vehicles were tested for a total of 27 tests): accuracy from -2.6 % to 2.1%, precision from 0.37 to 1.09
- Mercedes (one vehicle was tested, 9 tests were conducted): accuracy of -0.9%, precision of 1.59%
- Volvo (2 vehicles were tested for a total of 29 tests): accuracy of -3% and 0.9%, precision of 0.25% and 0.84%.
- For all engines except the Mercedes, the ECM indicated lower fuel consumption than the gravimetric measurement.

Conclusions

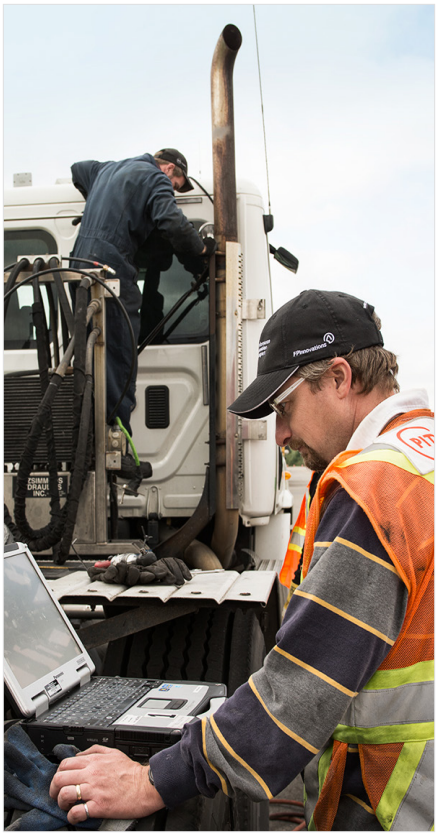
ECM data should be used with caution for evaluating the impact of a fuel saving technology or operational practices.

ECM data precision and accuracy varies between engine manufacturers and among engine models from a single manufacturer.

For a given vehicle, ECM data precision and accuracy will even vary from test to test.

ECM accuracy and precision measurements under controlled test track conditions are more reliable when averaging data over a larger number of test runs. In real world operations, however, other factors such as traffic, road condition, weather and payload will impact fuel consumption, making any fuel consumption comparison using ECM data risky.

ECM data can be useful for creating driver profiles and monitoring their activity relative to idle time, shifting, harsh and acceleration, speeding, etc.



About Performance Innovation Transport

Based in Montreal, Quebec, Performance Innovation Transport (PIT) is a subsidiary of FPInnovations. Formed in 2008, PIT is an unbiased, neutral testing organization to help manufacturers evaluate and refine prototypes and fleet managers select the best technologies to reduce costs and environmental impact. PIT works in cooperation with the U.S. SmartWay Transport Partnership, Natural Resources Canada, and Environment Canada who has selected PIT as the benchmark facility for testing green transportation technologies. PIT evaluates and implements technologies that promote efficient energy use in the commercial transportation, municipal and transit industries.

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