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Real-world accuracy requirements for vehicle on-board fuel and energy consumption monitoring

BACKGROUND

On-board fuel and energy consumption monitoring (OBFCM) devices determine the fuel and electric energy consumption, as well as distance driven on-board a vehicle. Based on the European Union type-approval regulation, OBFCM devices are mandatory for new types of passenger vehicles and most light commercial vehicles since January 2020, and since January 2021 for all new vehicles of these categories.

The European Commission plans to use anonymized OBFCM data to publish annually the average real-world CO_2 emissions, and the gap to type-approval CO_2 emissions, by manufacturer, vehicle category, and fuel type. This monitoring data will be used to assess how future growth of the gap can be counteracted by regulatory means. The European Commission also plans to analyze OBFCM data to determine the average real-world utility factor of plug-in hybrid vehicles (PHEVs), a parameter reflecting the distance share PHEVs are operated mainly from electric energy, which is used to calculate the offical PHEV CO_2 emission values at type-approval.

At present, verifiable accuracy requirements for OBFCM data only exist for tests in the laboratory under type-approval conditions and only for the volumetric fuel consumption. It is therefore necessary to define accuracy requirements for the distance driven and for real-world driving. A new ICCT report develops verifiable OBFCM accuracy requirements for real-world driving and laboratory testing. The study takes into account the accuracy of the OBFCM device itself, the uncertainties introduced by the verification methods, and the differences between type-approval and real-world test conditions.

KEY FINDINGS AND RECOMMENDATIONS

OBFCM FUEL CONSUMPTION ACCURACY RECOMMENDATIONS

» Based on tests performed on chassis dynamometer at conditions similar to type approval and using reference fuel, the OBFCM device accuracy is considered to be ±1.6%, which is much better than the ±5% currently required by the European Union

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type-approval regulation. When performing laboratory tests with market fuel, such as in-service conformity checks, it is justified to define accuracy requirements of ***±1.7% in case of diesel and ±2.7% for gasoline.***

» The wider range of dynamicity and operating conditions a vehicle encounters during real-world operation affect the OBFCM device accuracy. Furthermore, the uncertainty of the fuel consumption verification method needs to be accounted for. Therefore, for real-world driving using reference fuel, the study finds that introducing an OBFCM accuracy requirement of ±3.3% is reasonable. The uncertainty introduced when using market fuel requires lowering the accuracy to ±3.9% when using gasoline but has no significant effect for diesel fuel.

		OBFCM* accuracy requirements		
Test environment	**OBFCM parameter** OBFCM	**Currently defined** for type approval	**Recommended** when using... Reference wheels / Reference fuel	Random wheels / Market fuel
Chassis dynamometer testing	**Fuel consumption**	±5.0%	±1.6%	Diesel: ±1.7% Gasoline: ±2.7%
	Distance	None	±0.6%	±1.9%
Real-world testing	**Fuel consumption**	None	±3.3%	Diesel: ±3.3% Gasoline: ±3.9%
	Distance	None	±0.7%	±1.1%

*On-board fuel- and energy-consumption monitoring

Figure 1: Recommendations for OBFCM fuel consumption and distance accuracy when verified on chassis dynamometer and in real-world driving. Different accuracy recommendations apply when reference fuel and wheels or market fuel and random wheels are used.

OBFCM DISTANCE ACCURACY RECOMMENDATIONS

» A comparison of the distance measured by chassis dynamometer with OBFCM data suggests that an accuracy of ±0.6% can be required from OBFCM devices. During in-service verification tests, wheels different to those used during type approval might be installed on the vehicle. Variability in wheel diameter caused by different tire dimensions, wear and inflation pressure reduces the verifiable OBFCM accuracy to ±1.9%.

» For real-world tests, the uncertainty of the distance measurement method used for verifying the OBFCM accuracy needs to be considered. Together with a slightly better OBFCM device accuracy during real-world driving than on chassis dynamometer, the test results suggest a total OBFCM distance accuracy requirement of ±0.7% is reasonable when using the same wheels as used during type-approval. Using random wheels instead requires reducing the accuracy requirements to ±1.1%.

PLUG-IN HYBRID VEHICLE OBFCM RECOMMENDATIONS

Introducing accuracy requirements should also be considered for plug-in hybrid vehicle specific OBFCM parameters. The study results suggest that the same requirements as for total fuel consumption and distance can be applied for the PHEV operating mode-specific values. However, for verifying OBFCM accuracy, the vehicle needs to communicate the current PHEV operating mode and battery energy flow at the OBD interface. Furthermore, a safe and standardized access for measuring the voltage and current of the high-voltage battery is needed. For the recharged grid energy, it is necessary that the OBFCM value is reported by the vehicle with a higher resolution than currently defined.

PUBLICATION DETAILS

Title: Coming back to reality: A proposal for real-world accuracy requirements for vehicle on-board fuel and energy consumption monitoring

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