International Journal of Automotive Technology (2024) 25:1323–1330
https://doi.org/10.1007/s12239-024-00108-5

Study on the Necessity of Real-World Driving Tests for Passenger Electric Vehicles

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Received: 20 May 2024 / Revised: 27 May 2024 / Accepted: 29 May 2024 / Published online: 5 July 2024

Abstract
Numerous studies are currently focused on improving the performance and efficiency of electric vehicles (EVs). This research aims to evaluate the necessity for a practical testing methodology to simulate real-world driving scenarios by comparing the driving range measured on a chassis dynamometer with the ranges observed under various actual driving conditions. Tests were conducted on the chassis dynamometer using the multi-cycle test (MCT) mode, employing the urban dynamometer driving schedule (UDDS) and the highway fuel economy driving test (HWFET). Subsequently, we assessed the energy efficiency of three routes compliant with the real-driving emissions-light duty vehicles (RDE-LDV) regulations under real-world driving conditions. Our findings revealed disparities in energy efficiency ranging from 10.8 to 22.9% when driving on the same route and up to 29.3% when driving on different routes. This study highlights the importance of tailoring information provision, such as certification tests, to each country's environmental context.

Keywords Electric vehicle · Energy efficiency · Driving range · Real-world driving

Abbreviations

CAN	Controller area network
CSC	Constant speed cycle
EE	Energy efficiency
EV	Electric vehicle
HWET	Highway fuel economy driving test
OBD	On board diagnostics
SOC	State of charge
UDDS	Urban dynamometer driving schedule
WLTP	Worldwide harmonized light vehicle test procedure
RDE-LDV	Real driving emissions-light duty vehicles
MCT	Multi-cycle test

1 Introduction

As the significance of environmental protection and energy efficiency continues to increase, the development and proliferation of electric vehicles (EVs) are advancing rapidly (Sanguesa et al., 2021). Electric vehicles strive to minimize carbon dioxide emissions and promote sustainable utilization of energy, with ongoing research focusing on enhancing vehicle performance and efficiency (Park et al., 2023). Extensive research is underway on battery technology (Chen et al., 2022), lightweight materials (Cimprich et al., 2023), and regenerative braking (Hamada & Orhan, 2022).

To evaluate the performance of EVs under development, Europe employs the WLTP (UNECE, 2021), and the United States and Korea utilize the MCT (SAE, 2021). China adopts the CLTC (Yu et al., 2020) to assess the driving range and energy efficiency of each vehicle. This test mode involves the progression of the state of charge (SOC) of an EV from fully charged to fully discharged. With the advancement of the EV driving range owing to technological progress, there has been an associated increase in test time and costs, resulting in significant fatigue for certification test performers (Choi et al., 2021). Hence, Noh et al., (2024) conducted a study on methods for shortening tests and determined that the short process test (SPT) method can reduce testing times

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