EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 2, Issue 6, June 2026
brightmindpublishing.com
ISSN (E): 3061-6972

PRODUCTION TESTING OF AUTOMOBILE INTERNAL COMBUSTION ENGINES

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Abstract
This article analyzes the testing processes used in the production of automotive internal combustion engines (ICE). Testing plays a vital role in ensuring engine reliability, performance, and environmental compliance. The article discusses test methods that determine performance, durability, thermal performance, and emissions. The integration of automated test benches, digital technologies, and real-time data acquisition systems will also be considered. The role of testing systems in improving product quality and their contribution to sustainable development will be discussed.

Keywords: Internal combustion engine, testing process, automotive industry, emissions, quality control, automation.

Introduction

Internal combustion engines to drive the car were produced continuously from the first days of production. Initially, production capacity was the primary goal, but currently, reducing fuel consumption and emissions are the driving factors.

Internal combustion engines are currently considered an integral part of the automotive industry, despite the increasing popularity of electric vehicles. During the production of such engines, it is necessary to ensure testing and control at every stage. Testing not only guarantees product quality and reliability but also plays a crucial role in identifying, analyzing, and eliminating malfunctions occurring during the

production process. This article provides detailed information on the testing stages in IDP production, their technological solutions, and modern trends.
The automotive industry is considered one of the primary sectors of technological progress on a global scale. Internal combustion engines (ICs) used in this field are still widely used as the driving force of automobiles. Although the development of electric vehicles and hybrid vehicles is significantly reshaping the market, IDPs remain the primary engine type due to their high energy density, long range capabilities, and the development of the fuel industry. Therefore, improving the reliability, environmental safety, and energy efficiency of internal combustion engines is one of the important scientific and practical issues [1,2,3].
The production process of a car engine does not only end with its assembly, but is also fully evaluated through testing stages that determine the technical condition, parameters, quality, and compliance with environmental standards of each assembled engine. Testing processes serve to determine the engine's performance, durability, emission levels, and other important factors.
Modern engine testing systems are integrated with advanced technologies such as high-precision measuring instruments, automated control systems, real-time monitoring, and digital data analysis. In particular, with the help of digital twins, artificial intelligence (AI), and Industry 4.0 technologies, testing processes are becoming more efficient and predictive [4,5,6].
This article examines the main types of tests used in the production process of internal combustion engines, their technical and technological characteristics, and modern testing equipment.

Test methods for internal combustion engines:
Testing of operational activity. This test is conducted to evaluate the overall performance parameters of the engine. The key metrics are torque, power (horsepower), fuel consumption, and acceleration response. The engines are mounted on a dynamometer and tested under various load and speed conditions. This process determines how the engine performs throughout the full cycle.
Endurance and reliability tests. This type of test simulates the long-term operation of the engine. The purpose of this is to obtain information on the degree of wear of components, thermal fatigue, the reliability of the lubrication system, and the total

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service life. During the tests, the engine is used in various environments and load conditions.

Thermal and mechanical stress tests. The engine is tested at extreme temperatures, ranging from a cold start to high temperatures. This will be used to assess the efficiency of the cooling system, thermal expansion, and material durability.

Vibration tests also help determine the mechanical stability of the engine.

Emission tests. To ensure compliance with environmental standards, the gases emitted by the PV plant are tested for carbon monoxide (CO), nitrogen oxide (NOx), hydrocarbons, and particulate matter. This process is carried out using gas analyzers. Emission testing is aimed at determining compliance with Euro 6, US EPA, and China VI standards [7,8,9].

Equipment and technological integration. Modern engine test stands include the following technologies:

• Dynamometers - for accurate measurement of momentum and power.
• Gas analyzers - accurately analyze exhaust gases.
• DAQ (Data Acquisition System) - collects operational parameters in real time.
• HIL (Hardware-in-the-Loop) - allows for testing based on virtual simulation.
• Automated systems - conduct tests without human intervention.

Additionally, digital twin technology allows for the simulation of a real engine model in a virtual environment. This greatly helps in reducing test costs and ensuring rapid diagnostics [10,11,12,13].

As a practical example, a system implemented at a European automobile plant. Automated test stands developed by a major European automaker test each engine in both cold and hot modes after assembly. These tests determine fuel pressure, the accuracy of combustion time, and emission levels. Any malfunctions detected in the engine are automatically recorded in the database, and the product is sent to the processing or rejection line. The automated testing system implemented at this plant reduced quality deviations by 15% and increased the speed of fault detection by 30% [14,15,16].

Challenges and future directions. The increasing complexity of internal combustion engines, hybrid systems, and increasing environmental constraints require new testing approaches [17,18,19]:

• Pre-simulation using digital twins.
• Fault prediction systems based on artificial intelligence.

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• Modular test stands - adaptable to hybrid and electromechanical systems.
• Energy-efficient testing technologies - environmentally and economically advantageous [20,21].

Below is an Ishikawa diagram for analyzing problems arising during the production testing of automotive internal combustion engines (Fig. 1). This diagram helps identify the causes of problems during the testing process.

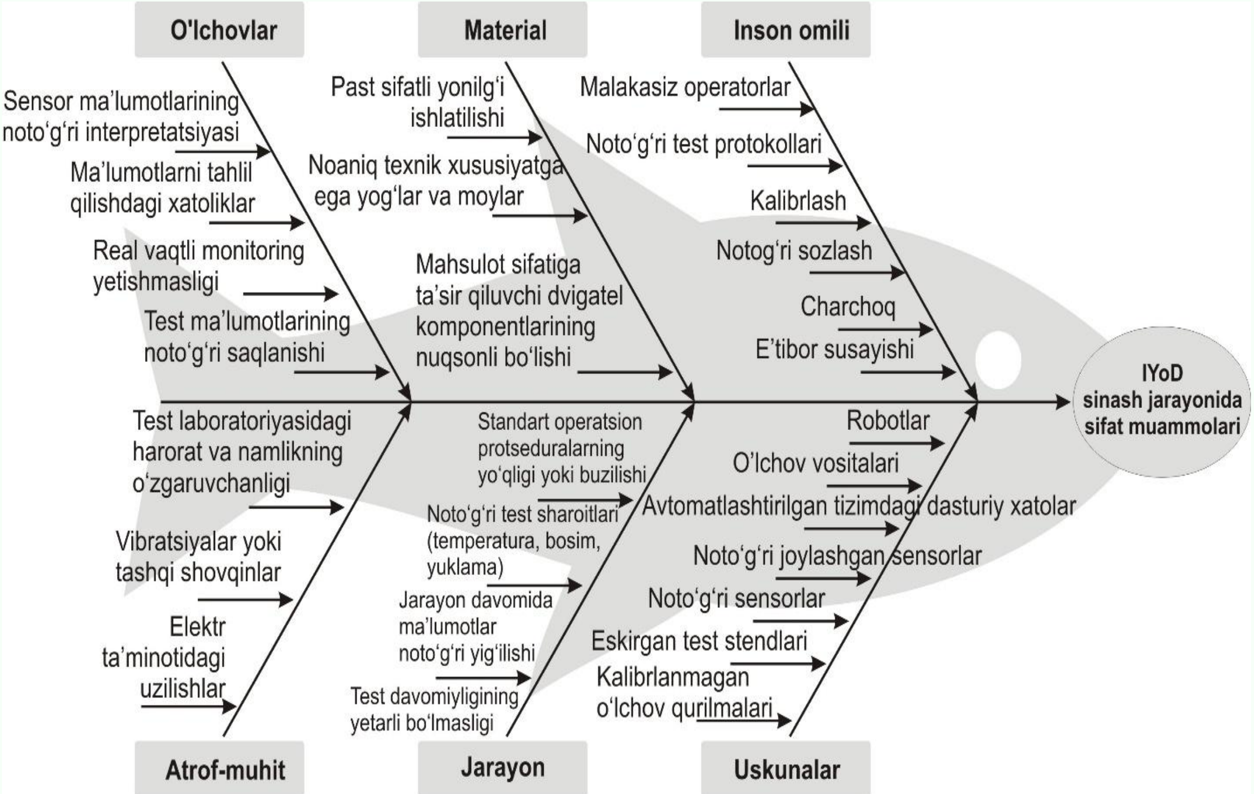

Figure 1. Ishikawa diagram for analyzing problems that arise during the testing process in the production of automotive internal combustion engines.

In the production of internal combustion engines, testing is an integral stage that ensures compliance with quality, safety, and environmental standards. As a result of modern technological advancements, testing processes are becoming more precise, rapid, and highly automated. Internal combustion engines will continue to play an important role in the automotive industry for many years to come. Therefore, the further improvement of testing systems remains a strategic priority for automakers.

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References

1. V A Likhanov and O P Lopatin 2020 IOP Conf. Ser.: Mater. Sci. Eng. **919** 032011. https://doi.org/10.1088/1757-899X/919/3/032011
2. G.I. Pavlov, O.R. Sitnikov, K.A. Valeeva. Performance Evaluation of Internal Combustion Engines Silencers based on Comparative Testing of Their Characteristics on Non-Motorized Test Stand. Procedia Engineering, Volume 206, 2017, Pages 1672-1677, https://doi.org/10.1016/j.proeng.2017.10.696.
3. Harach, T., Simonik, P., Vrtkova, A., Mrovec, T., Klein, T., Ligori, J. J., & Koreny, M. (2023). Novel Method for Determining Internal Combustion Engine Dysfunctions on Platform as a Service. Sensors (Basel, Switzerland), 23(1), 477. https://doi.org/10.3390/s23010477
4. Wanhua Su, Zhongjie Zhang, Ruilin Liu, QiaoYingjun. Development Trend for Technology of Vehicle Internal Combustion Engine. Strategic Study of CAE, 2018, 20(1): 97–103. https://doi.org/10.15302/J-SSCAE-2018.01.014.
5. Andrych-Zalewska, M., Chłopek, Z., Merkisz, J., & Pielecha, J. (2022). Analysis of the operation states of internal combustion engine in the Real Driving Emissions test. Archives of Transport, 61(1), 71–88. https://doi.org/10.5604/01.3001.0015.8162
6. Andrych-Zalewska M. Research of pollutant emissions from automotive internal combustion engines in conditions corresponding to the actual use of vehicles. Combustion Engines. 2023;193(2):64-70. https://doi.org/10.19206/CE-162621
7. Evdonin E.S., Dushkin P.V., Kuzmin A.I., Khovrenok S.S., Kremnev V.V. Automation of an automobile internal combustion engine bench calibration tests. Trudy NAMI. 2021;(4):12-21. (In Russ.) https://doi.org/10.51187/0135-3152-2021-4-12-21
8. Rolf D. Reitz. Directions in internal combustion engine research. Combustion and Flame, Volume 160, Issue 1, 2013, Pages 1-8, https://doi.org/10.1016/j.combustflame.2012.11.002.
9. Guardiola, C., Baron, P., Sala, S., Vera, X. et al., "Engine Combustion Hardware Diagnostics in an End-of-Line Cold Test Stand," SAE Technical Paper 2022-01-0270, 2022, https://doi.org/10.4271/2022-01-0270.
10. Dömötör, Ferenc, and József Zoltán Szabó. "Vibration Diagnostics as an effective Tool for Testing Engines of Internal Combustion" Production Engineering

Archives, vol. 16, no. 16, Sciendo, 2017, pp. 3-6. https://doi.org/10.30657/pea.2017.16.01
11. Felix Leach, Gautam Kalghatgi, Richard Stone, Paul Miles. The scope for improving the efficiency and environmental impact of internal combustion engines, Transportation Engineering, Volume 1, 2020, 100005, https://doi.org/10.1016/j.treng.2020.100005.
12. Biernat, K.; Samson-Bręk, I.; Chłopek, Z.; Owczuk, M.; Matuszewska, A. Assessment of the Environmental Impact of Using Methane Fuels to Supply Internal Combustion Engines. Energies 2021, 14, 3356. https://doi.org/10.3390/en14113356
13. Bebkiewicz, K., Chłopek, Z., Sar, H. et al. Comparison of pollutant emission associated with the operation of passenger cars with internal combustion engines and passenger cars with electric motors. Int J Energy Environ Eng 12, 215–228 (2021). https://doi.org/10.1007/s40095-021-00382-4
14. Johann Peter Murmann, Benedikt Alexander Schuler. Exploring the structure of internal combustion engine and battery electric vehicles: implications for the architecture of the automotive industry, Industrial and Corporate Change, Volume 32, Issue 1, February 2023, Pages 129–154, https://doi.org/10.1093/icc/dtac049
15. Nguyen-Tien, V., Zhang, C., Strobl, E. et al. The closing longevity gap between battery electric vehicles and internal combustion vehicles in Great Britain. Nat Energy 10, 354–364 (2025). https://doi.org/10.1038/s41560-024-01698-1
16. J. Sroka, Z. (2021). Work Cycle of Internal Combustion Engine Due to Rightsizing. IntechOpen. doi: https://doi.org/10.5772/intechopen.97144
17. Fogaça, P., Souza, D. L. de ., & Manéa, F.. (2018). Comparação entre os processos de Cold Test e Hot Test em uma empresa fabricante de motores diesel. Gestão & Produção, 25(2), 343–353. https://doi.org/10.1590/0104-530X3094-16
18. Koten H, Mostafa Namar M. Artificial Intelligence in Diesel Engines [Internet]. Diesel Engines - Current Challenges and Future Perspectives. IntechOpen; 2024. http://dx.doi.org/10.5772/intechopen.1003741
19. MAMALA, J., BROL, S., JANTOS, J. (2011). The operating parameters of internal combustion engines in the road test. Combustion Engines, 146(3), 45-52. https://doi.org/10.19206/CE-117092
20. Amandine Lecocq, Marie Bertana, Benjamin Truchot, Guy Marlair. Comparison of the fire consequences of an electric vehicle and an internal combustion engine

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brightmindpublishing.com
ISSN (E): 3061-6972

vehicle. 2. International Conference on Fires In Vehicles - FIVE 2012, Sep 2012, Chicago, United States. pp.183-194. https://ineris.hal.science/ineris-00973680

21. Daniel, K. (2014). Engine Performance Test Development. In: Mang, T. (eds) Encyclopedia of Lubricants and Lubrication. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-22647-2_161.