

THE USB AUTOSCOPE IV IN RESEARCHING THE PARAMETERS OF INTERNAL COMBUSTION ENGINES WITH FOURTH-GENERATION LPG SYSTEMS

The significant economic advantage of using vehicles converted to use liquefied petroleum gas as an alternative fuel has led to the widespread presence of such vehicles in the Ukrainian automotive market. However, there is a need for servicing and repairing such vehicles, which involves proper diagnosis of fuel delivery system parameters, evaluation of the ignition, intake and exhaust systems (including catalytic exhaust gas neutralization systems), as well as systems controlling engine operation on liquefied petroleum gas (LPG).

Postolovsky IV (USB Autoscope IV) digital oscilloscope significantly speeds up the diagnosis of faults in the elements of the vehicle engine system equipped with LPG, as well as expands the range of recorded parameters during testing to identify faults that are not detected by the onboard OBD2 diagnostic system. The USB Autoscope IV diagnostic complex consists of Postolovsky IV digital oscilloscope, a set of sensors and cables for it, and a software interface that allows recording parameters in real time for further analysis.

One of the principles of using this diagnostic complex is assessing the crankshaft rotation speed of the vehicle engine in various operating modes by registering the signal from the crankshaft sensor and the ignition coil signal used for synchronization. The crankshaft sensor signal carries information about the nature of the shaft rotation due to impulses from fuel-air mixture flashes in the combustion chamber. The quality of these impulses and the crankshaft rotation speed allow evaluating the fuel system condition, ignition system condition, engine mechanics condition, detecting signal deviations from the standard, and identifying and localizing faults.

This is possible by following a specific sequence of measurements. Typically, parameters are recorded in idle mode on gasoline, followed by a sharp increase in engine speed to evaluate its condition under load. Without interrupting the recording, similar actions are taken after switching the vehicle to operate on liquefied gas for comparison. At the end of the recording, there is a sudden over-rev with simultaneous ignition cut-off and fully pressed accelerator pedal until the engine stops. During this mode, fuel delivery stops, but the crankshaft continues to rotate due to inertia, compressing air in the

chambers. Analyzing the crankshaft rotation speed at this stage allows assessing relative compression and combustion chamber sealing.

As an example, the diagram of the crankshaft rotation speed of a Nissan Qashqai car converted to operate on liquefied petroleum gas using the STAG Qbox Basic distributed injection system is provided. The owner complained about the loss of dynamic characteristics of the car and unstable engine operation. The OBD2 onboard diagnostic system detected a P300 error – multiple ignition misfires.

As can be seen from Figure 1, the fourth cylinder operates inefficiently, only occasionally engaging in operation. During the fuel cut-off stage, gas compression in the cylinder occurs similarly to the other engine cylinders. Considering that a similar situation is observed when running on gas and gasoline, a conclusion was made about a malfunction in the ignition system of the fourth cylinder, in the form of a damaged spark plug, which was subsequently confirmed.

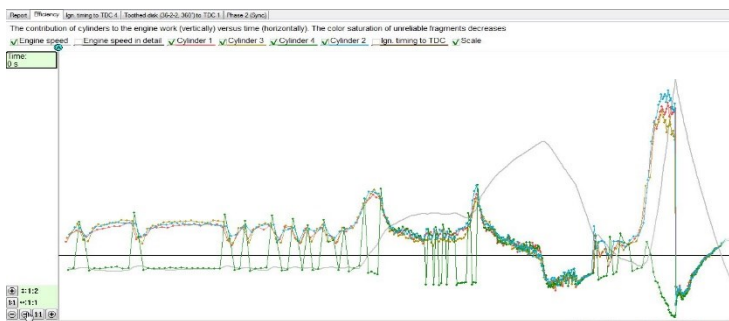


Figure 1 - Cylinder Contribution Diagram for the Nissan Qashqai Engine Operation on Different Fuels

Using USB Autoscope IV diagnostic complex in this case allowed pinpointing the malfunction with one measurement. Based on the recorded data, it is possible to analyze the performance of the gasoline, gas, high-voltage systems of the vehicle, as well as the engine mechanics.