

# Comparative constant speed and idle tests with air conditioner On/Off

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## THE PURPOSE OF STUDY

Study of the influence of the operation of climate control and conditioning systems on the content of pollutants in the interior air of car category M1 .

## LOCATION AND TEST MODES

The tests were carried out on the dynamometer road of NICIAMT FSUE NAMI.

The tests were carried out for a long time in various temporary and climatic conditions from May to October 2019.

**Test Modes 1** – The movement of the test car at a constant speed of  $50\pm 5$  km/h.

**The operation of ventilation systems and climate control of the car during the execution of the mode**

- the climate control system or air conditioning is turned **on**, the interior temperature is set at  $20\pm 5^{\circ}\text{C}$ , forced ventilation is turned on in the minimum or middle position, internal recirculation is turned off;
- climate control system or air conditioning **off**, forced ventilation turned on in the minimum or middle position, internal recirculation off.

**Test mode 2** - “Idle” mode in the parking zone The car is installed so that the exhaust pipe is against the main direction of the wind.

**The operation of ventilation systems and climate control of the car during the execution of the mode:**

- climate control system or air conditioning is turned **on**, the interior temperature is set at  $20\pm 5^{\circ}\text{C}$ , forced ventilation is turned on in the minimum or middle position, internal recirculation is turned off;
- climate control or air conditioning **off**, forced ventilation turned on in minimum or middle position, internal recirculation off.

# Test objects

There were tested the cars category of the M1 of various manufacturers with different body styles and various types of engines running on gasoline, gas and diesel fuels.

The total number of tested cars are 28.

The number of cars with engines running on gasoline fuel - 20

The number of cars with diesel engines - 7

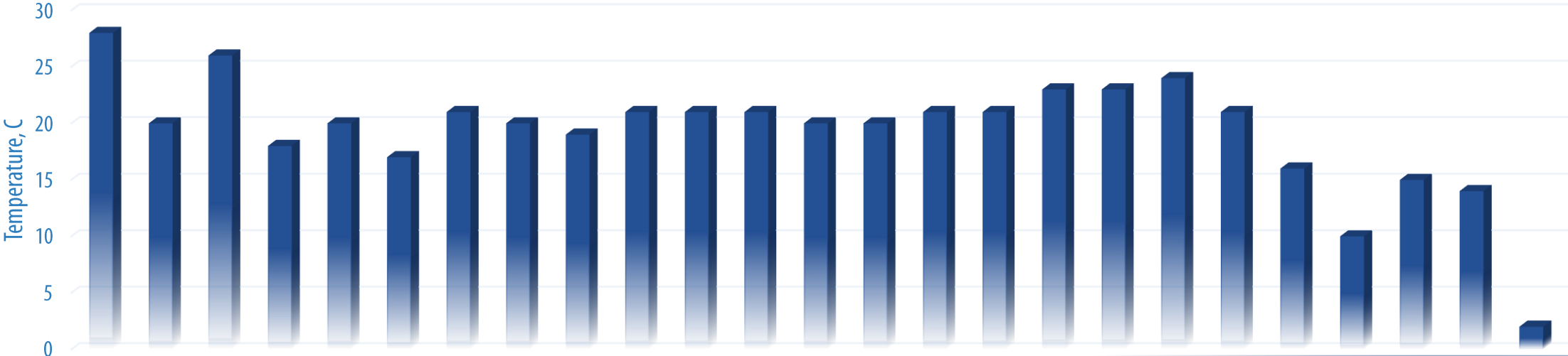
The number of cars with a dual-fuel gas-diesel engine - 1

Body types of tested cars - sedan, hatchback, station wagon, convertible.

# Test conditions

The tests were carried out on a dynamometer road in the absence of other cars, which may affect on the appearance of pollutants in the passenger compartment of the test car. Windows, doors, windows, ventilation hatches of the test car during the test should be closed. The vehicle mileage was not critical to the choice of the test object and was recorded in the test report. The vehicle should be filled up to 80% of the fuel tank capacity before testing. Wind speed was varied from 0 to 5 m/s during test modes and was recorded in the test report.

**Ambient temperature during test period**



## Test methods and equipment

Quantitative measurement of pollutants in the air of internal space (salon) of test vehicles shall be performed with the use of following methods:

### **For nitrogen oxide and dioxide, NO, NO<sub>2</sub>**

Method - Chemiluminescence, CLD

Gas analyser - R-310 A , Optek , S-Petersburg

Chemiluminescent (heterogenic)

Measuring of NO, NO<sub>2</sub> in ambient atmospheric air, nominal resolution - 0,001 mg/m<sup>3</sup> (0,001 ppm), main error limits ±25% or ±0,5 parts of main error, discreteness of the analysis – 180 s

### **For carbon monoxide, CO**

Method - High sensitivity electrochemistry

Gas analyser - Optogas 500-4-CO, Optec, S-Petersburg

Measuring of CO in ambient atmospheric air, nominal resolution - 0,01 mg/m<sup>3</sup>  
main error limits ±25%, discreteness of the analysis – 10 s

## Test methods and equipment (continuation)

Two methods of measurement are possible:

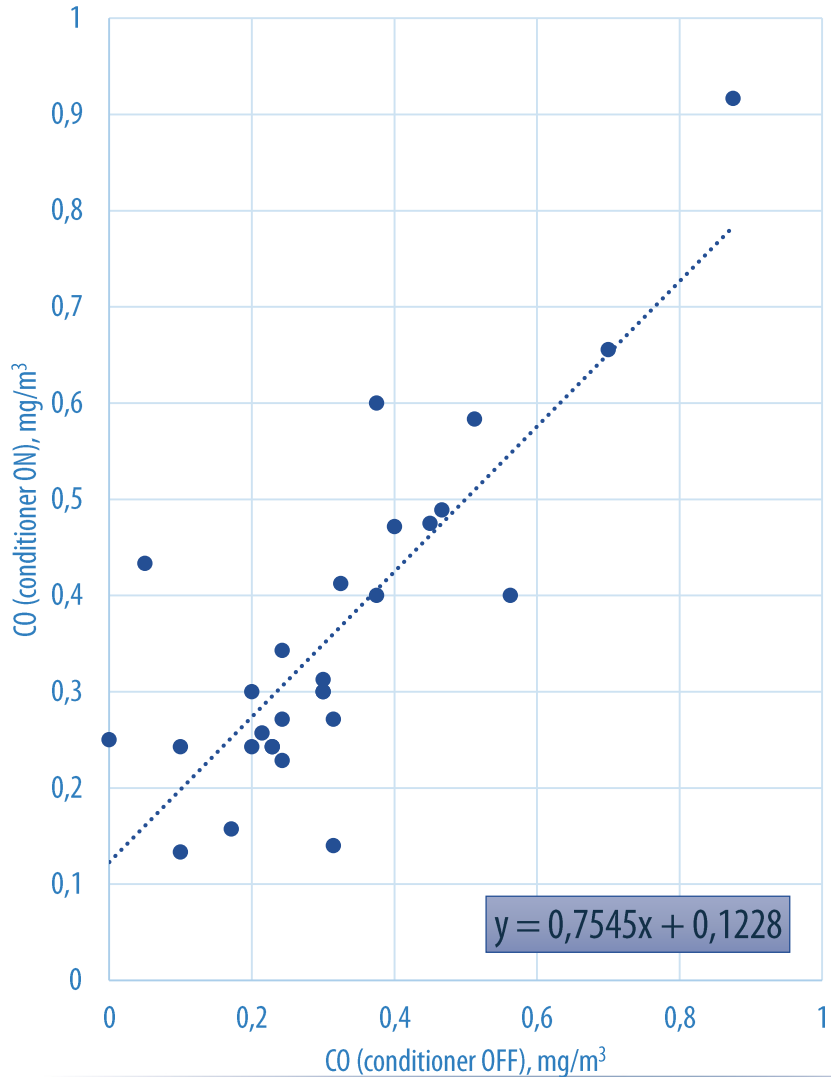
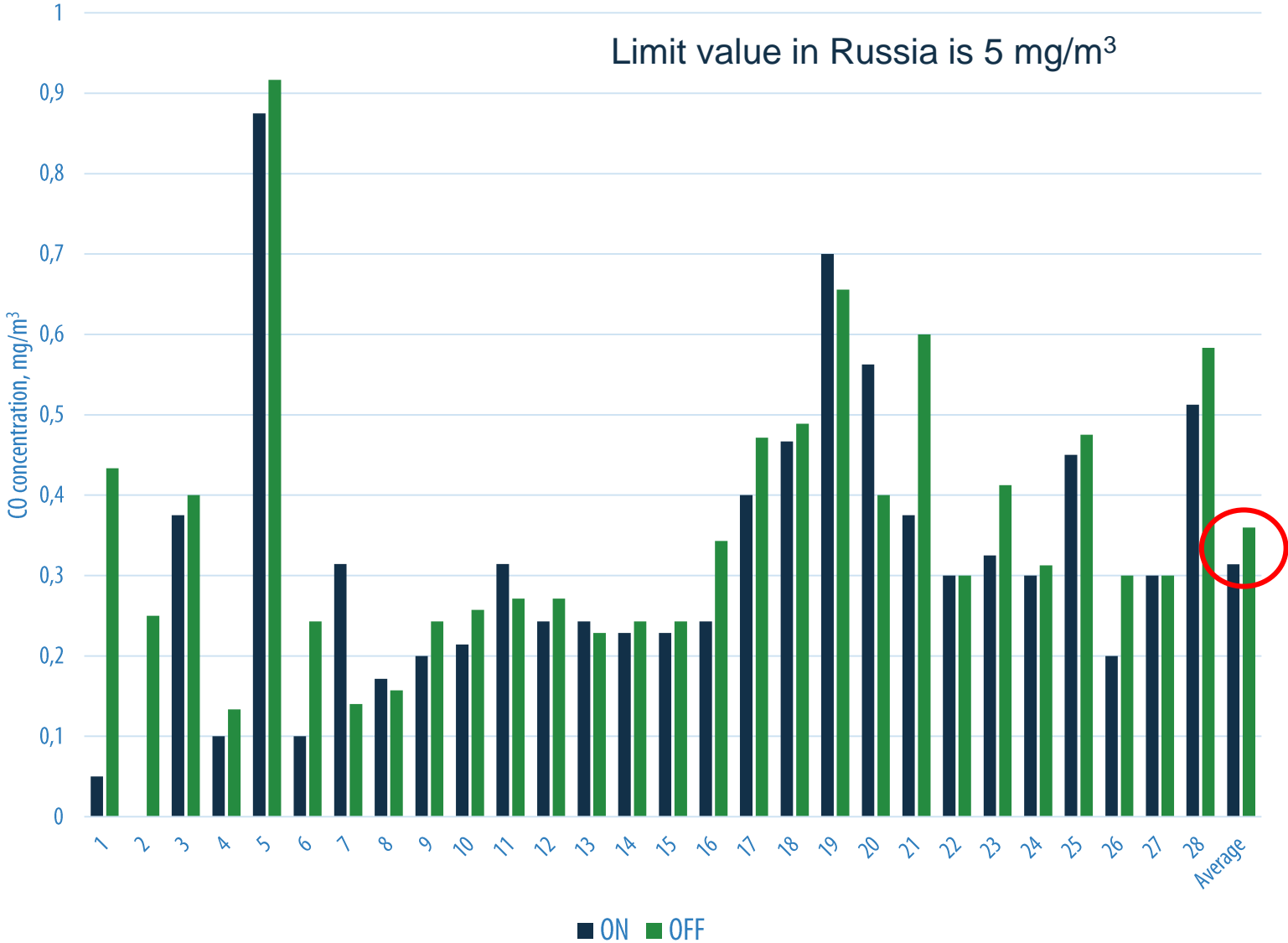
- On-line analysis of pollutants directly in the air of the interior of the test vehicles
- Stationary method of measuring pollutants in the laboratory after preliminary sampling of air in sealed bags, pipettes, sorption tubes and cartridges.

The choice of the method of measurement depends, first of all, on the mass, the dimensions of the used measuring tools (MT), their installation in the vehicle before the test.

When the MT have the optimum dimensions and the required technical parameters, it shall be on-line measurement of the pollutants.

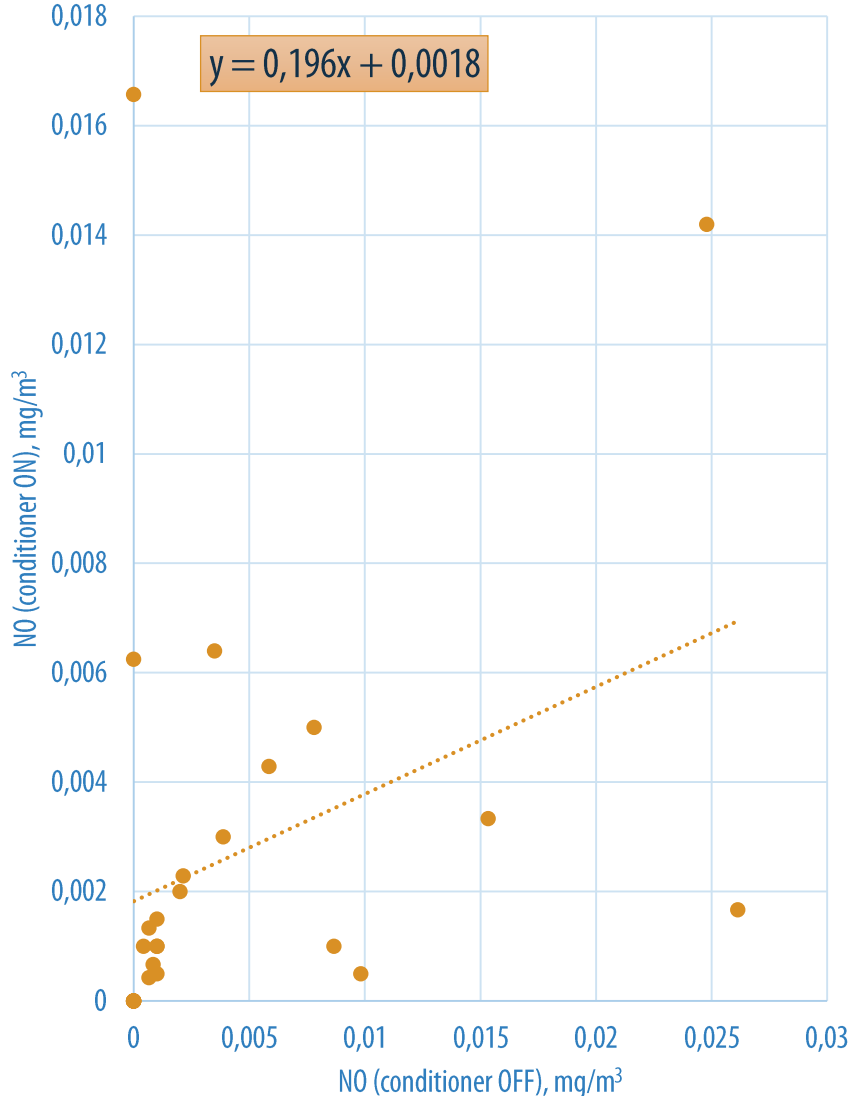
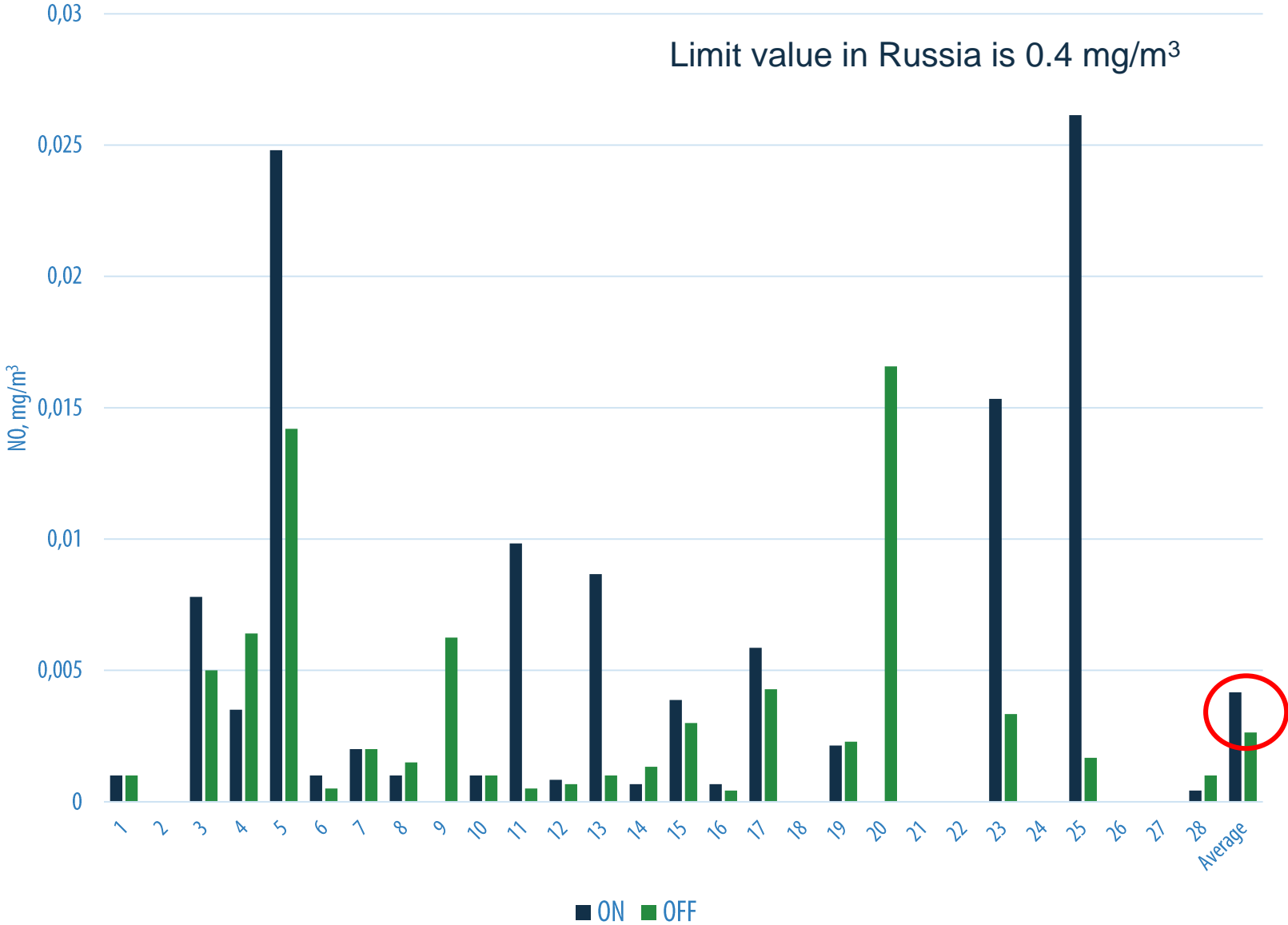
In all cases online analysis were used in the tests. Only when testing a convertible car with low passenger compartment preliminary sampling in bags was used with subsequent analysis under stationary conditions in laboratory.

# Comparative constant speed tests with air conditioner On/Off results (CO concentration)

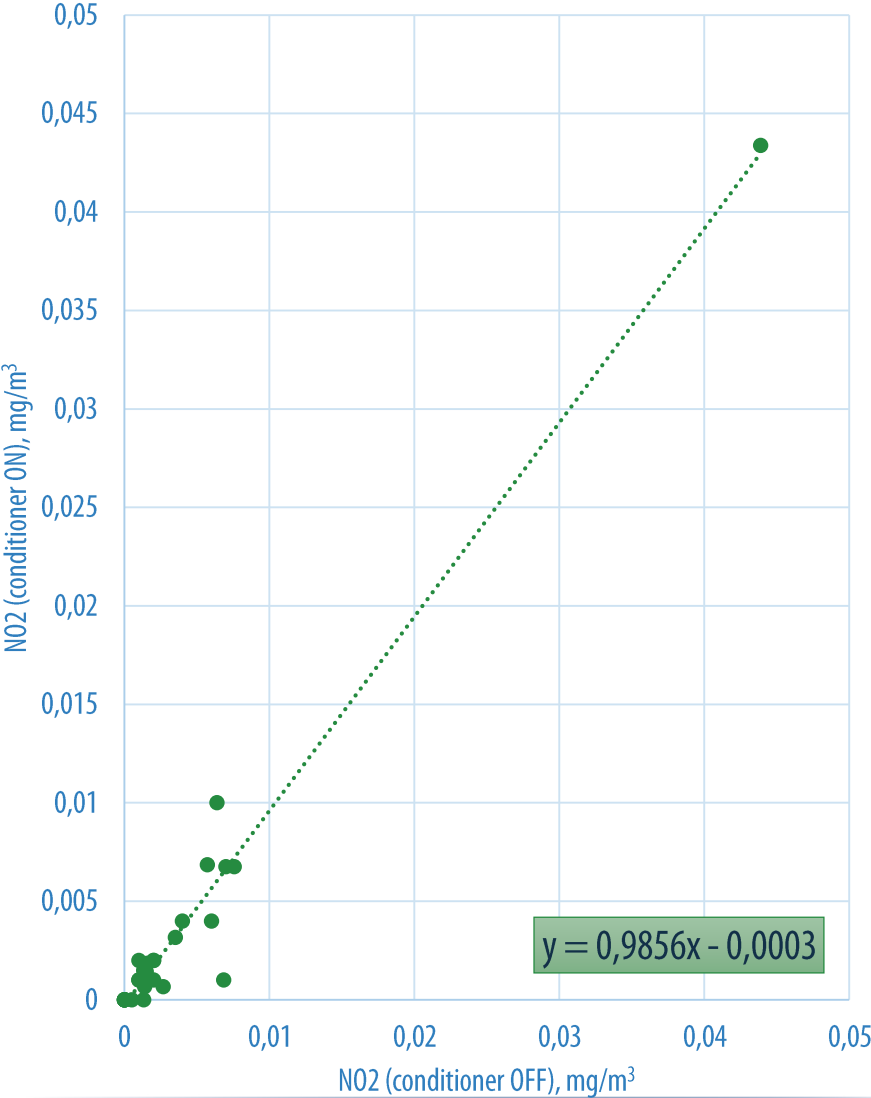
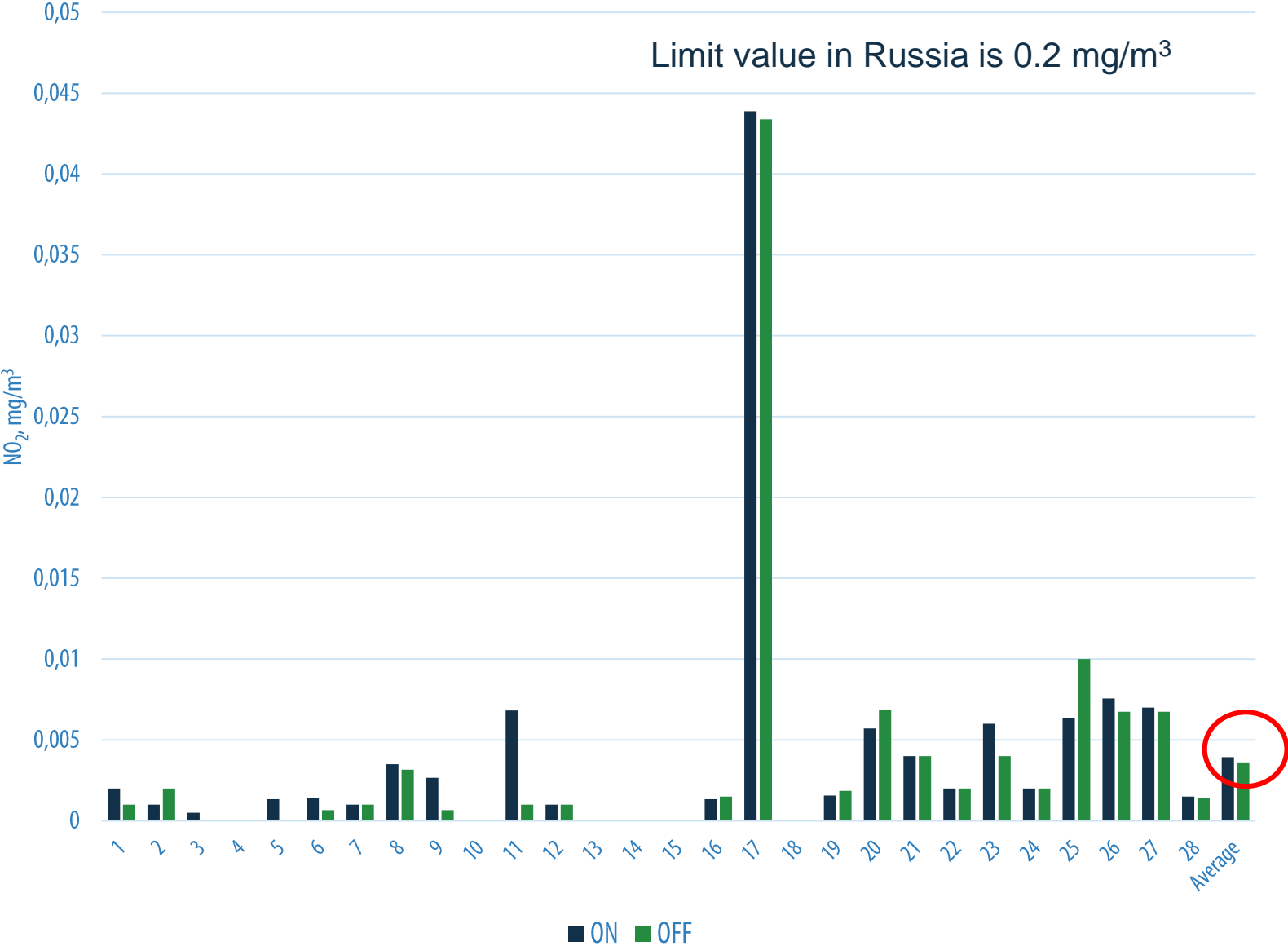




# Comparative constant speed tests with air conditioner On/Off results (NO concentration)

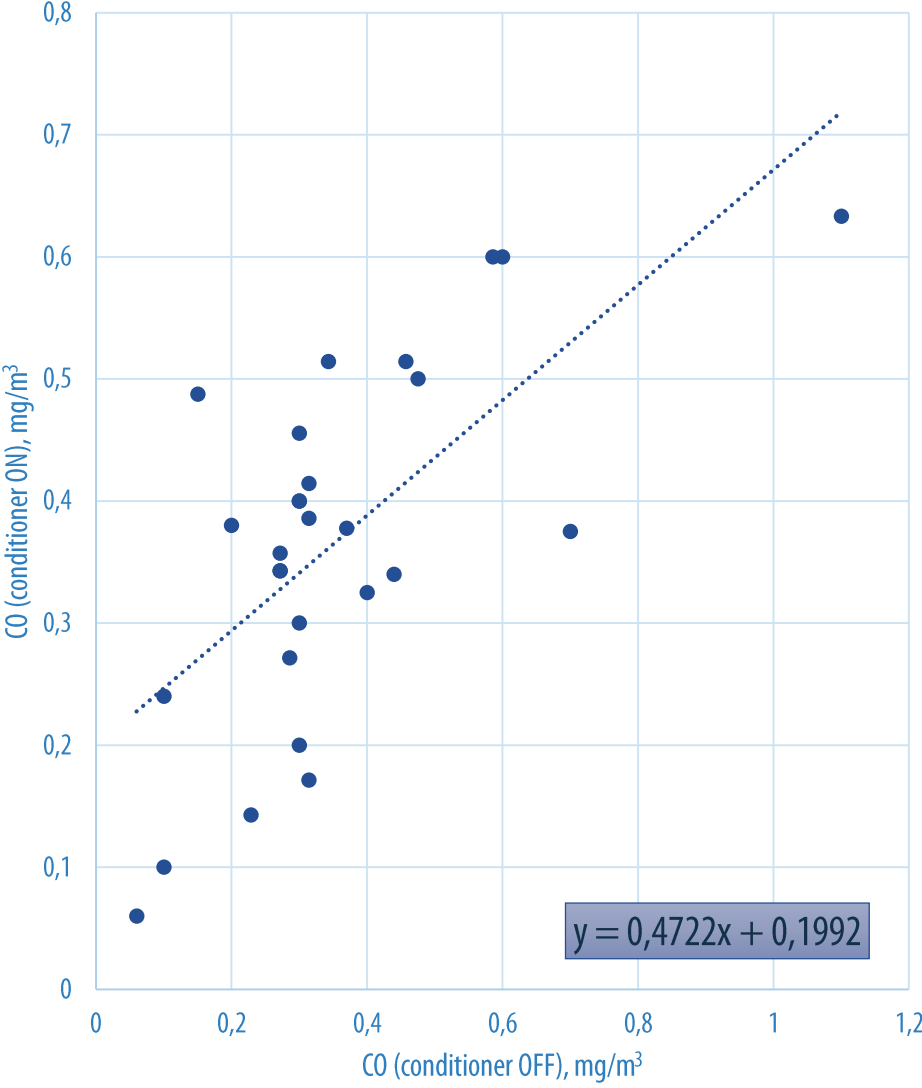
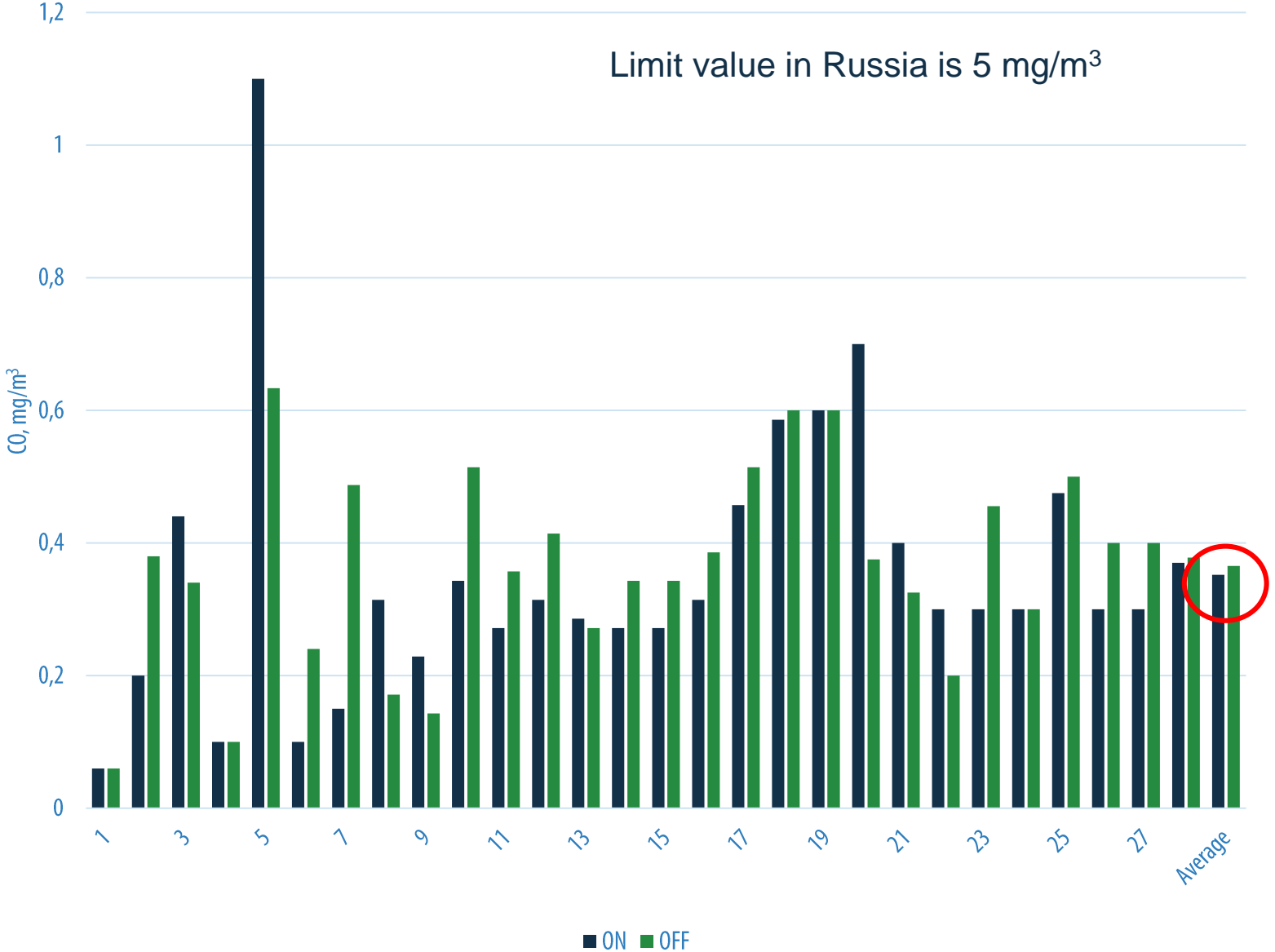


# Comparative constant speed tests with air conditioner On/Off results (NO<sub>2</sub> concentration)

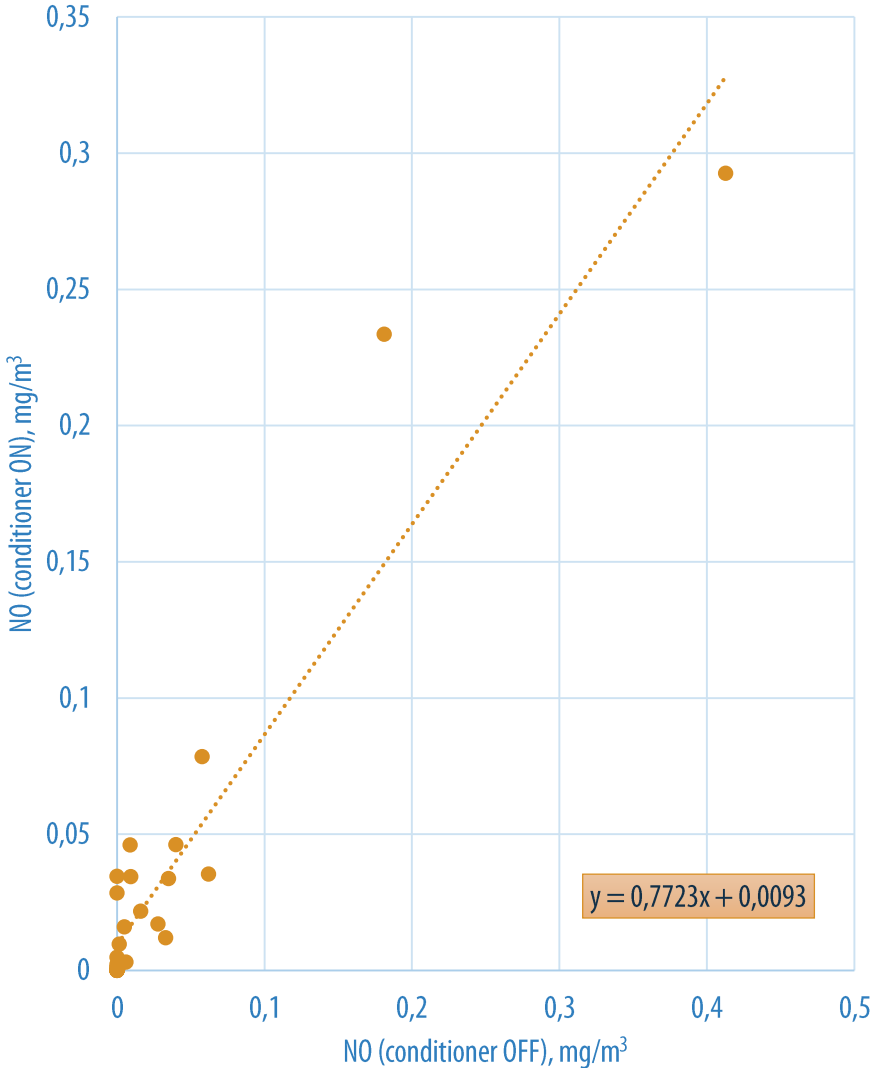
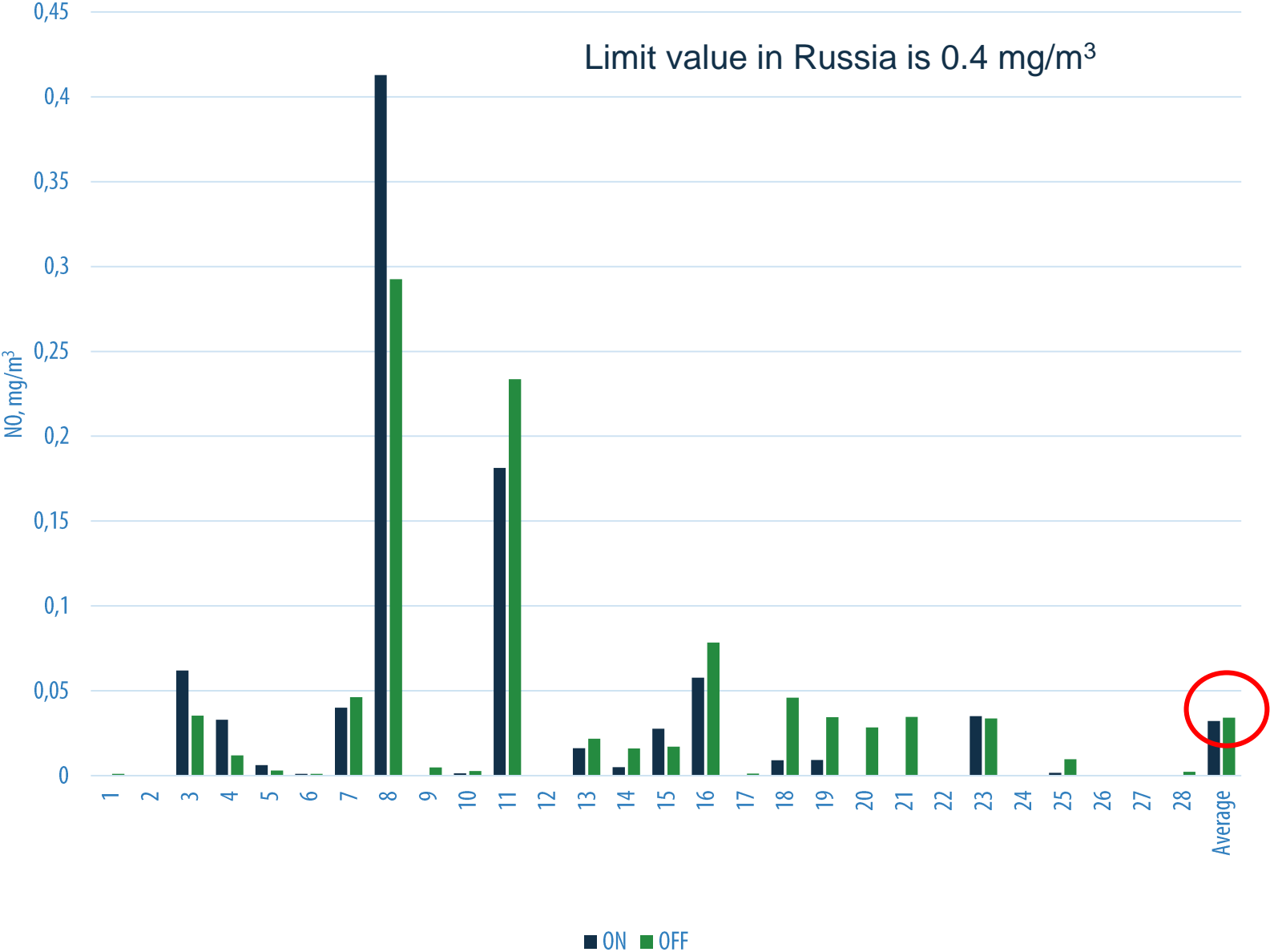


# Comparative idle tests with air conditioner On/Off results (CO concentration)

Limit value in Russia is 5 mg/m<sup>3</sup>



# Comparative idle tests with air conditioner On/Off results (NO concentration)



# Comparative idle tests with air conditioner On/Off results (NO<sub>2</sub> concentration)



1. A slight influence of the air conditioning systems operation mode is noted. On the content of pollutants in the interior air of the test vehicles with gasoline and diesel engines both tested at constant speed and during idling mode.
2. In some cases, during testing when the climate control and conditioning systems were turned off, the air temperature at the passenger compartment of the tested car was rose to critical values for human health - +32...34°C.
3. The obtained results allow to recommend the conducting tests of vehicles when climate control and air conditioning systems should be turned on.

**Thank you for your attention!**

