

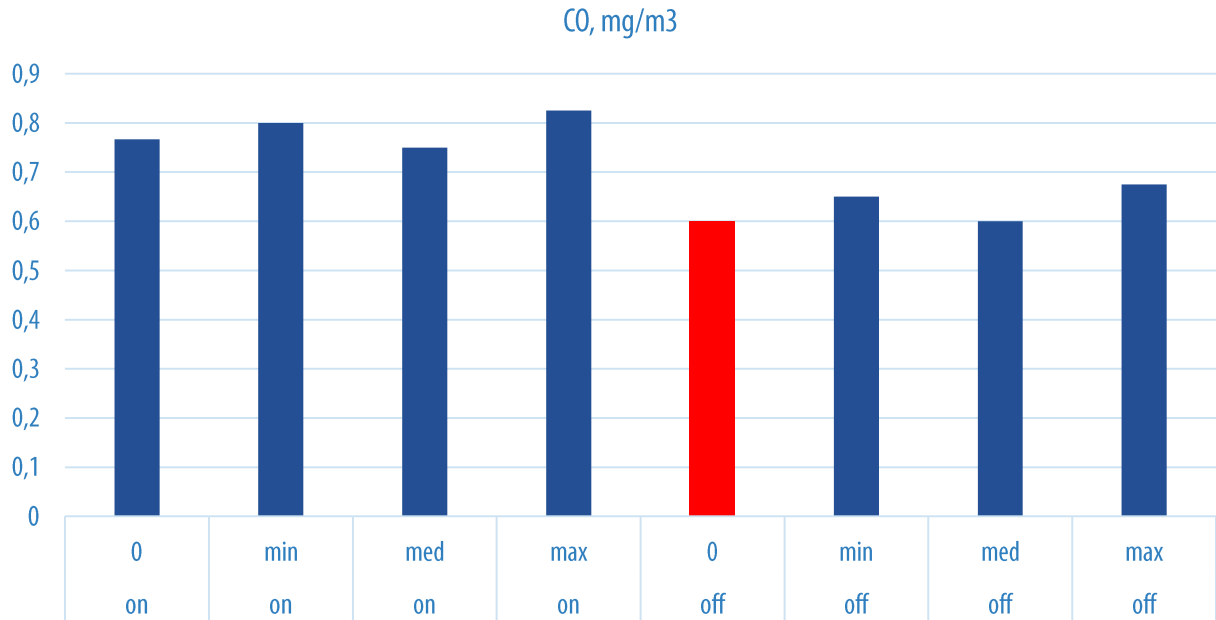
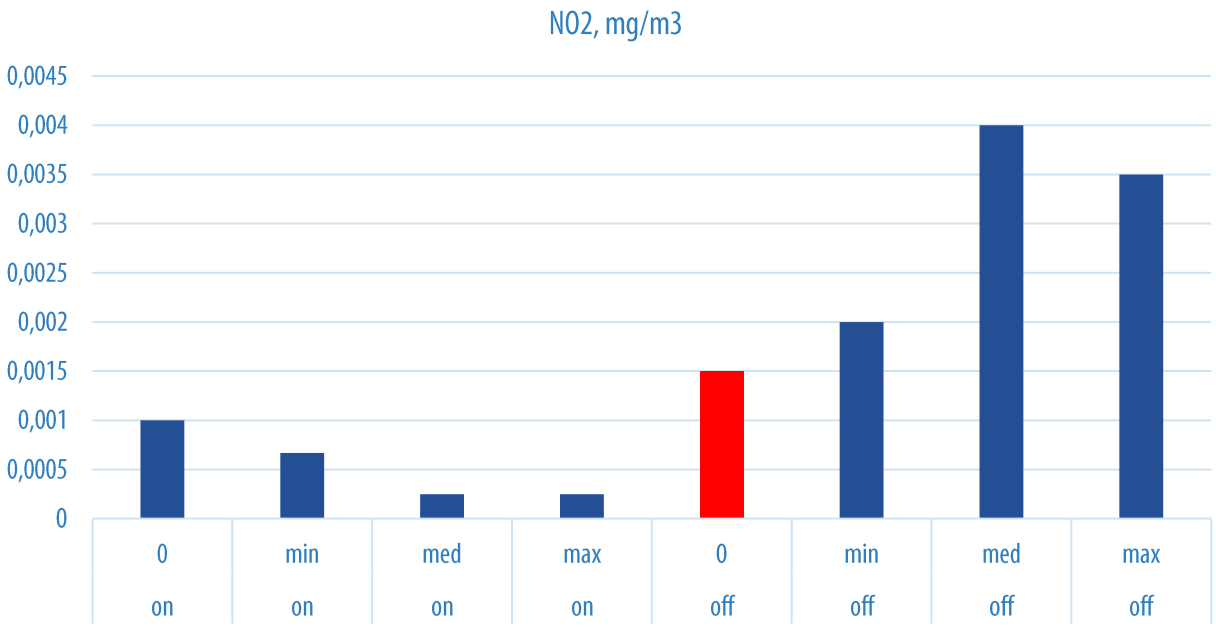
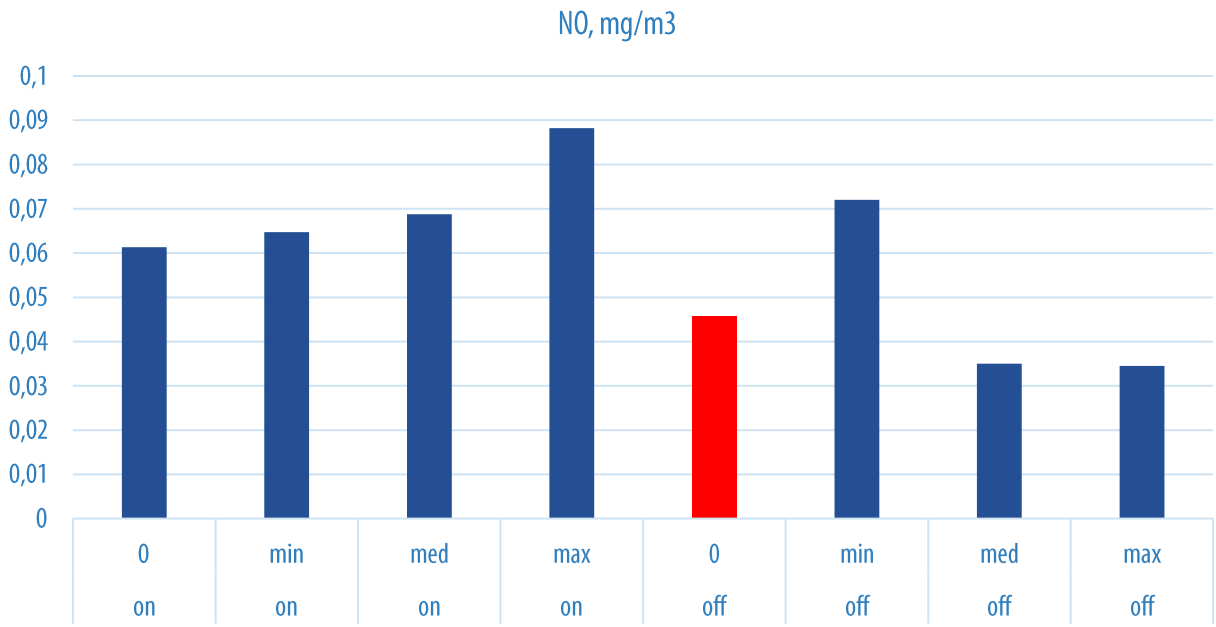
Analysis of car interior air quality investigation results

Andrey KOZLOV
Zinaida BULYCHEVA



Idling

Test car #1 (gasoline), manual transmission



Air fan mode: 0-off., min, med, max
Recirculation mode: on, off

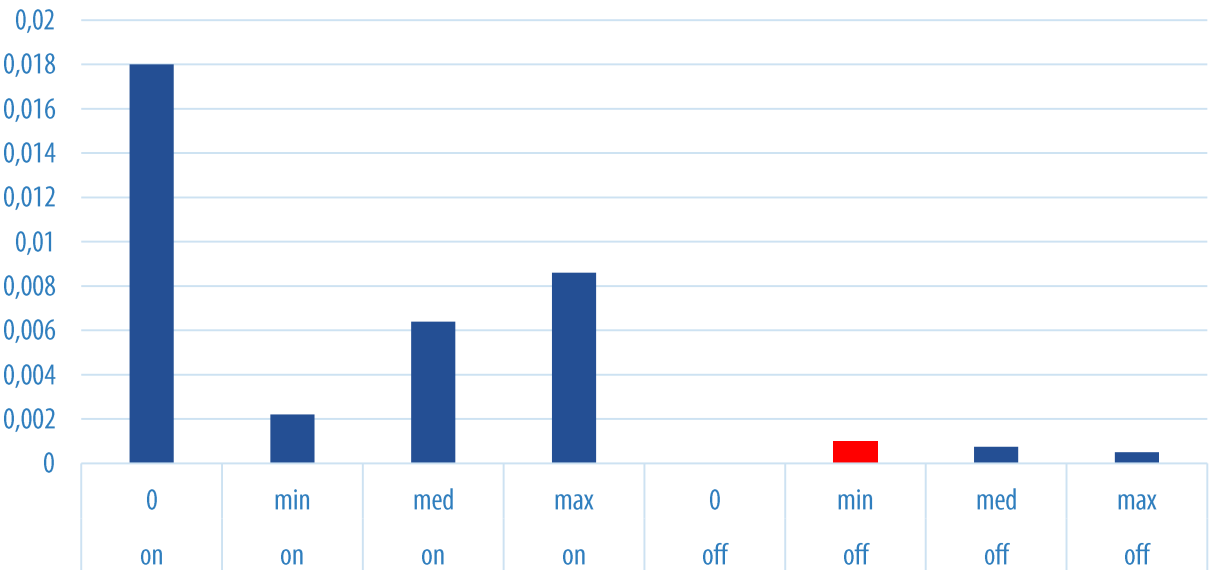
 The mode corresponds to test mode II of GOST 33554-15



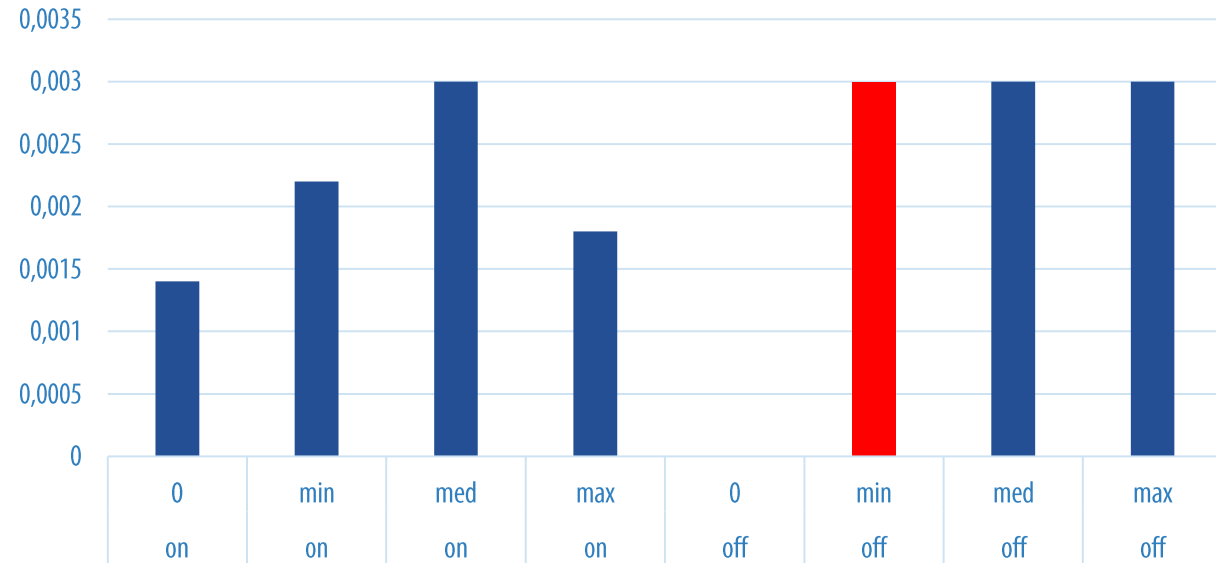
Idling

Test car #2 (gasoline), automatic transmission

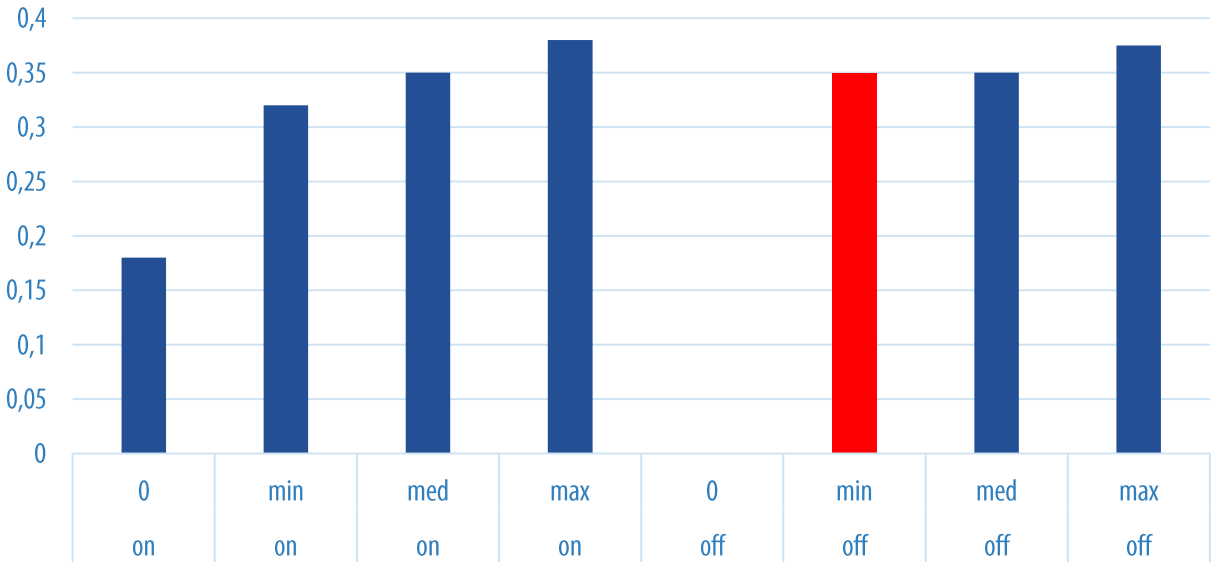
NO, mg/m3



NO2, mg/m3



CO, mg/m3



Air fan mode: 0-off., min, med, max
 Recirculation mode: on, off



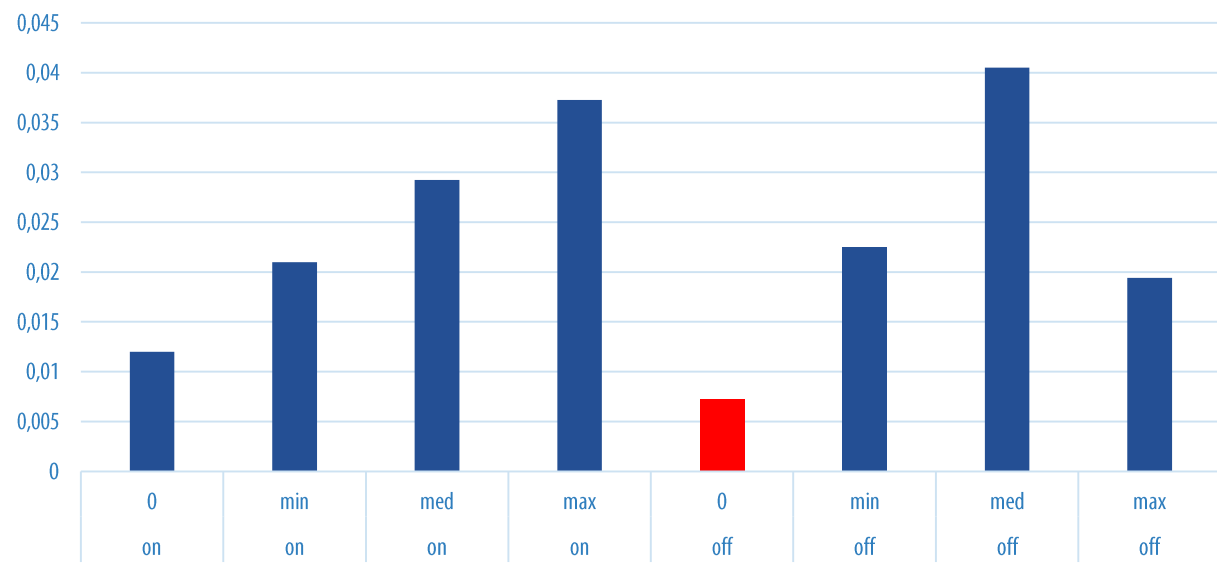
The mode corresponds to test mode II of GOST 33554-15



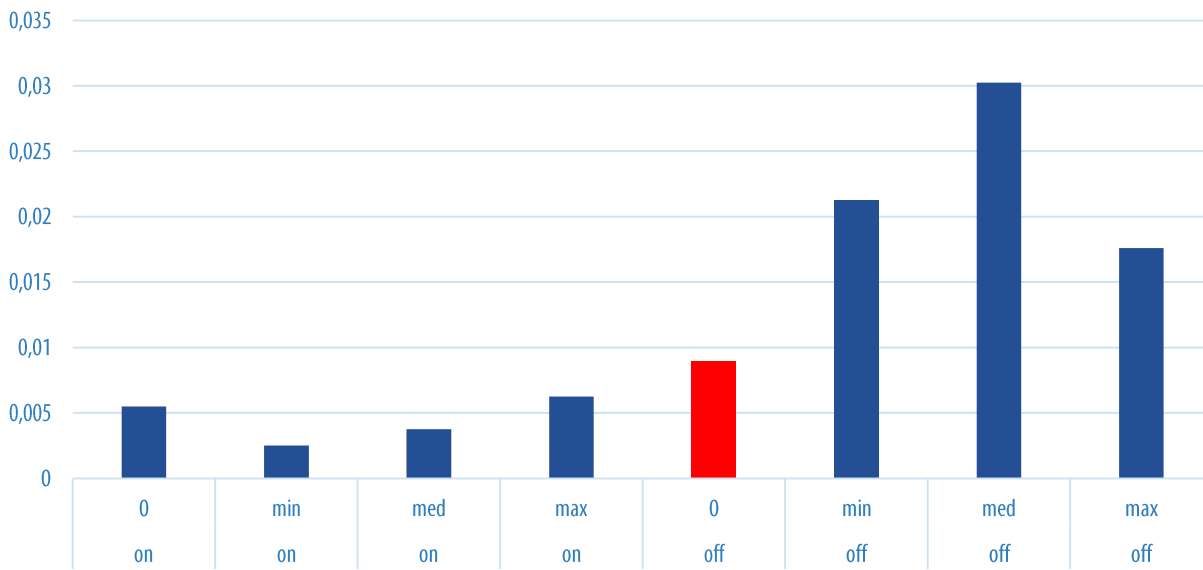
Idling

Test car #3 (gasoline), manual transmission

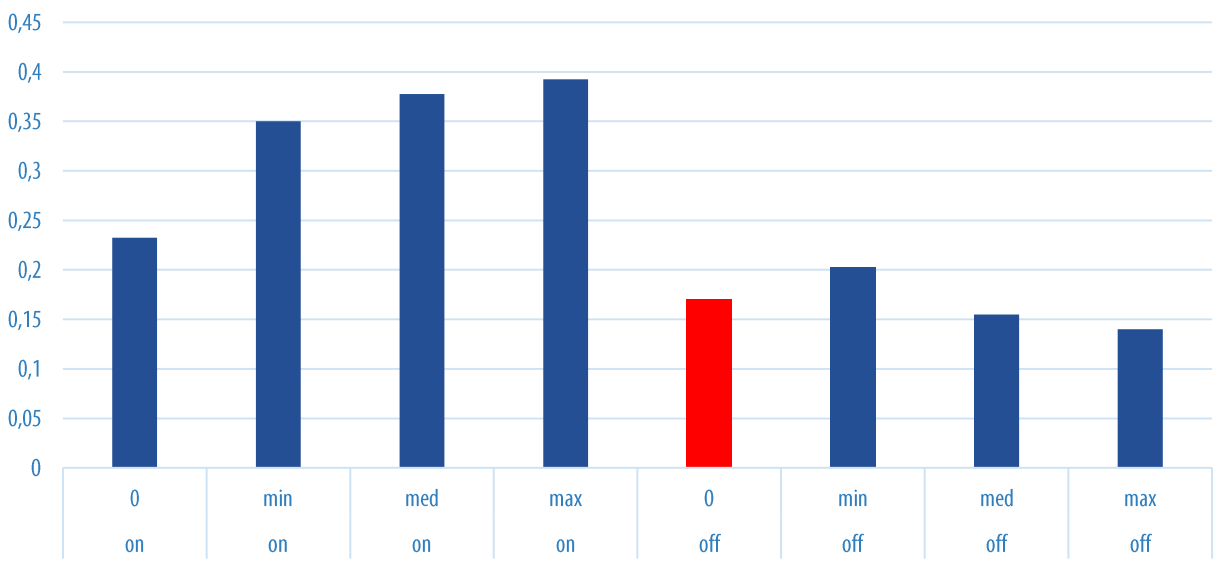
NO, mg/m3



NO2, mg/m3



CO, mg/m3



Air fan mode: 0-off., min, med, max
Recirculation mode: on, off



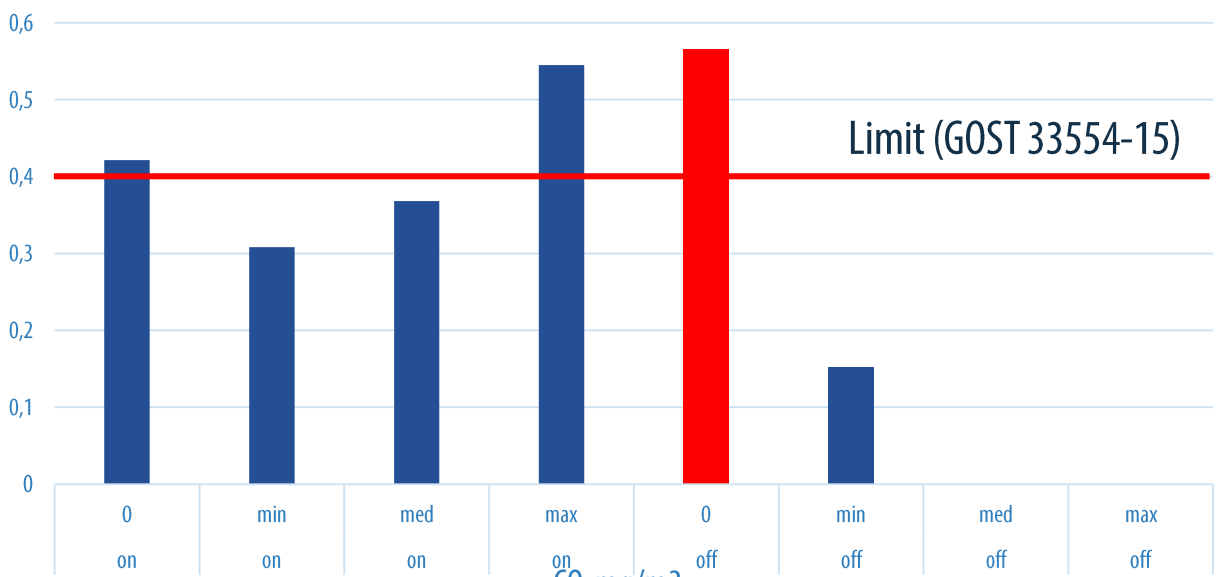
The mode corresponds to test mode II of GOST 33554-15



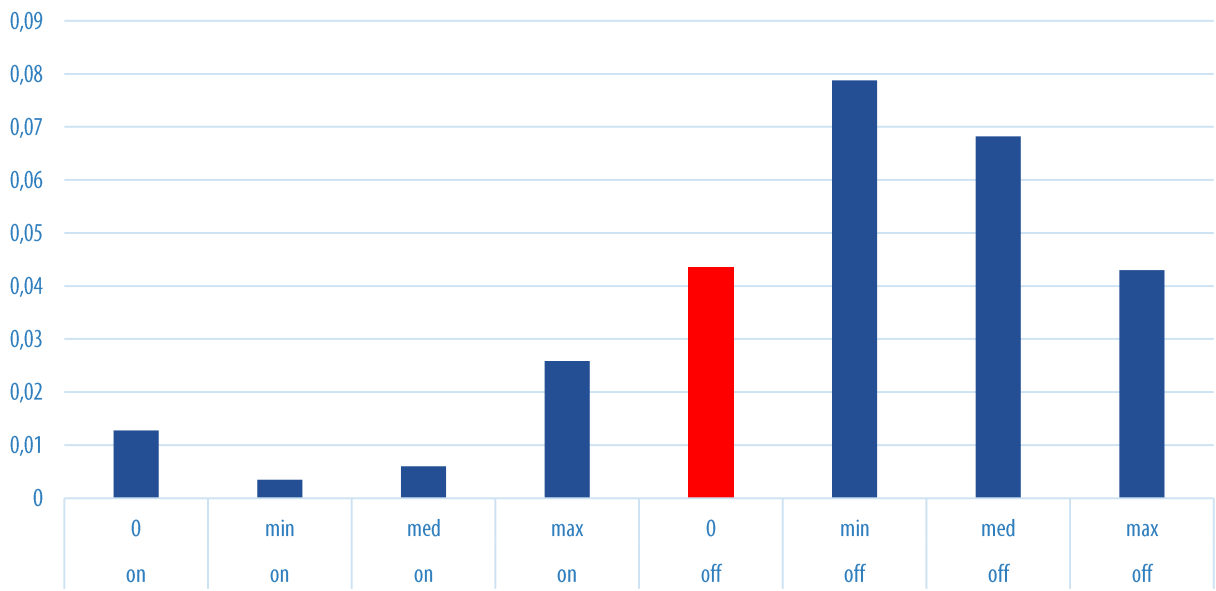
Idling

Test car #4 (diesel), automatic transmission

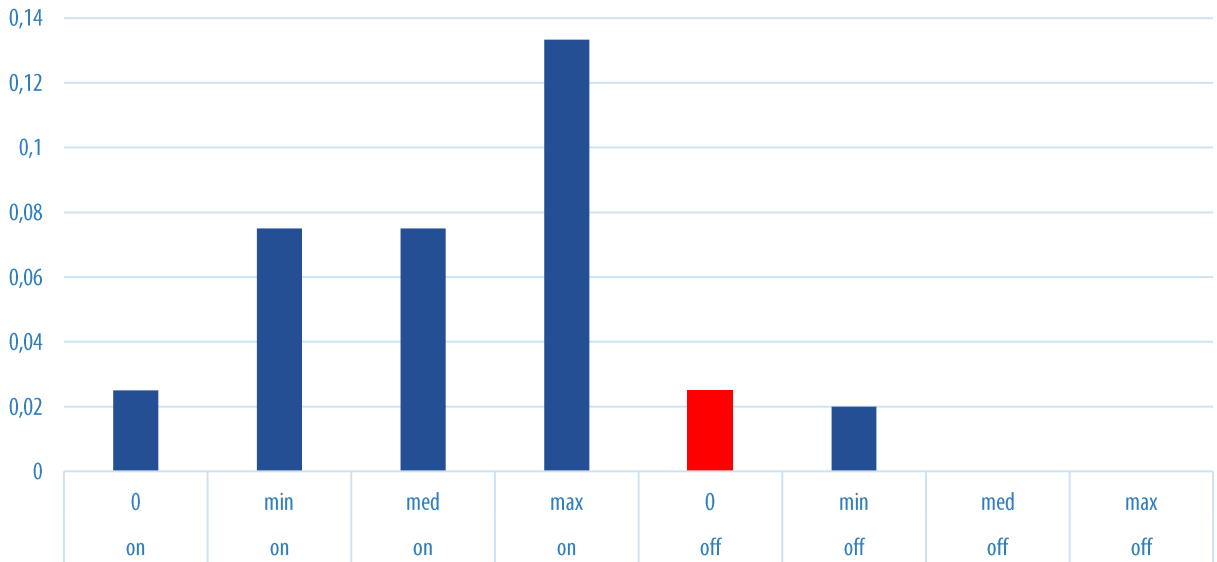
NO, mg/m3



NO2, mg/m3



CO, mg/m3



Air fan mode: 0-off., min, med, max

Recirculation mode: on, off

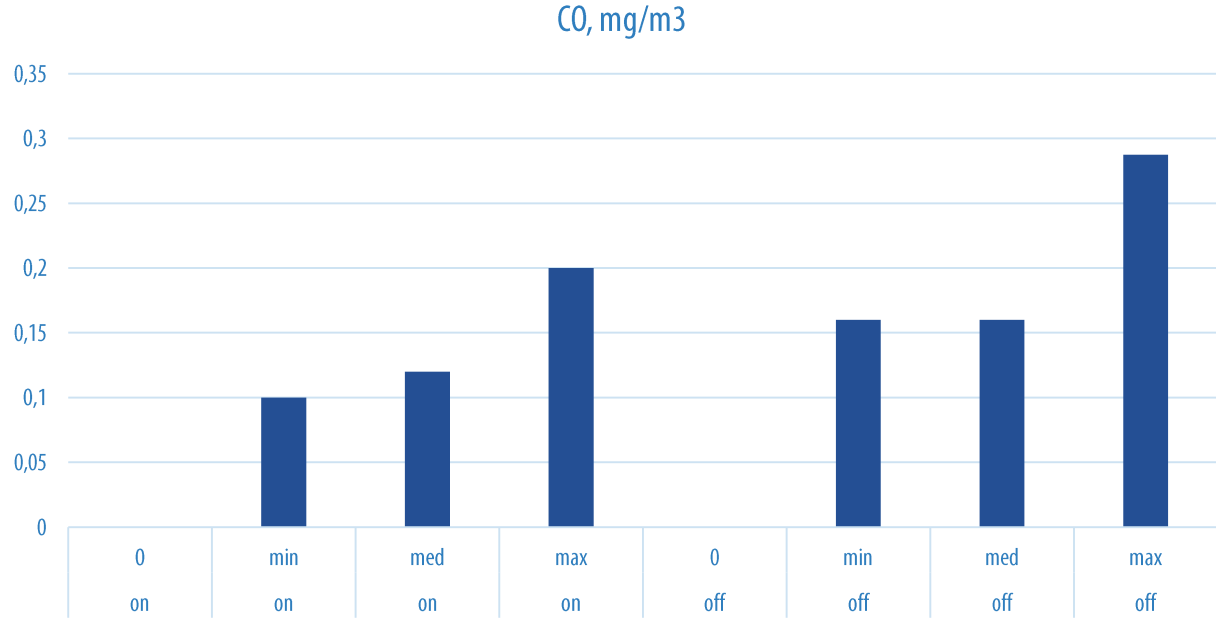
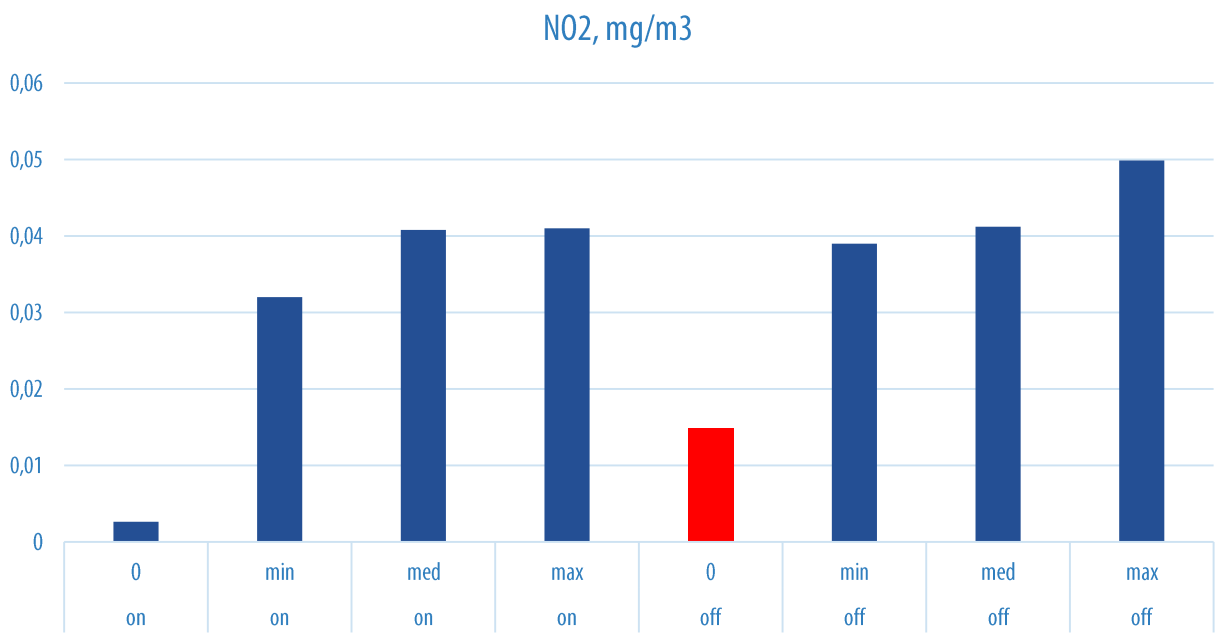
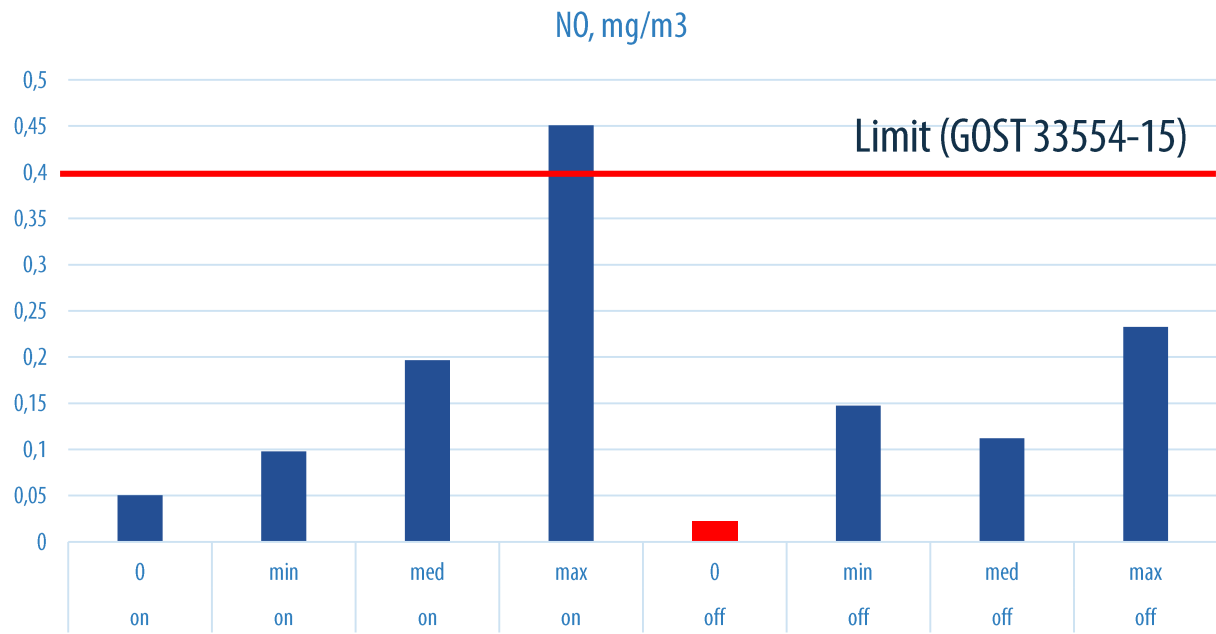


The mode corresponds to test mode II of GOST 33554-15



Idling

Test car #5 (diesel), manual transmission



Air fan mode: 0-off., min, med, max
Recirculation mode: on, off

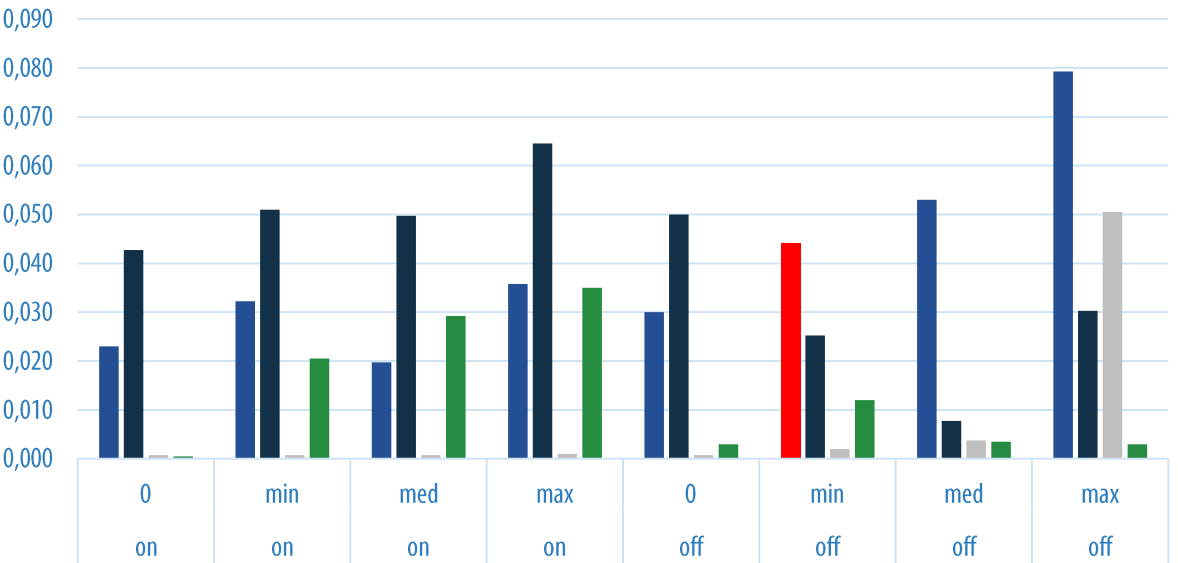
 The mode corresponds to test mode II of GOST 33554-15



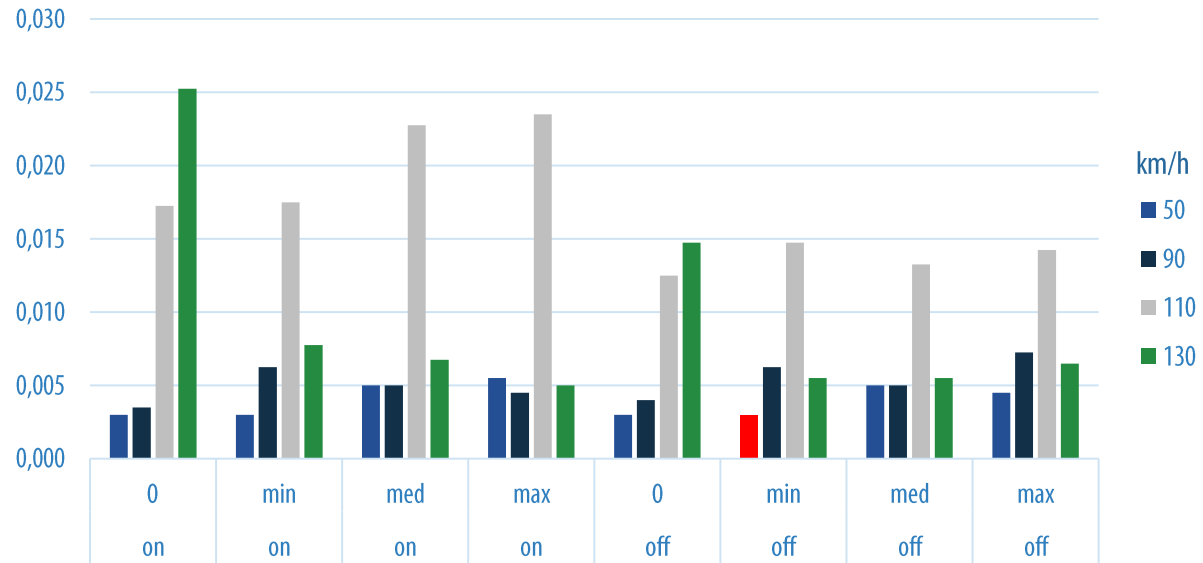
Driving at constant speed

Test car #1 (gasoline), manual transmission

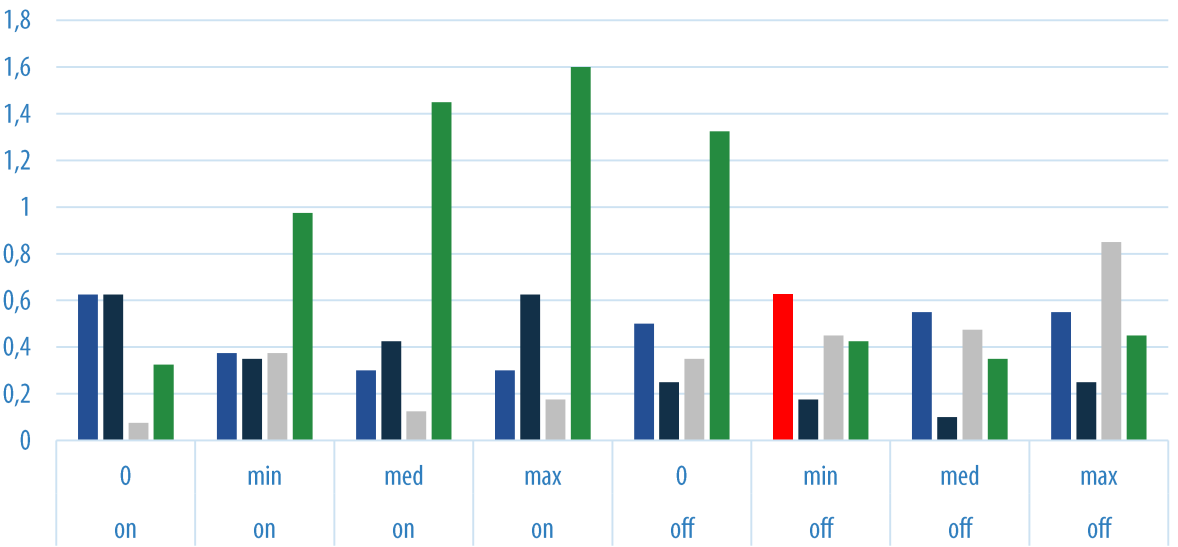
NO, mg/m3



NO2, mg/m3



CO, mg/m3



Air fan mode: 0-off., min, med, max
Recirculation mode: on, off

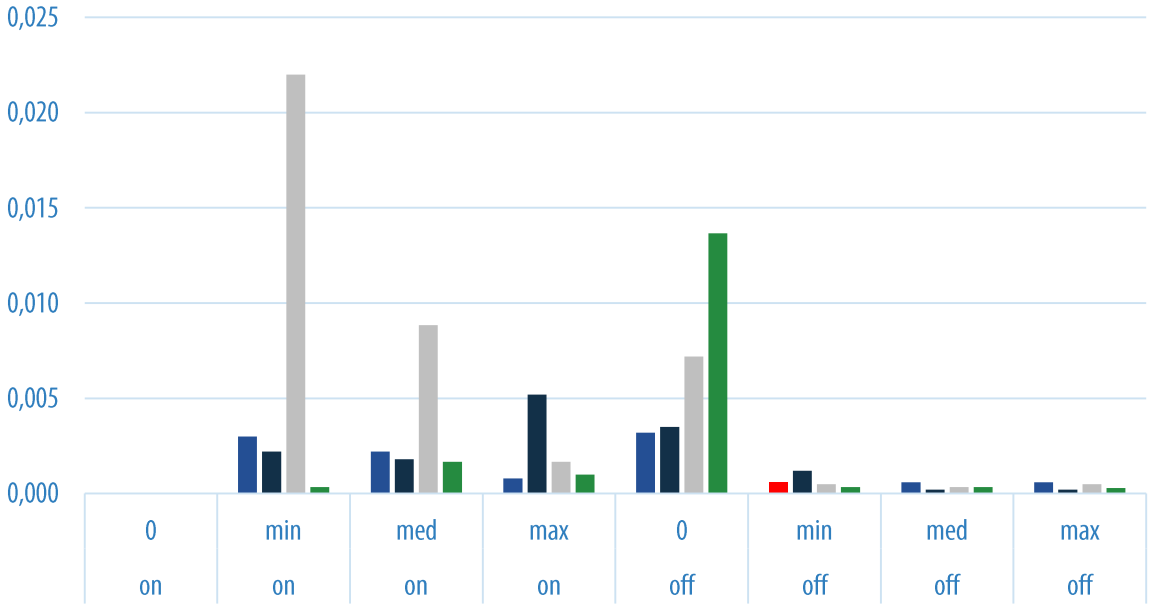
 The mode corresponds to test mode I of GOST 33554-15



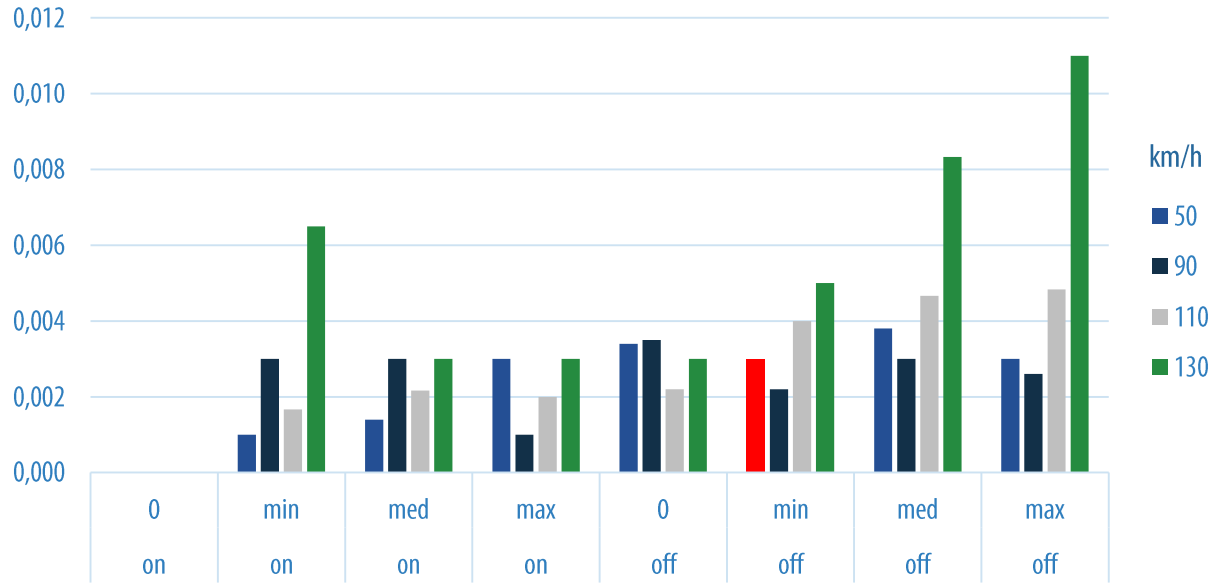
Driving at constant speed

Test car #2 (gasoline), automatic transmission

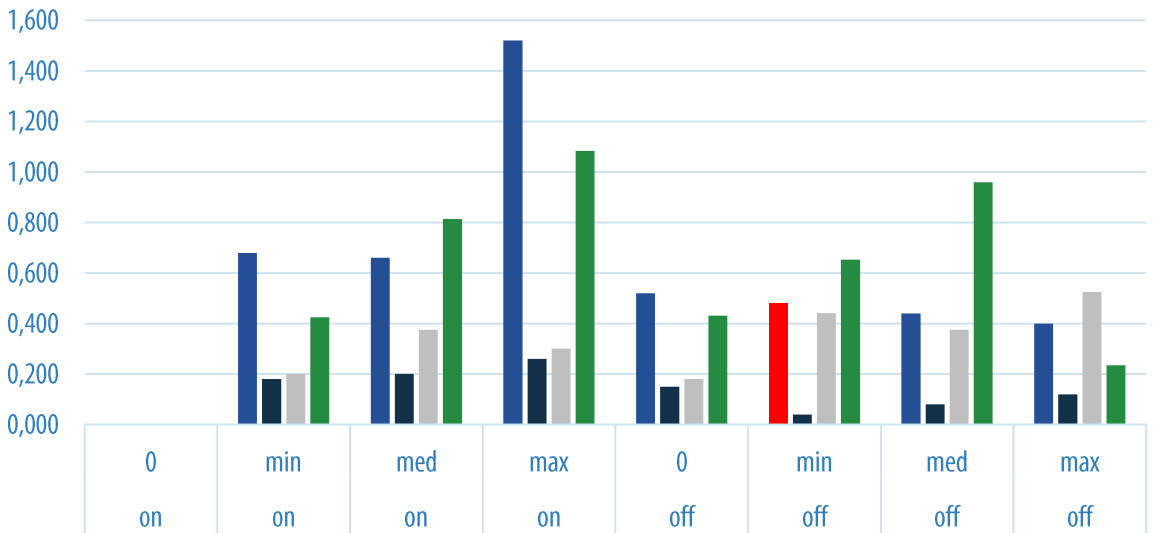
NO, mg/m3



NO2, mg/m3



CO, mg/m3



Air fan mode: 0-off., min, med, max

Recirculation mode: on, off

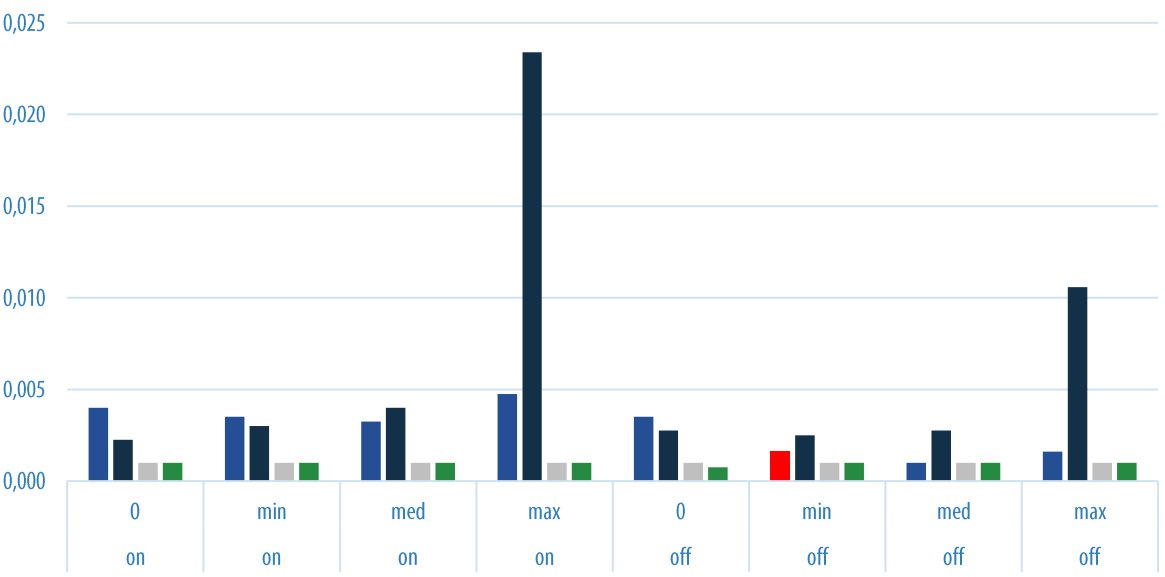
■ The mode corresponds to test mode I of GOST 33554-15



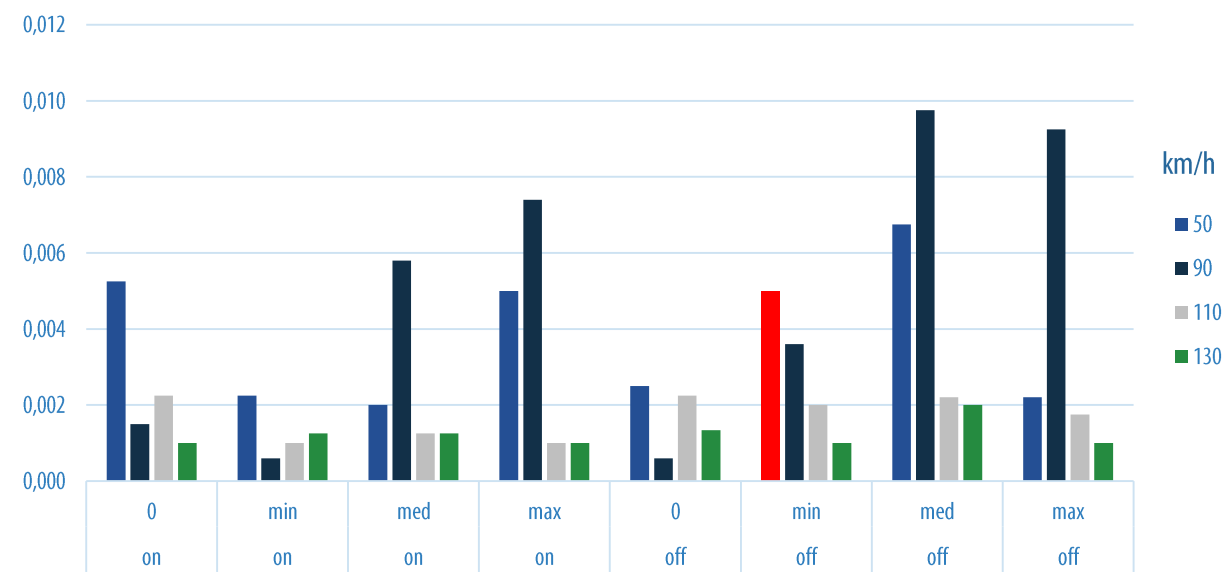
Driving at constant speed

Test car #3 (gasoline), manual transmission

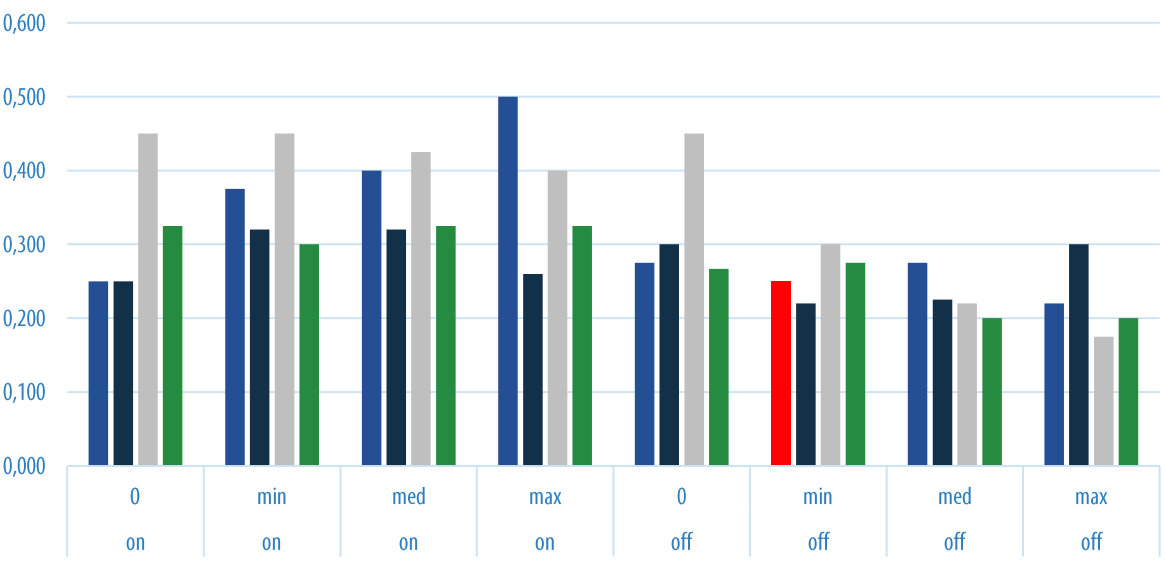
NO, mg/m3



NO2, mg/m3



CO, mg/m3



Air fan mode: 0-off., min, med, max

Recirculation mode: on, off

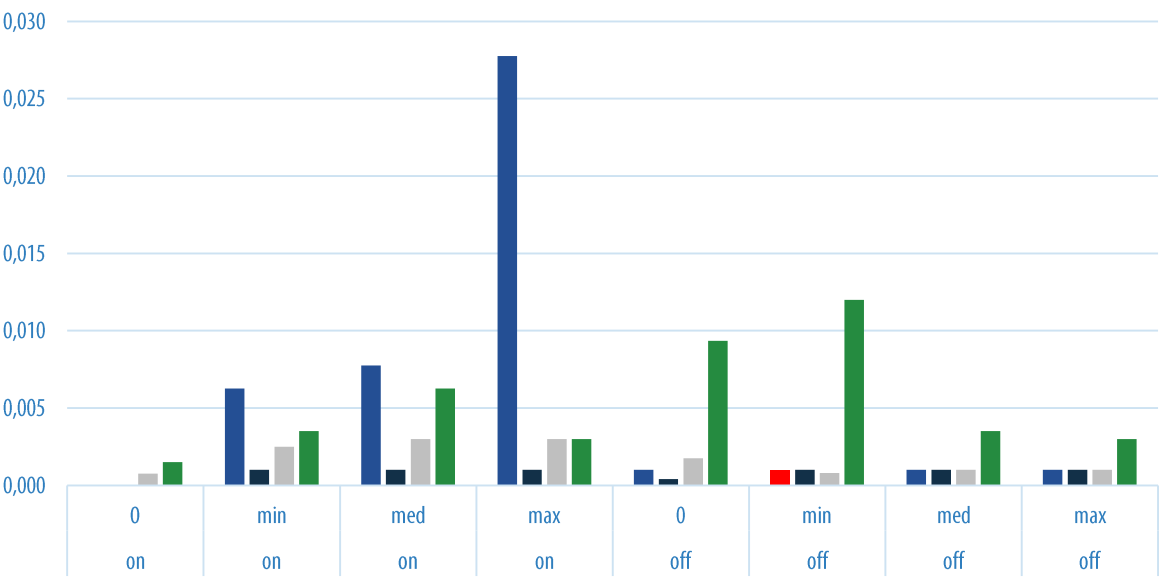
 The mode corresponds to test mode I of GOST 33554-15



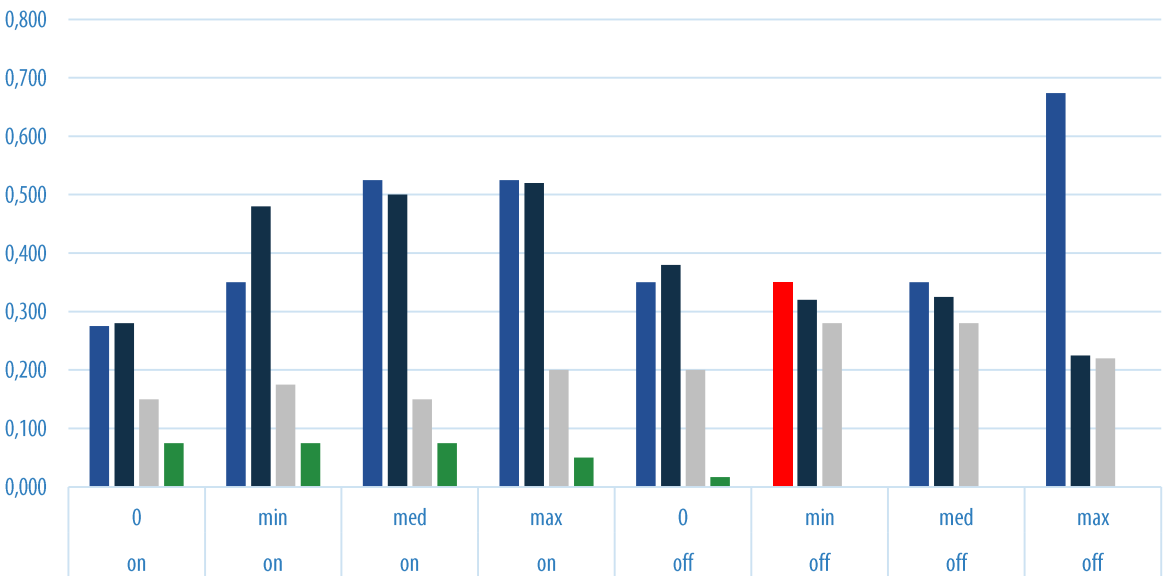
Driving at constant speed

Test car #4 (diesel), automatic transmission

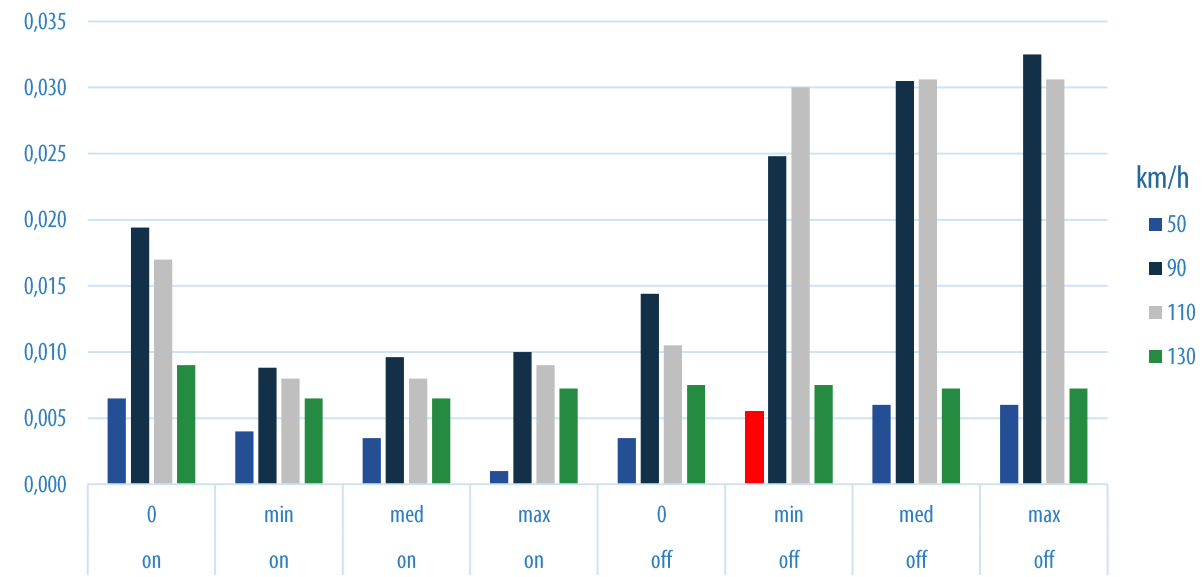
NO, mg/m3



CO, mg/m3



NO2, mg/m3



Air fan mode: 0-off., min, med, max

Recirculation mode: on, off

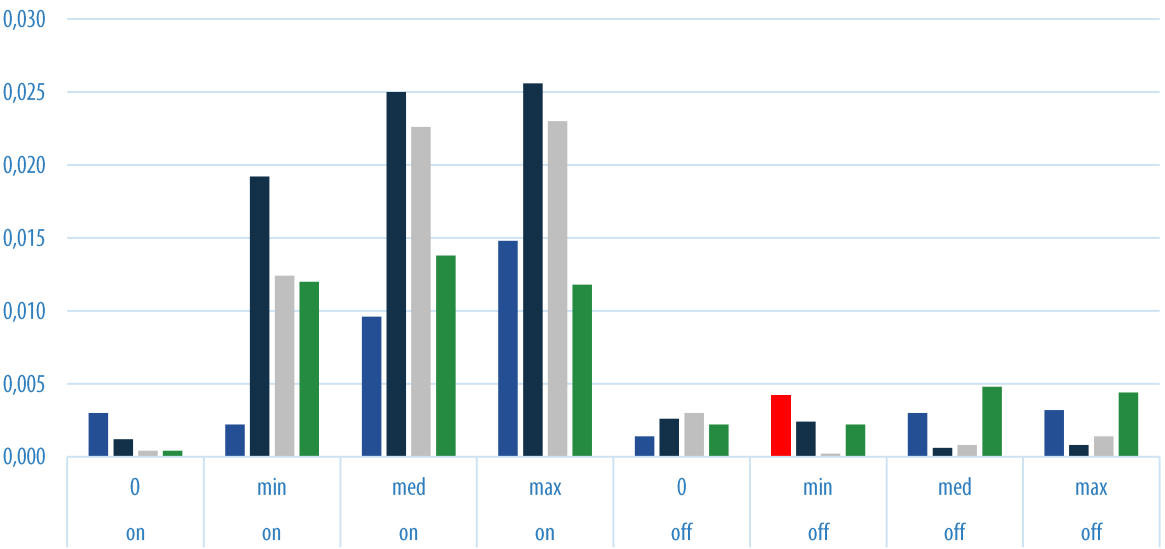
 The mode corresponds to test mode I of GOST 33554-15



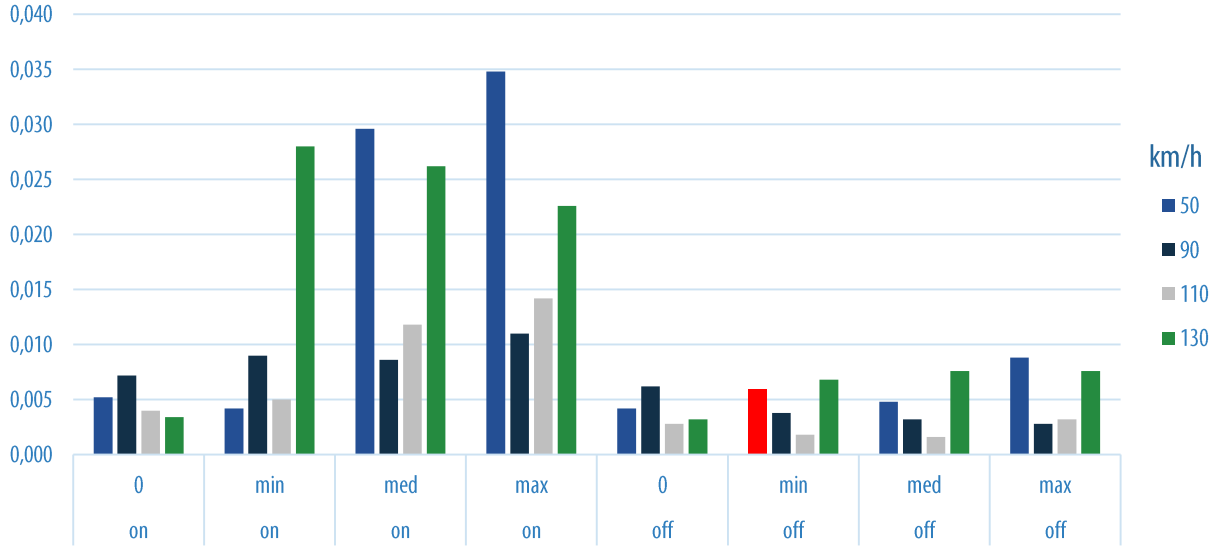
Driving at constant speed

Test car #5 (diesel), manual transmission

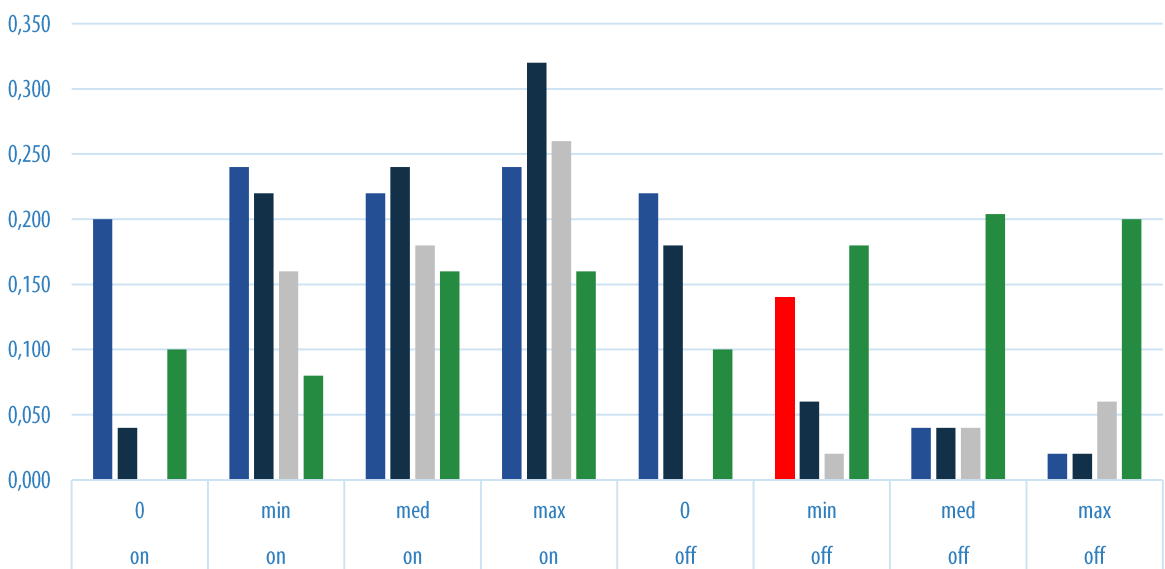
NO, mg/m3



NO2, mg/m3



CO, mg/m3



Air fan mode: 0-off., min, med, max

Recirculation mode: on, off

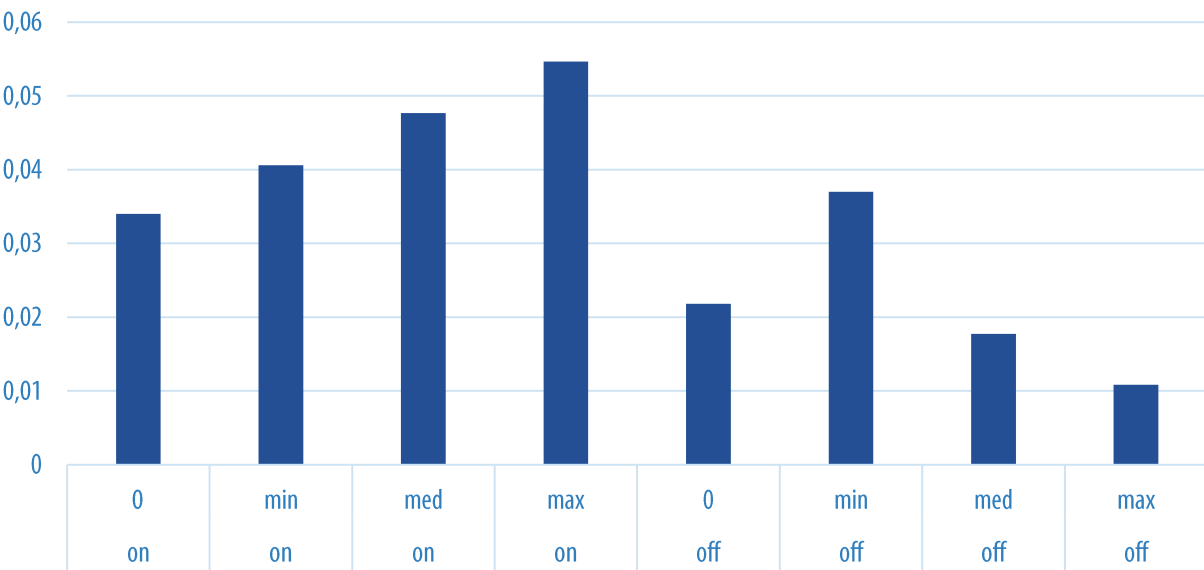
 The mode corresponds to test mode I of GOST 33554-15



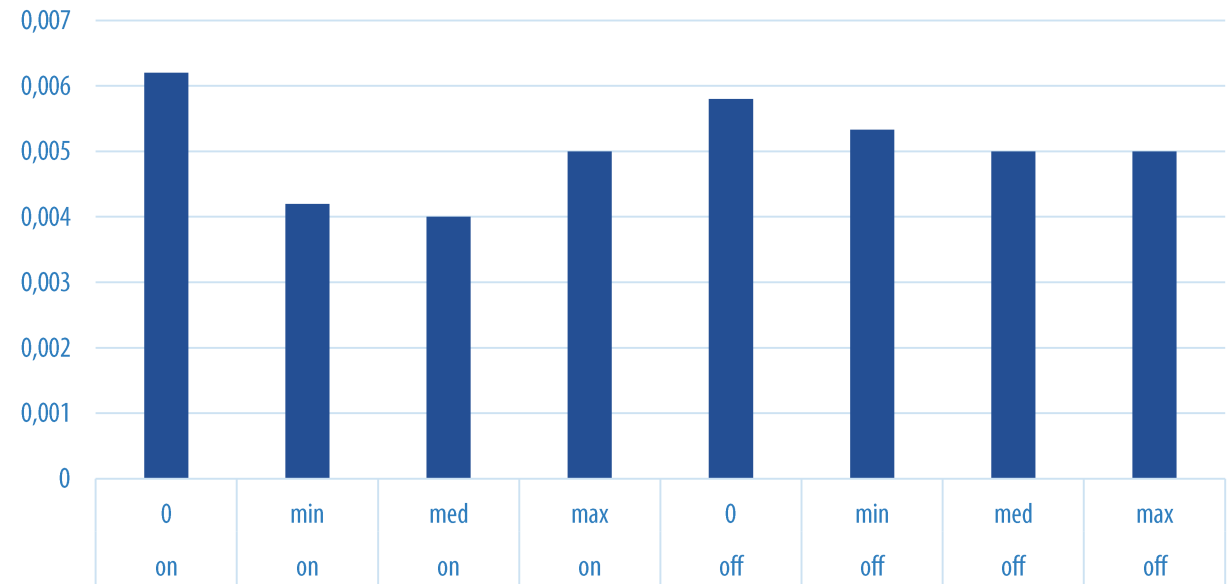
Acceleration and coasting down (60-130-60 km/h; 5-8 cycles)

Test car #1 (gasoline), manual transmission

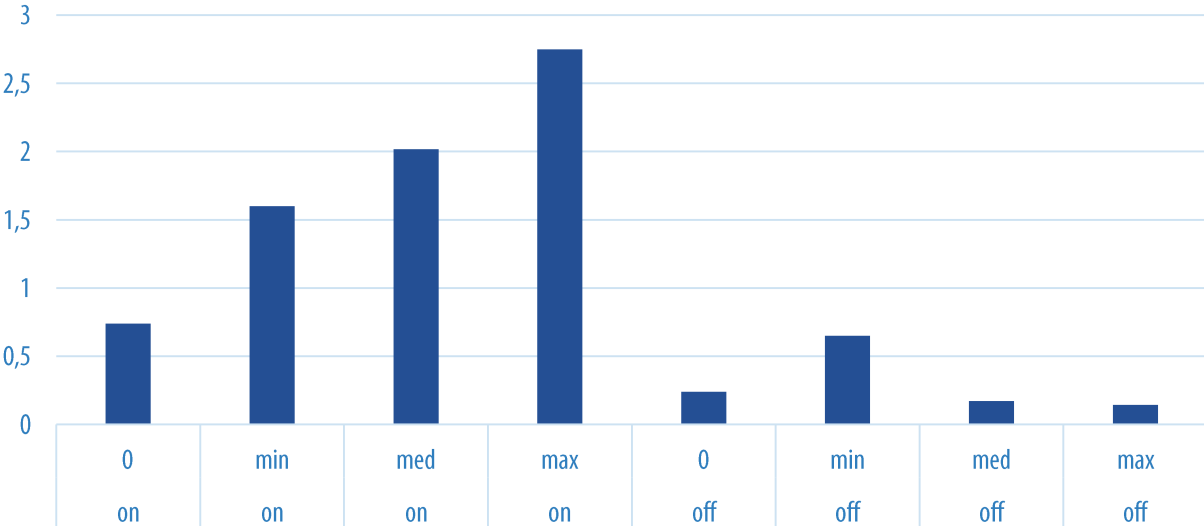
NO, mg/m3



N02, mg/m3



CO, mg/m3



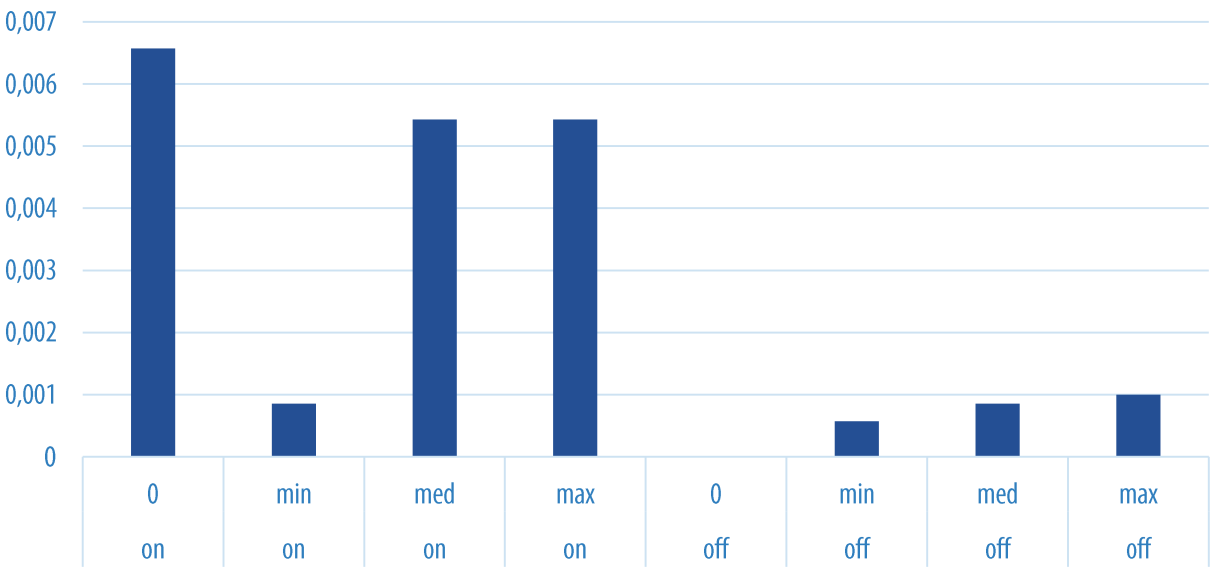
Air fan mode: 0-off., min, med, max
 Recirculation mode: on, off



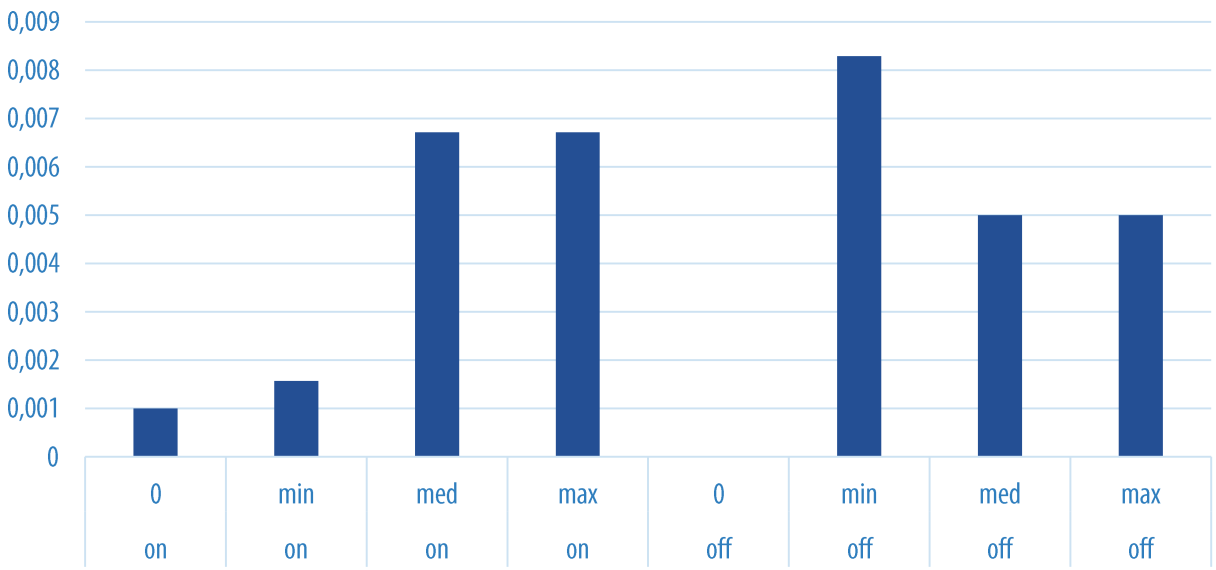
Acceleration and coasting down (60-130-60 km/h; 5-8 cycles)

Test car #2 (gasoline), automatic transmission

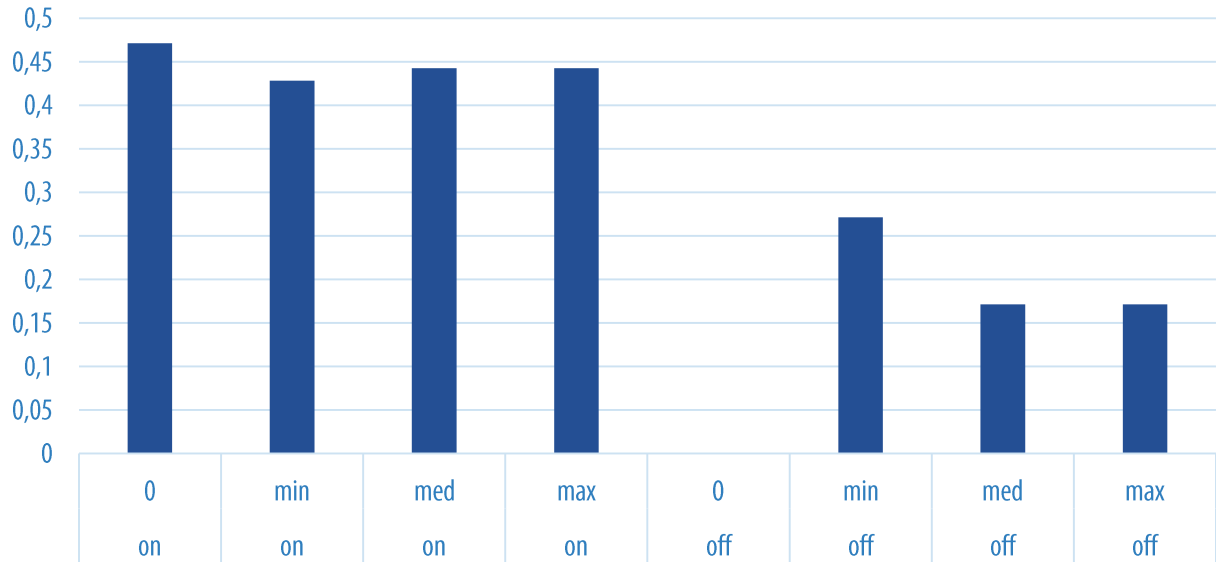
NO, mg/m3



NO2, mg/m3



CO, mg/m3



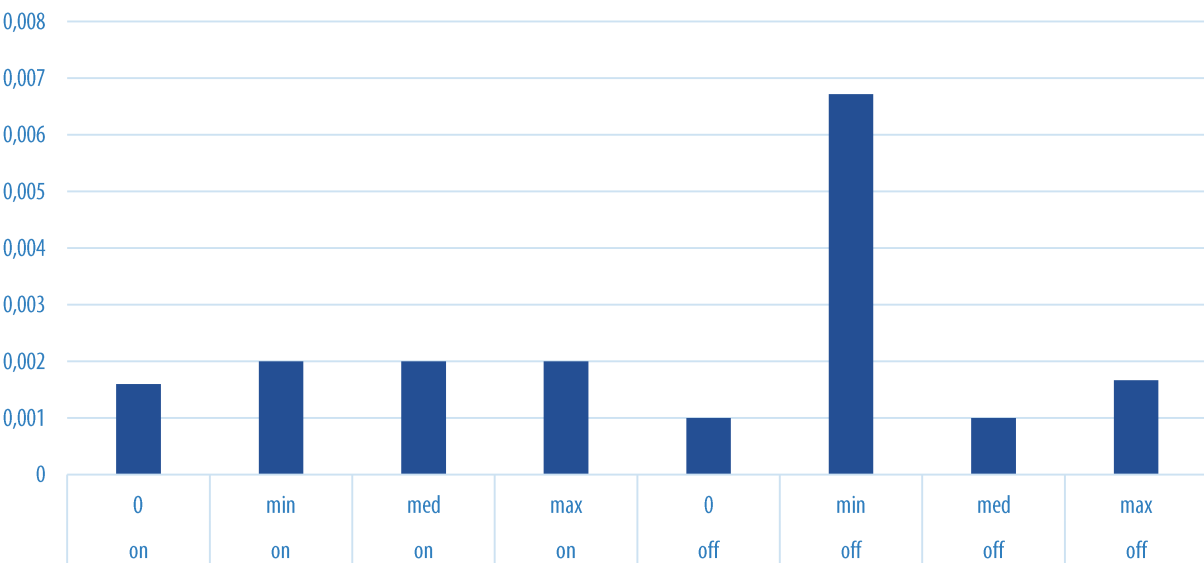
Air fan mode: 0-off., min, med, max
 Recirculation mode: on, off



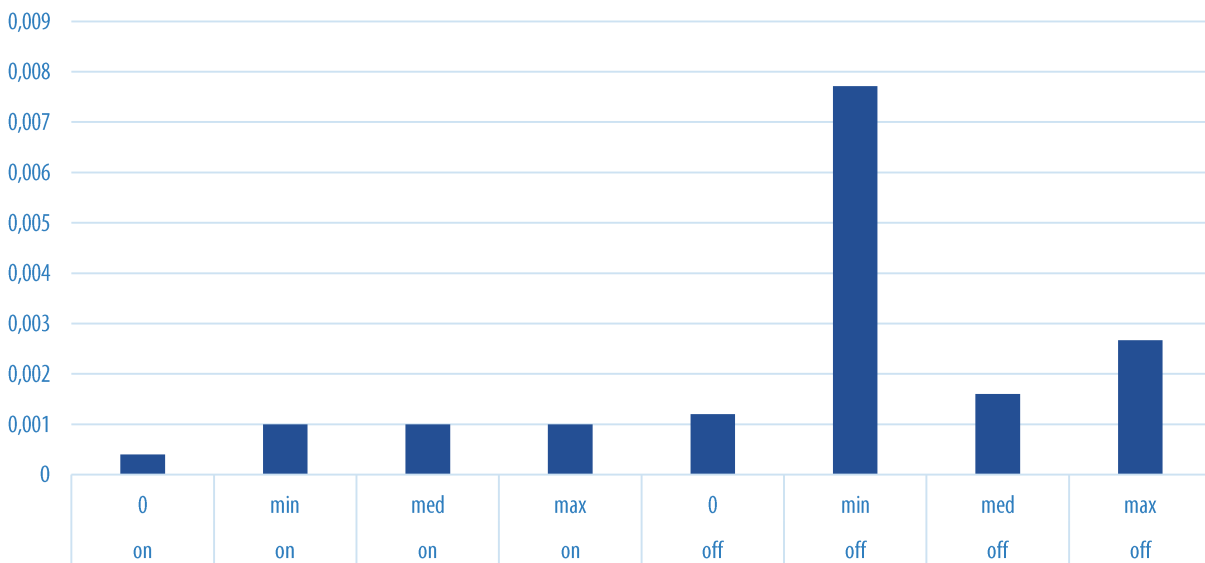
Acceleration and coasting down (60-130-60 km/h; 5-8 cycles)

Test car #3 (gasoline), manual transmission

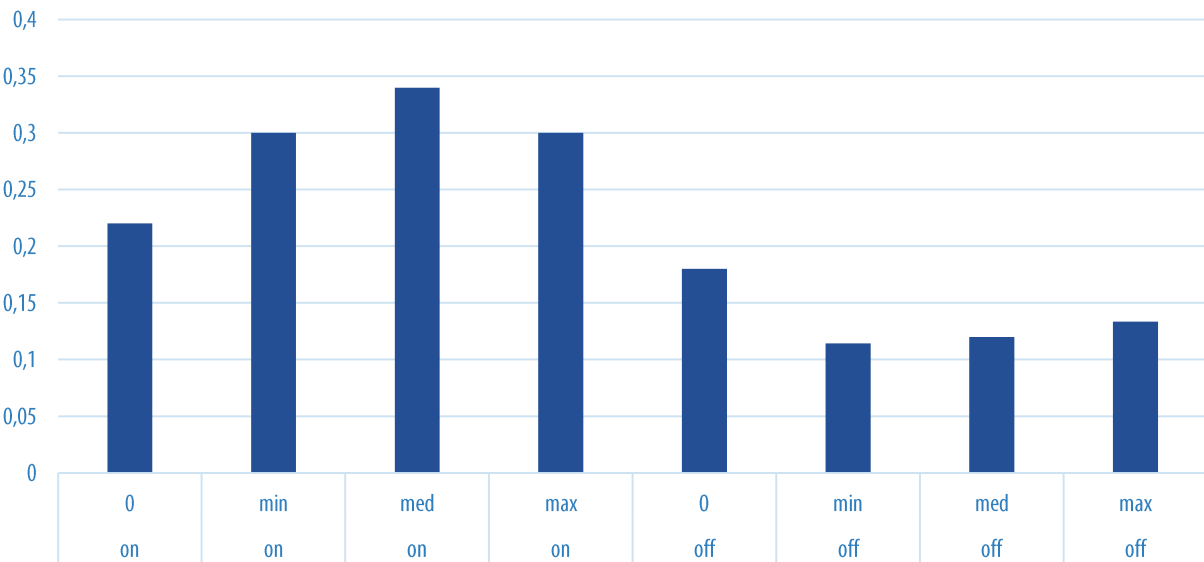
NO, mg/m3



NO2, mg/m3



CO, mg/m3



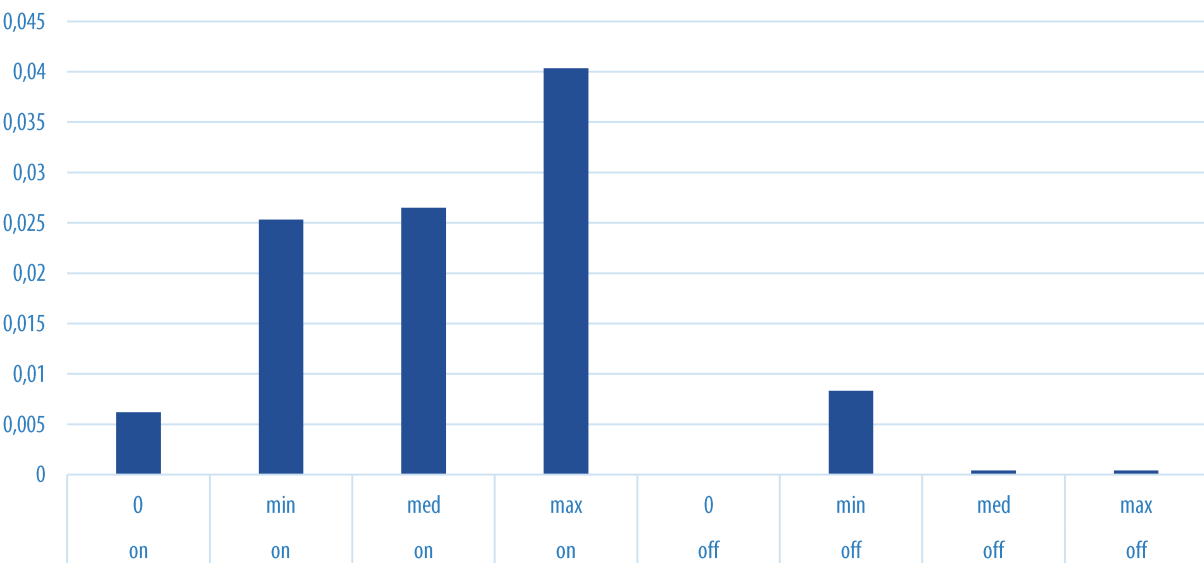
Air fan mode: 0-off., min, med, max
 Recirculation mode: on, off



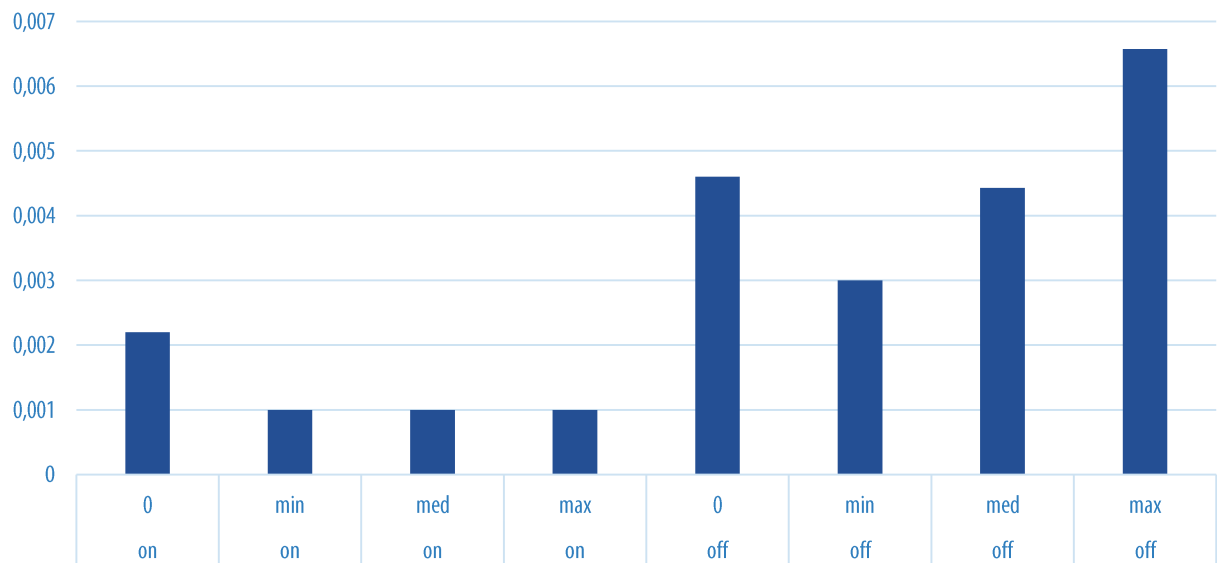
Acceleration and coasting down (60-130-60 km/h; 5-8 cycles)

Test car #4 (diesel), automatic transmission

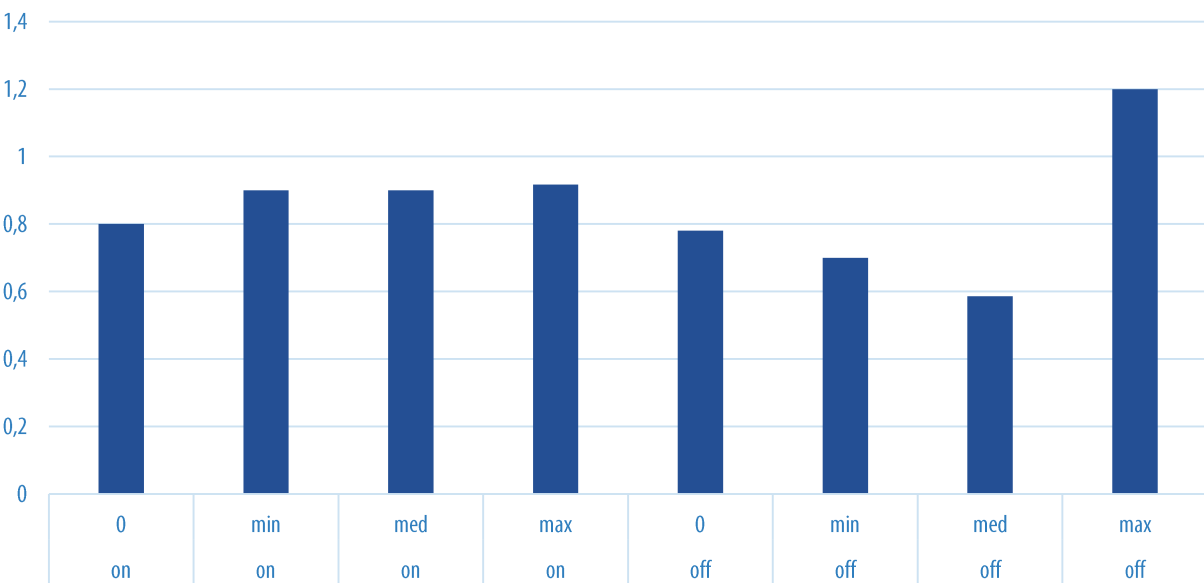
NO, mg/m3



NO2, mg/m3



CO, mg/m3



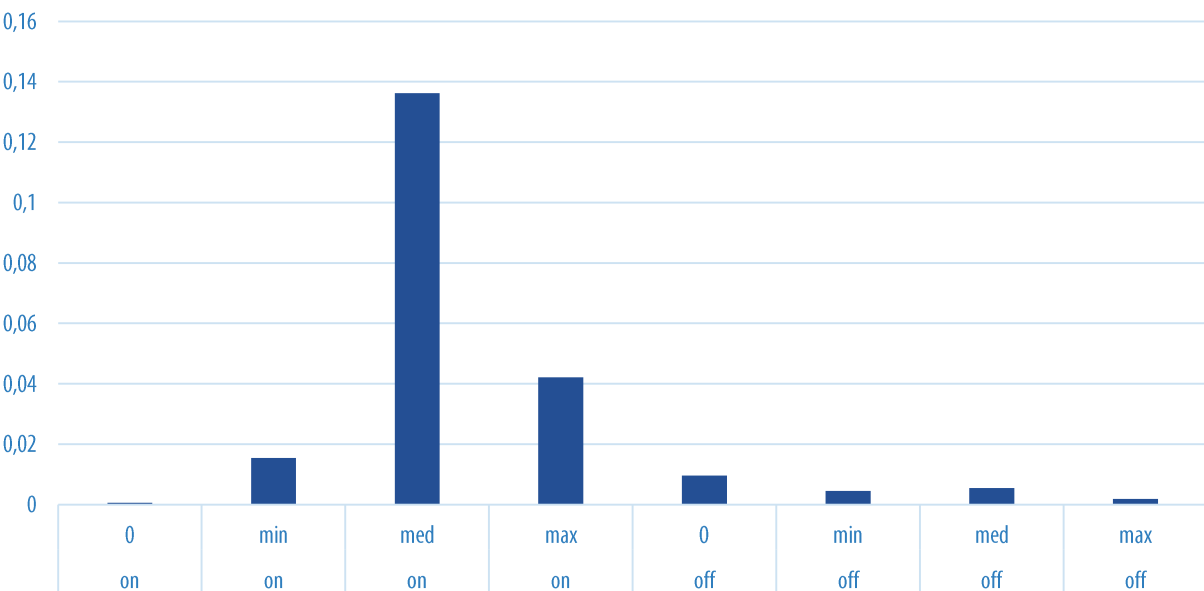
Air fan mode: 0-off., min, med, max
 Recirculation mode: on, off



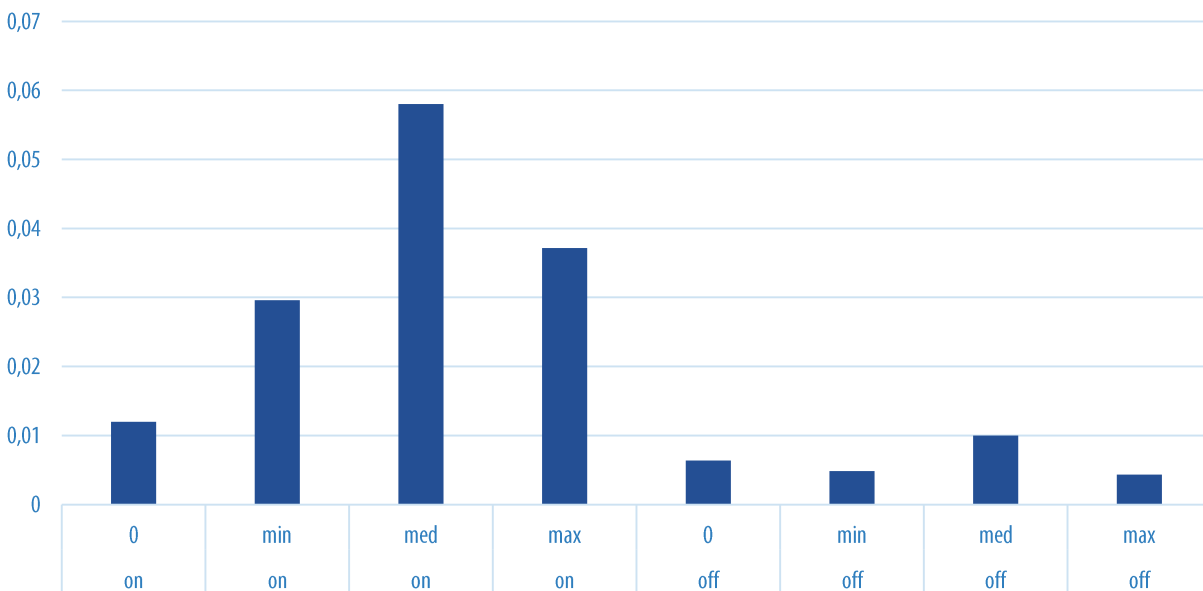
Acceleration and coasting down (60-130-60 km/h; 5-8 cycles)

Test car #5 (diesel), manual transmission

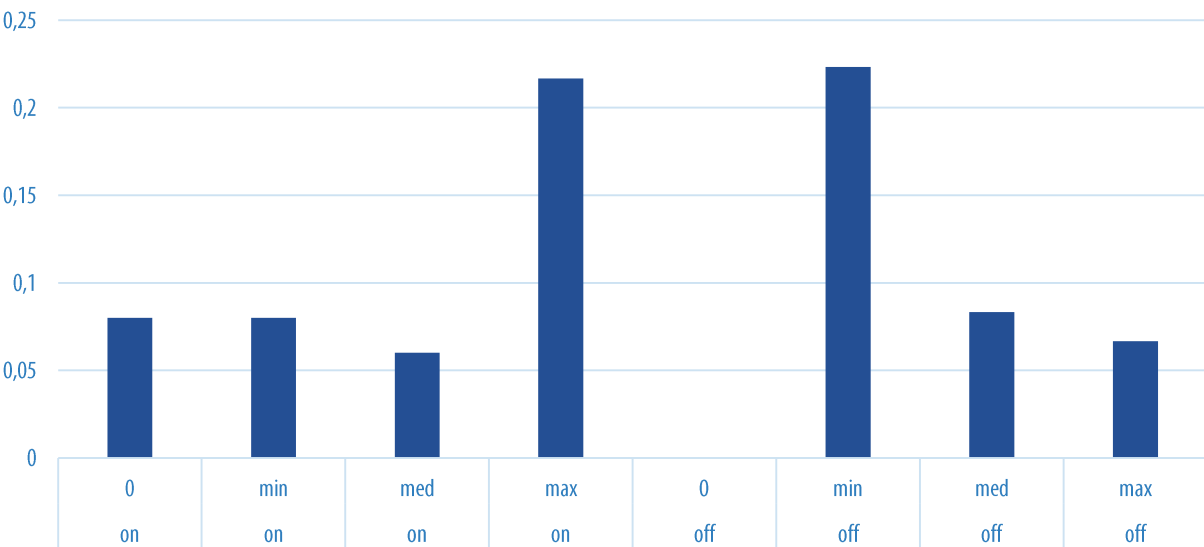
NO, mg/m3



NO2, mg/m3



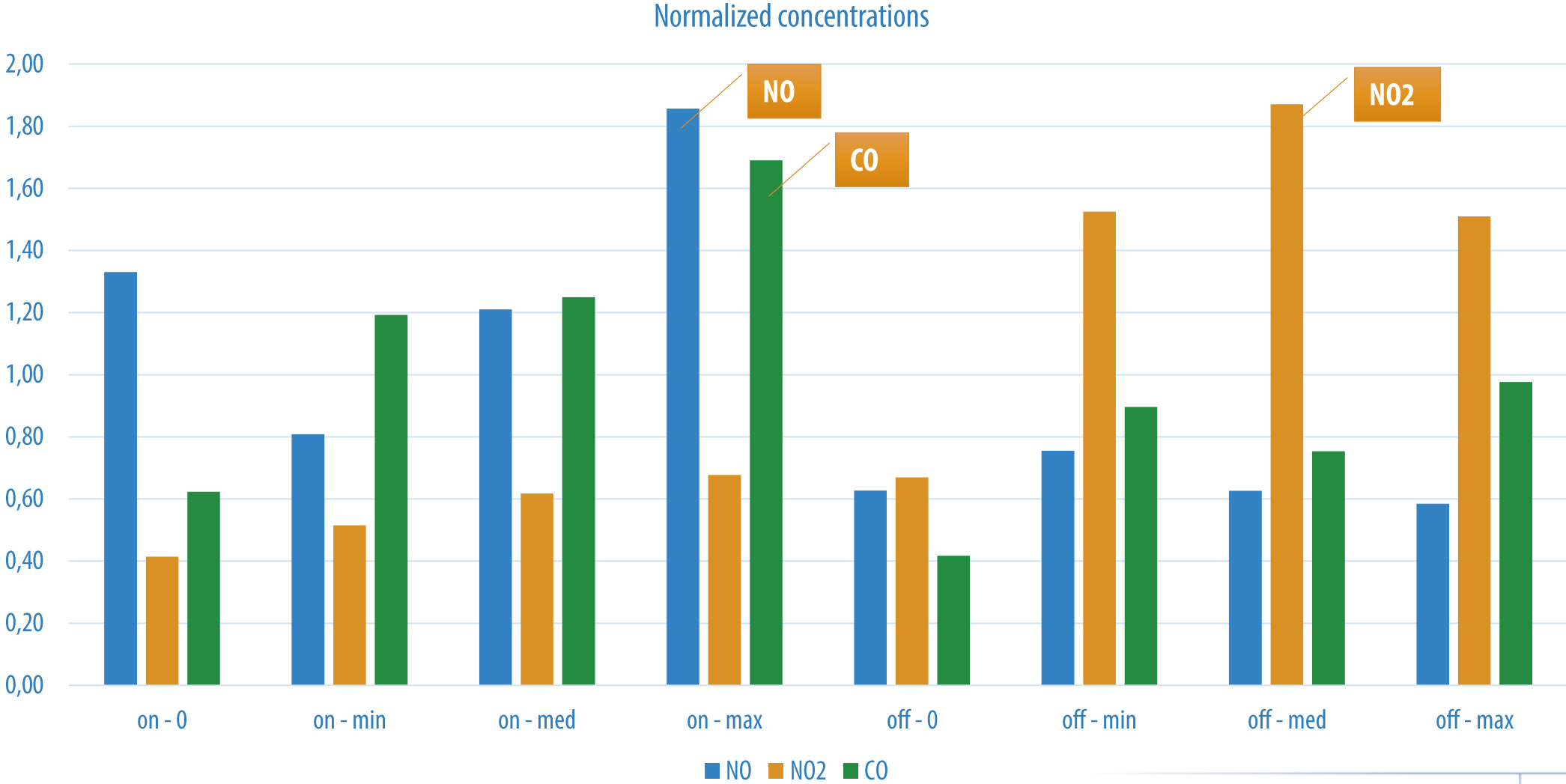
CO, mg/m3



Air fan mode: 0-off., min, med, max
 Recirculation mode: on, off



Analysis of results for idling test mode



Analysis of results for idling: maximal concentrations at recirculation/ventilation operating mode combinations

NO

Recirculation mode	Ventilation mode			
	Off	Minimal	Medium	Maximum
Off	Green	Grey	Purple	Grey
On	Yellow	Grey	Grey	Red 2

NO₂

Recirculation mode	Ventilation mode			
	Off	Minimal	Medium	Maximum
Off	Grey	Green	Red 3	Dark Blue
On	Grey	Grey	Grey	Grey

CO

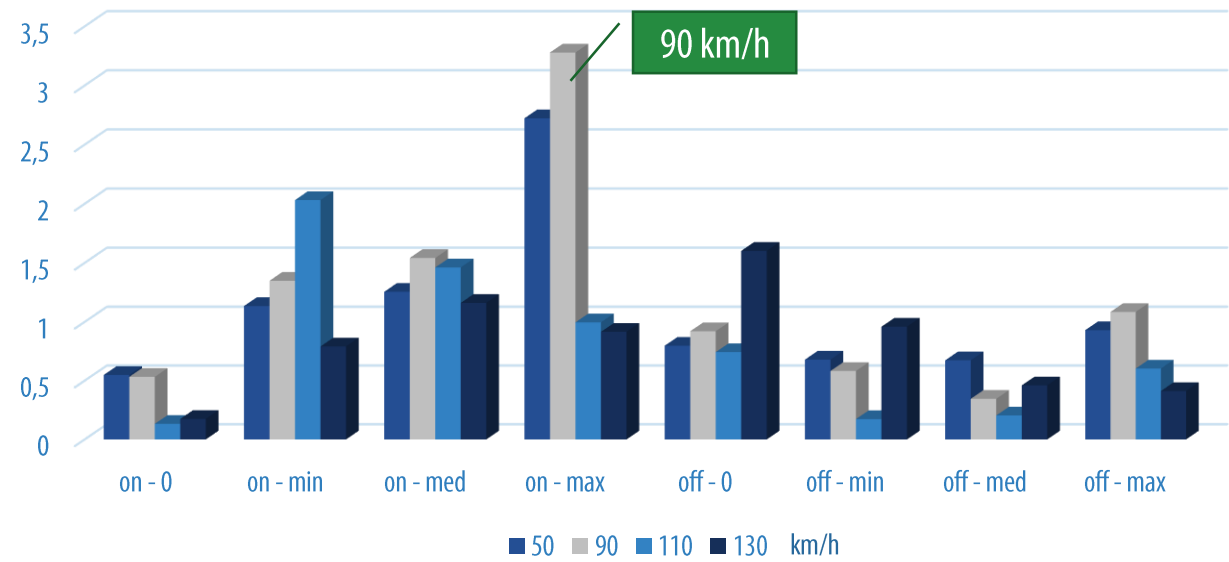
Recirculation mode	Ventilation mode			
	Off	Minimal	Medium	Maximum
Off	Grey	Grey	Grey	Dark Blue
On	Grey	Grey	Grey	Red 4

- More than one car
- Test car #1 (G)
- Test car #2 (G)
- Test car #3 (G)
- Test car #4 (D)
- Test car #5 (D)

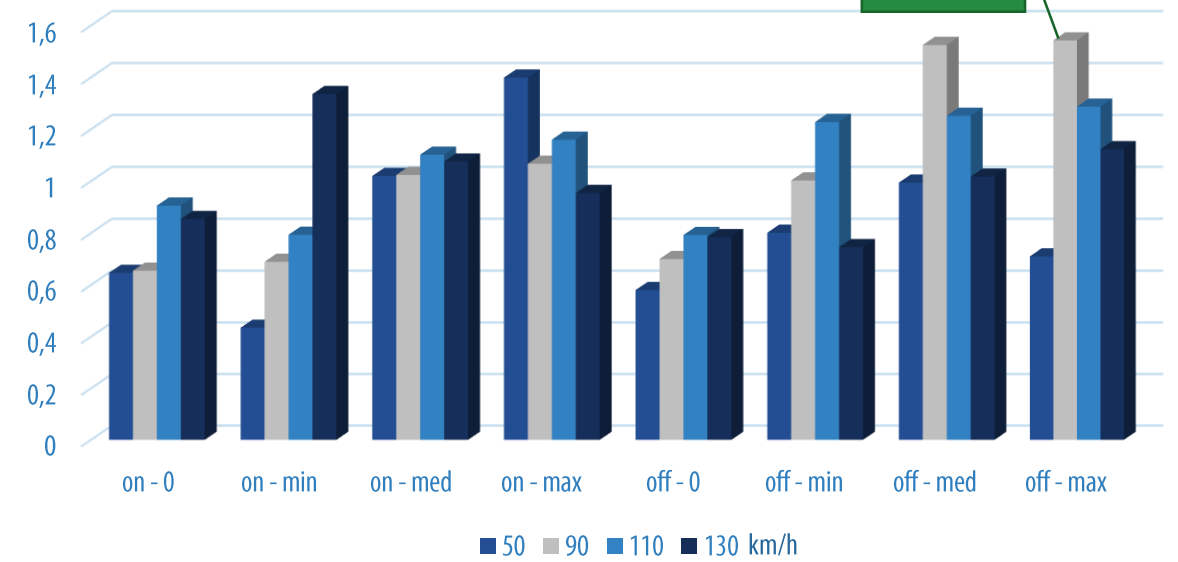


Analysis of results for constant speed test modes

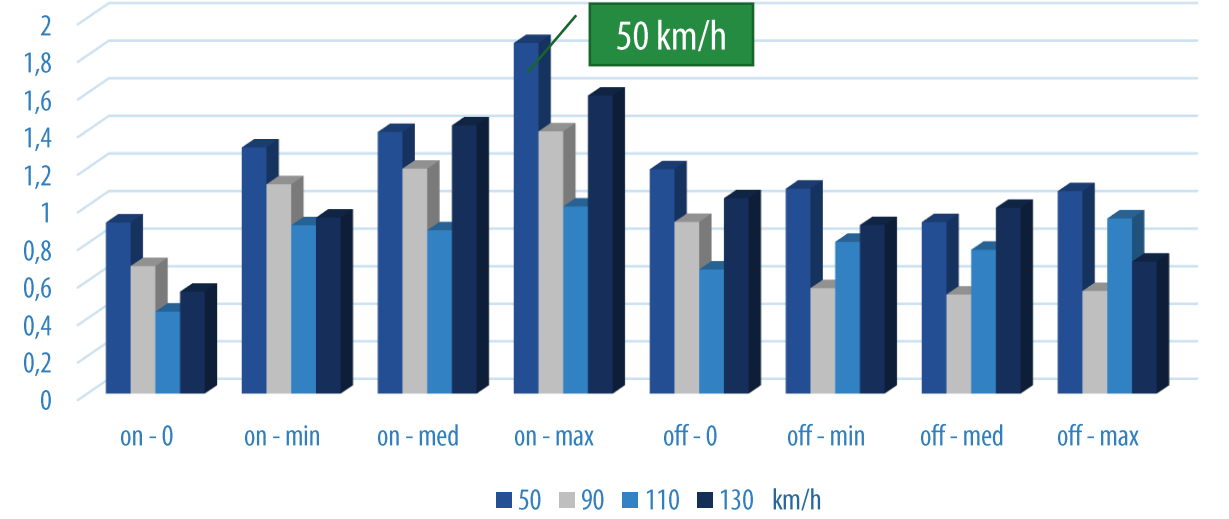
NO



NO2



CO

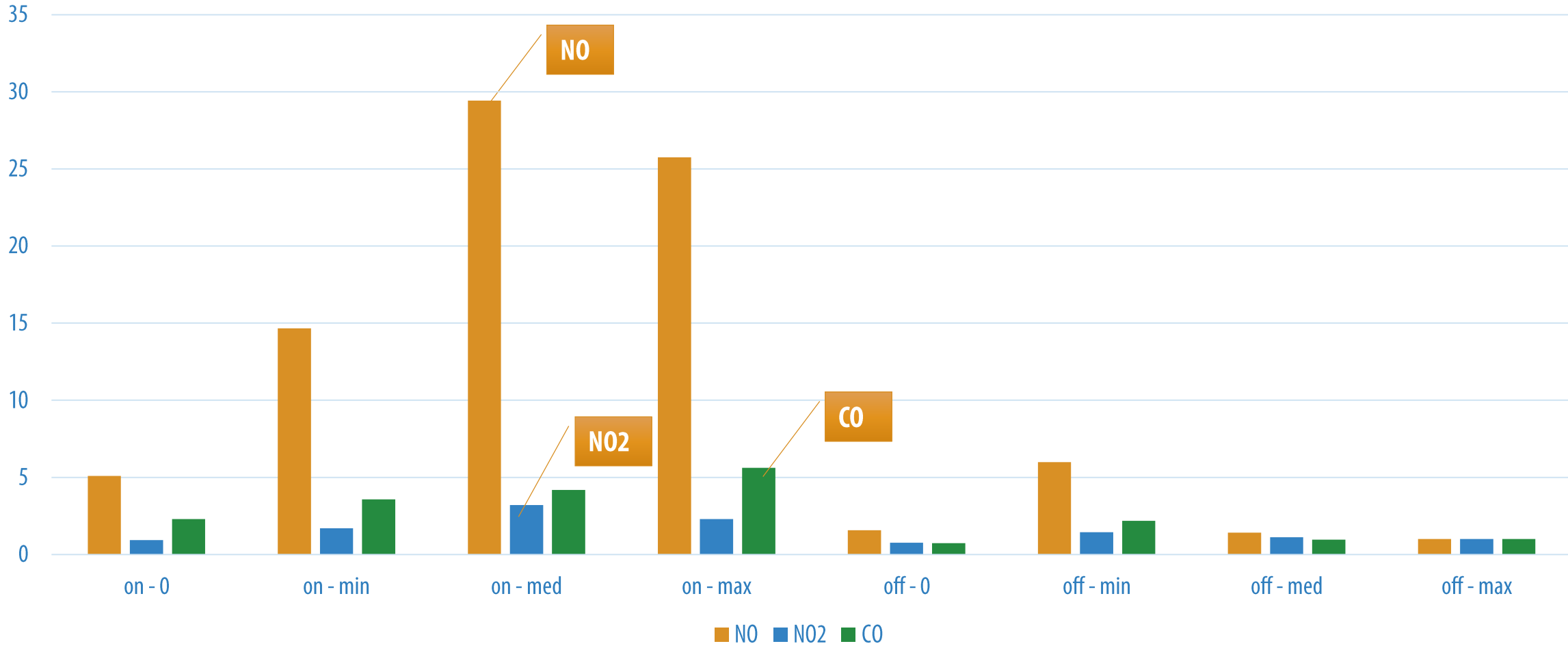


Concentration was normalized



Analysis of results for acceleration test mode

Normalized concentrations



Analysis of results for acceleration: maximal concentrations at recirculation/ventilation operating mode combinations

NO

Recirculation mode	Ventilation mode			
	Off	Minimal	Medium	Maximum
Off		Test car #3 (G)		
On	Test car #2 (G)		Test car #5 (D)	2

NO₂

Recirculation mode	Ventilation mode			
	Off	Minimal	Medium	Maximum
Off		2		Test car #4 (D)
On	Test car #1 (G)		Test car #5 (D)	

CO

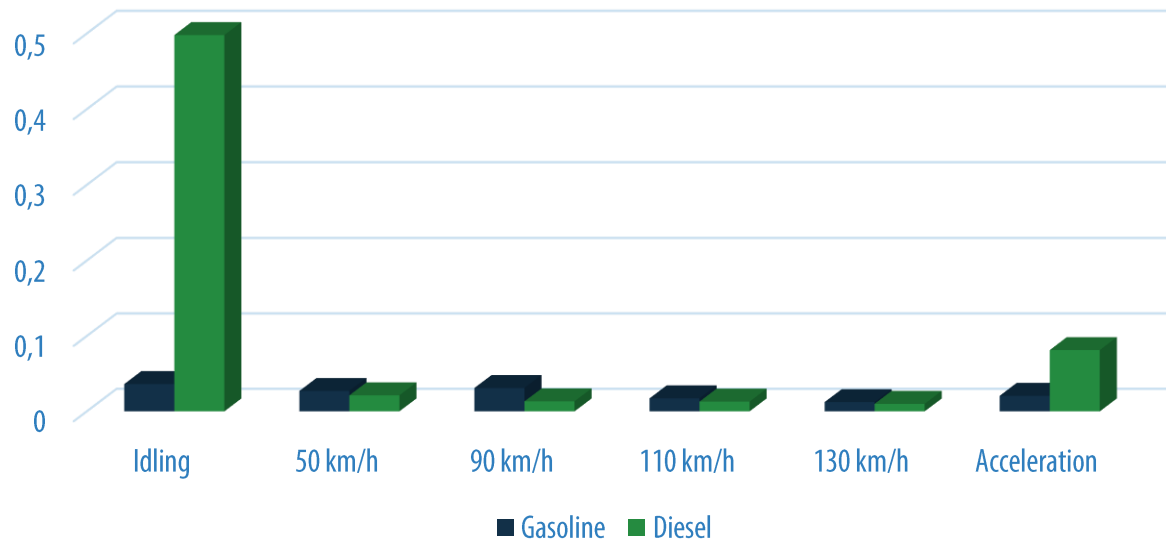
Recirculation mode	Ventilation mode			
	Off	Minimal	Medium	Maximum
Off		Test car #5 (D)		Test car #4 (D)
On	Test car #2 (G)		Test car #3 (G)	Test car #1 (G)

- More than one car
- Test car #1 (G)
- Test car #2 (G)
- Test car #3 (G)
- Test car #4 (D)
- Test car #5 (D)

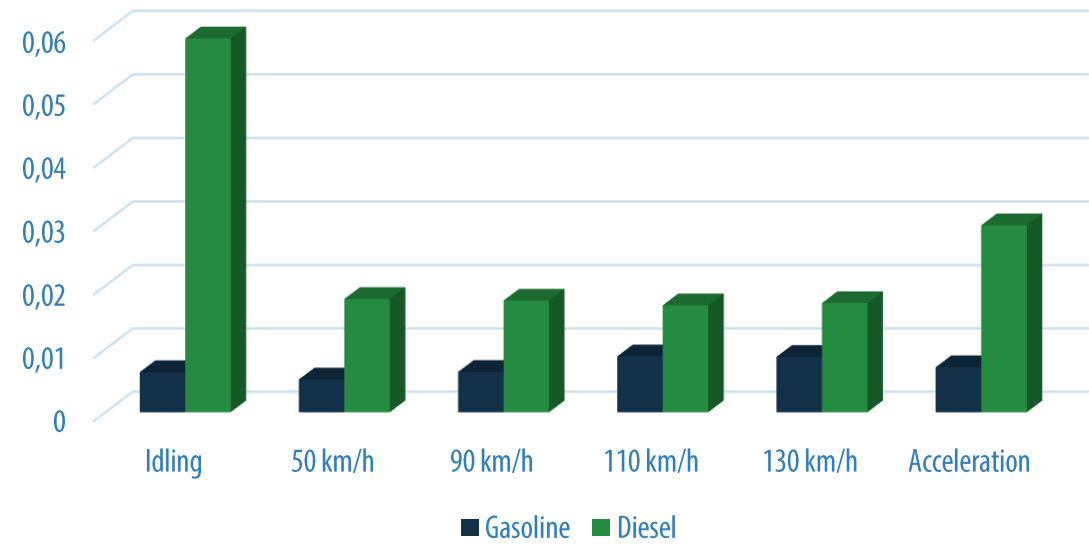


Comparative analysis of results for different test modes

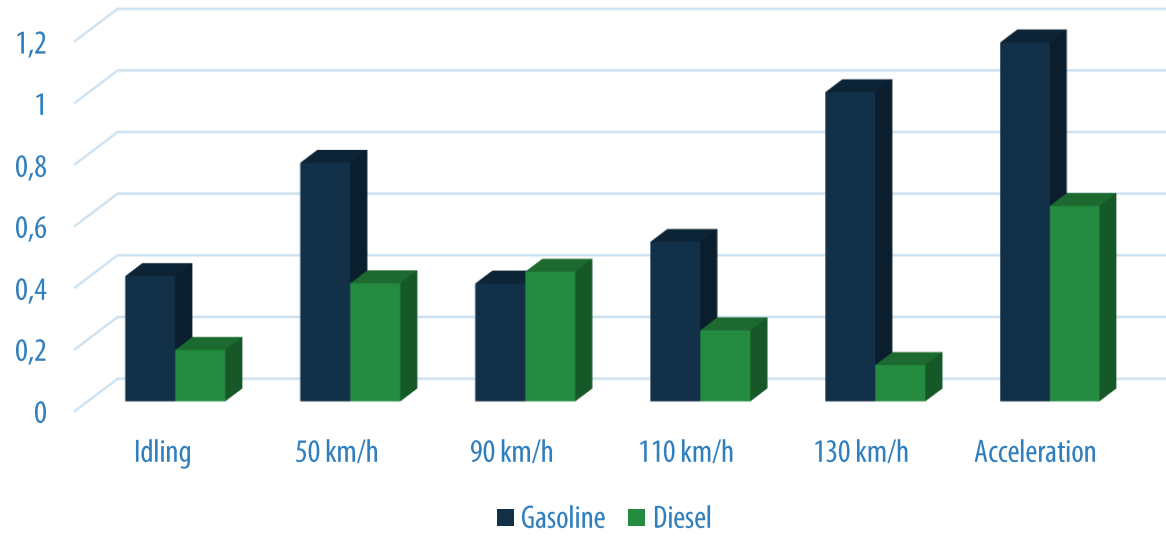
NO, mg/m³



NO₂, mg/m³



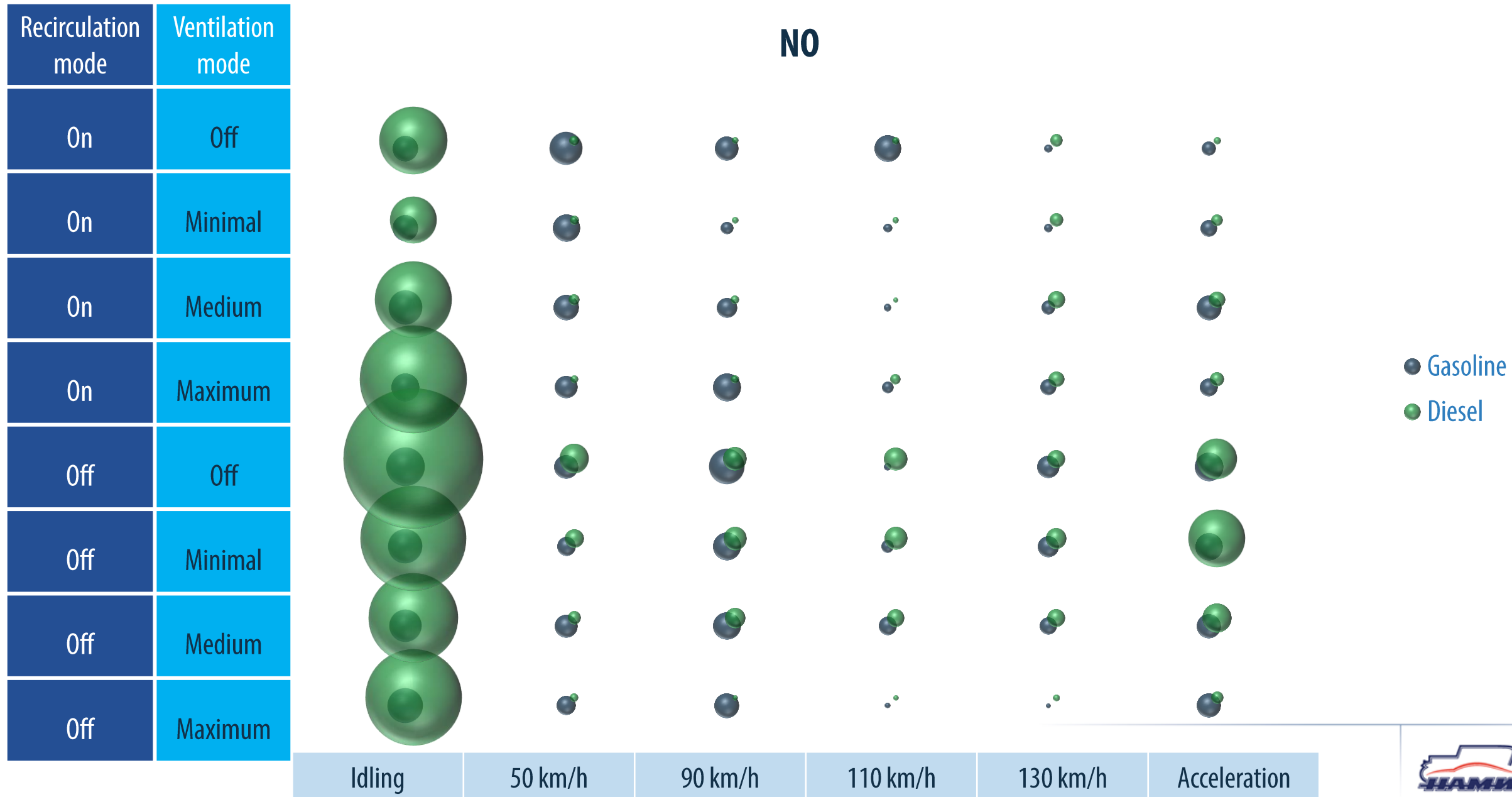
CO, mg/m³



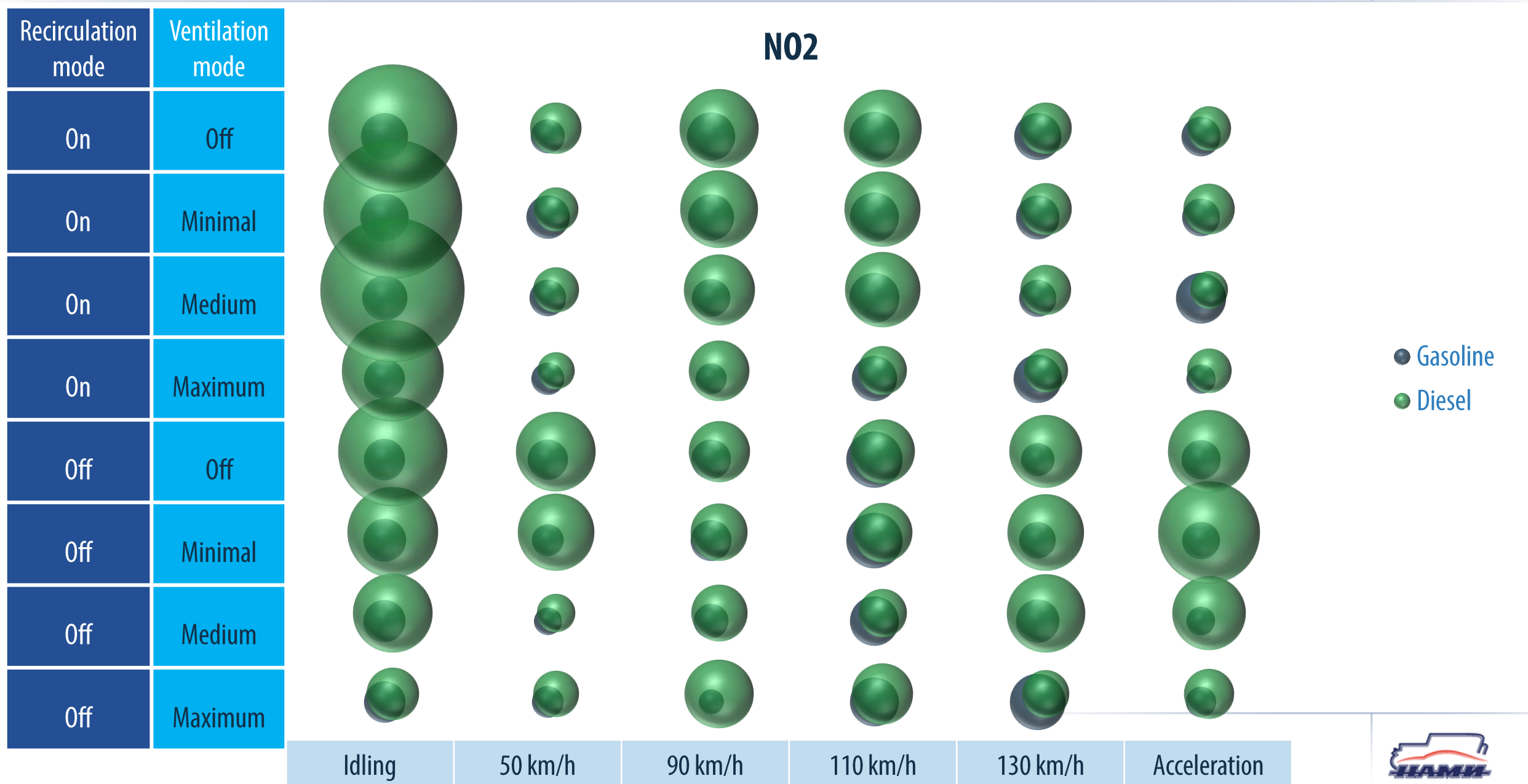
Mean concentrations for both gasoline and diesel cars



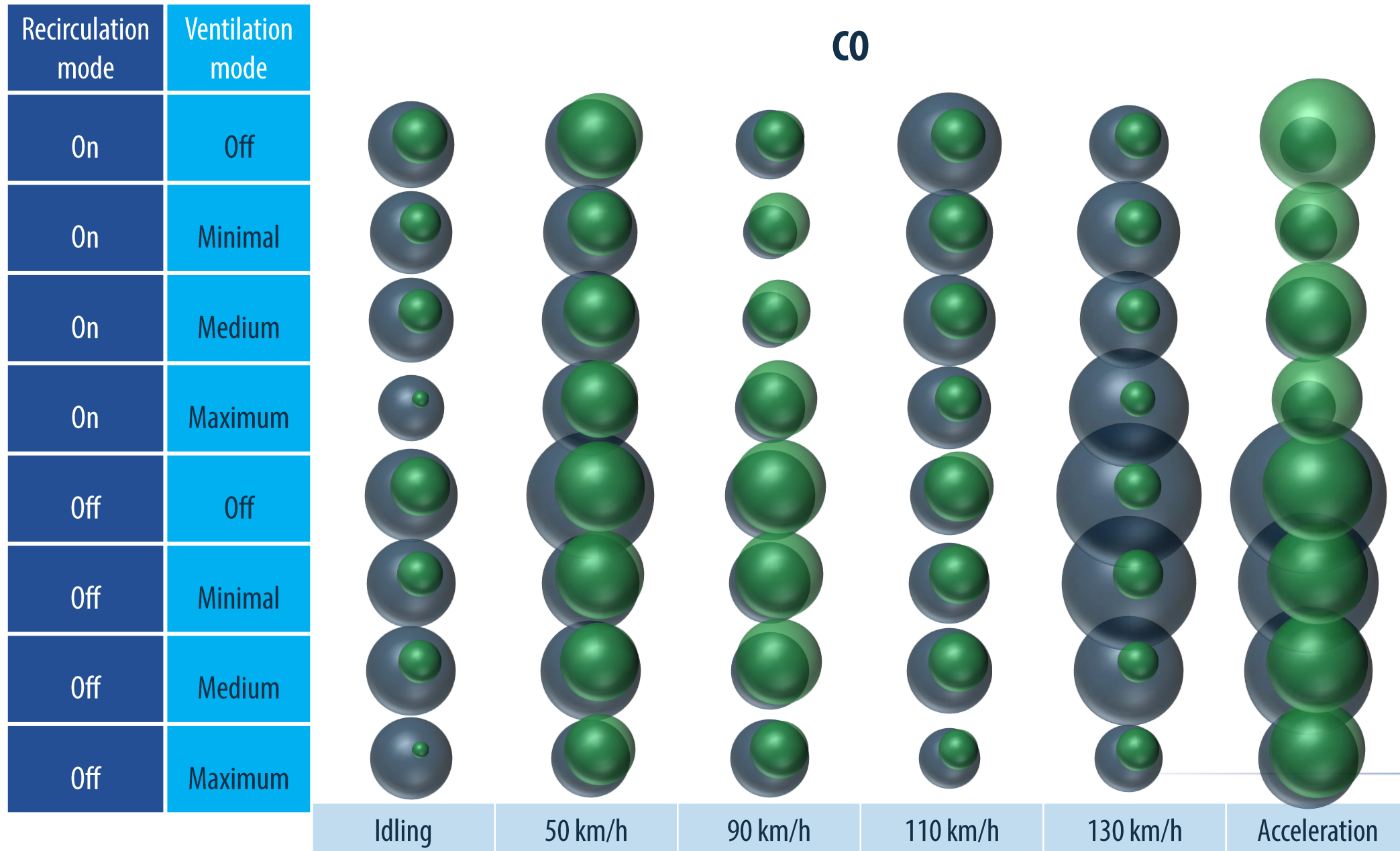
Analysis of results for test matrix: concentration of nitrogen oxide



Analysis of results for test matrix: concentration of nitrogen dioxide



Analysis of results for test matrix: concentration of carbon monoxide



- Gasoline
- Diesel



1. Five passenger cars was tested regarding to interior air quality. 240 combinations of test and ventilation system working modes were analyzed. More than 1200 concentrations measurements was done.
2. Concentrations of pollutants strongly depend on testing and ventilation system working modes.
3. Exceeding of limit values of NO concentration (GOST 33554-15) were registered in both diesel cars on idling test mode.
4. Worse conditions in point of view air quality was observed at idling, movement at 130 km/h and acceleration.
5. Selection of test mode/ventilation mode/recirculation mode combinations need more statistics and farther analysis.

Thank you for your attention!

