

**Summary:**

# **Emission from vehicles with Euro 6/VI-technology**

## **Results from the measurement programme EMIROAD 2014**

*TØI Report 1405/2015*

*Author(s): Christian Weber, Rolf Hagman, Astrid H. Amundsen*

*Oslo 2015, 39 pages Norwegian language*

---

*Exhaust measurements show that the tested heavy vehicles and buses with Euro VI engines have greatly reduced the emissions of NO<sub>x</sub> and PM compared to vehicles with engines that comply with the Euro V requirements. The tested Euro 6 diesel cars show some reduction of NO<sub>x</sub> emissions at 23 °C compared to Euro 5 diesel passenger cars, but the emissions in real traffic are still higher than the type approval value. In cold weather, and in real city traffic, the emission is up to 25 times higher than the type approval value for NO<sub>x</sub>. The tested cars with petrol engines have barely measurable emissions of NO<sub>x</sub>. All tested vehicles have low emissions of particulate matters and other regulated emission factors.*

From 2014-2015 new and stricter emission standards were implemented, these standards apply to new lightweight (Euro 6) vehicles and engines of heavy (Euro VI) vehicles. TØI has been commissioned by the Norwegian Public Roads Administration and their research programme EMIROAD, to examine emissions from Euro 6/VI vehicles in real traffic. The vehicles have all met the type approval limit value when tested using the standard type approval test. We wanted to investigate what to expect of emissions from these vehicles in real traffic situations, especially in city traffic and when used during the cold Nordic winters. An interesting question is whether the new Euro 6/VI requirements will reduce emissions from road traffic as much as was expected in advance.

An earlier measurement program conducted by TØI and VTT found that heavy vehicles with Euro VI engines comply with the limits for Euro-approval in real traffic, while diesel cars are still struggling with the NO<sub>x</sub> reduction, especially in cold weather (Hagman and Amundsen 2013a, 2013b). The preliminary conclusion from these earlier tests has been further strengthened by this test round.

### **Big reduction in the emissions from Euro VI buses**

In this test round we performed exhaust measurements for six city buses with Euro VI engines. The results were compared with emissions from a typical city bus with Euro V engine.

## Emission from vehicles with Euro 6/VI-technology

The measurements of the city buses with Euro VI diesel engines show extremely low levels of PM and NO<sub>x</sub>. In comparison to emissions from a typical bus with Euro V diesel engine, emissions of PM and NO<sub>x</sub> are reduced by approximately 90 respective 98 percent. Emissions of NO<sub>x</sub> are presented in Figure S.1.

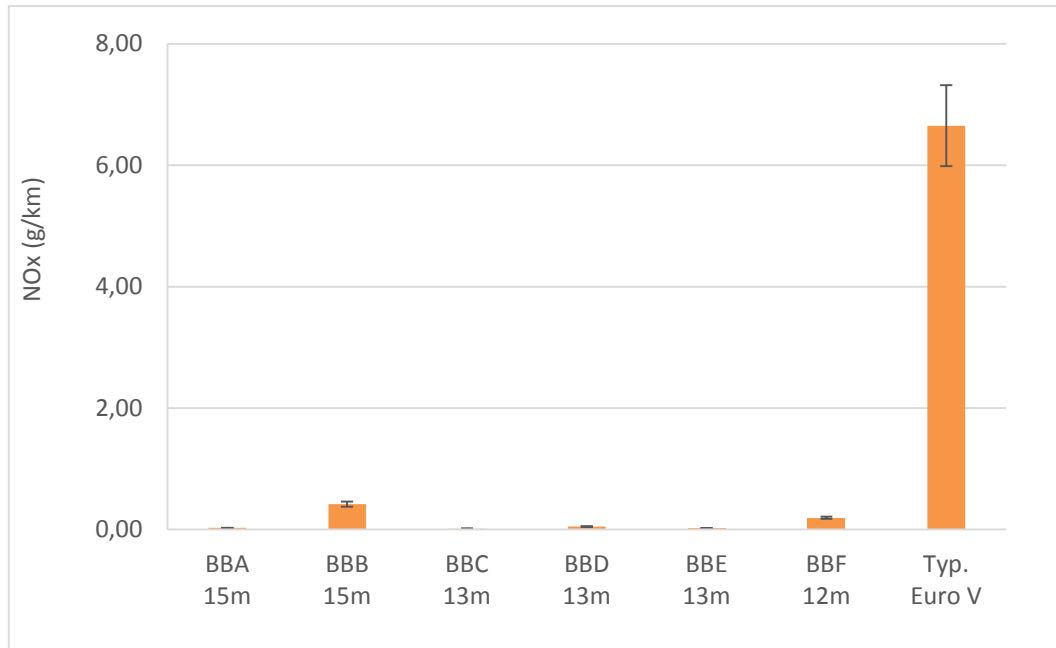


Figure S.1: NO<sub>x</sub> emissions in g/km for six city buses (BBA-BBF) with Euro VI engine. Emission values are very low compared to the emissions from a typical 12 meter bus with Euro V engine.

The exhaust treatment systems with DPF<sup>1</sup>, SCR<sup>2</sup> and urea, together with an advanced management and control system, seem to work very well in real traffic and at 23 °C. We have not discovered any weaknesses in the technology during our measurements. It remains to investigate the possible long-term effects of the technology, in order to assess whether the technology is just as good after several years of use.

### Trucks with Euro VI engines show the same good tendency as city buses

Measurements of emissions from trucks confirm the findings for city buses: Exhaust treatment systems work well and the tested heavy vehicles will not be a major source to local NO<sub>x</sub> pollution.

### Euro 6 cars still have NO<sub>x</sub> emissions in real traffic that is higher than the type approval limit

During this test round we also tested four cars, two diesel and two petrol cars. As expected, petrol cars have no problem complying with the type approval

<sup>1</sup> DPF - Diesel Particulate Filter

<sup>2</sup> SCR - Selective Catalytic Reduction

requirements even when tested in virtually real traffic, and in cold weather conditions, see Figure S.2. Euro 6 diesel cars still have (like the other Euro 6 diesel cars tested in 2013) problems with high emission of NO<sub>x</sub> in real traffic. Even if they manage to comply with the type approval requirements when tested in the standard type approval test cycle, our tests show that this is not representative for what the vehicle emits in real city traffic (and in cold weather).

The driving cycle used for the current type approval tests will only to a small extent reflect emissions in typical city driving, and the type approval of new vehicles are only performed at 23 °C.

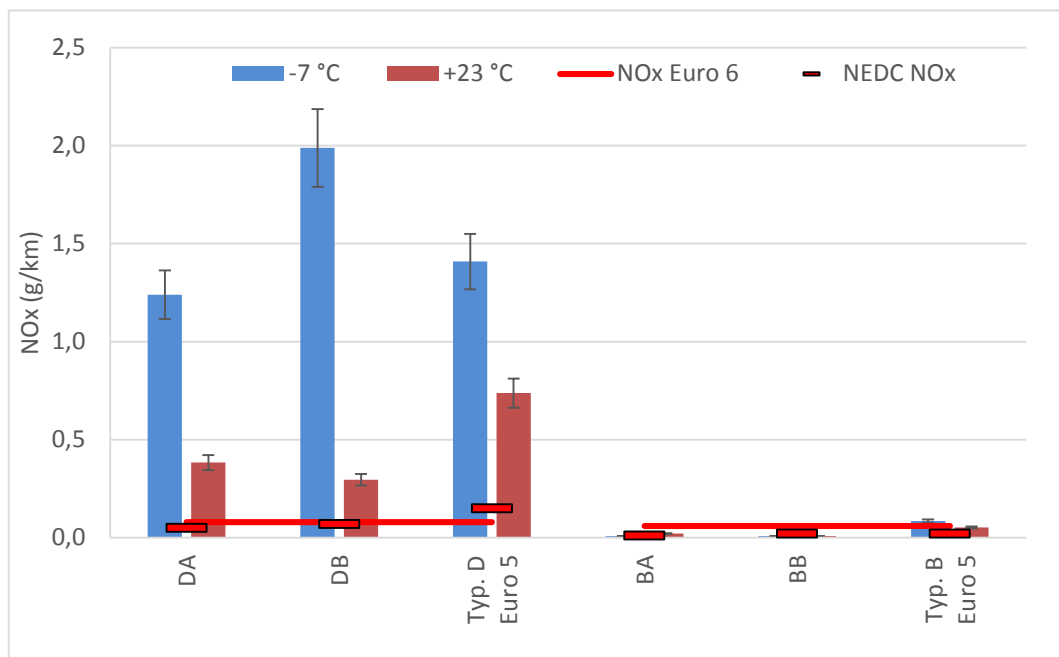


Figure S.2: NO<sub>x</sub> emissions in g/km for the tested Euro 6 diesel cars (DA, DB) and passenger cars with petrol engine (BA, BB). The red marker (NEDC NO<sub>x</sub>) shows the emission value as specified by the manufacturers. The red line (NO<sub>x</sub> Euro 6) shows the type approval requirement for Euro 6. As a reference we have also included the test results of a typical Euro 5 passenger car with respectively, diesel and gasoline engine. Our emission tests are performed both at -7°C and at 23 °C, using the Helsinki city cycle.

For all the tested passenger cars, CO<sub>2</sub> emissions and thus fuel consumption in real traffic are significantly higher than indicated in the vehicles registration documents, see Figure S.3. Along with the high values of NO<sub>x</sub> emissions from diesel passenger cars in real traffic (see Figure S.2), this strengthens the demand for re-evaluation and adjustments of the driving cycles used in Euro type approval so that they better represent a more realistic driving pattern. Only when the type approval cycle reflects real traffic, the type approval requirements can be used in a more equitable manner when estimating vehicle taxes, road-toll rates etc.

Emissions of PM and other regulated emission factors is very low for both petrol and diesel cars.

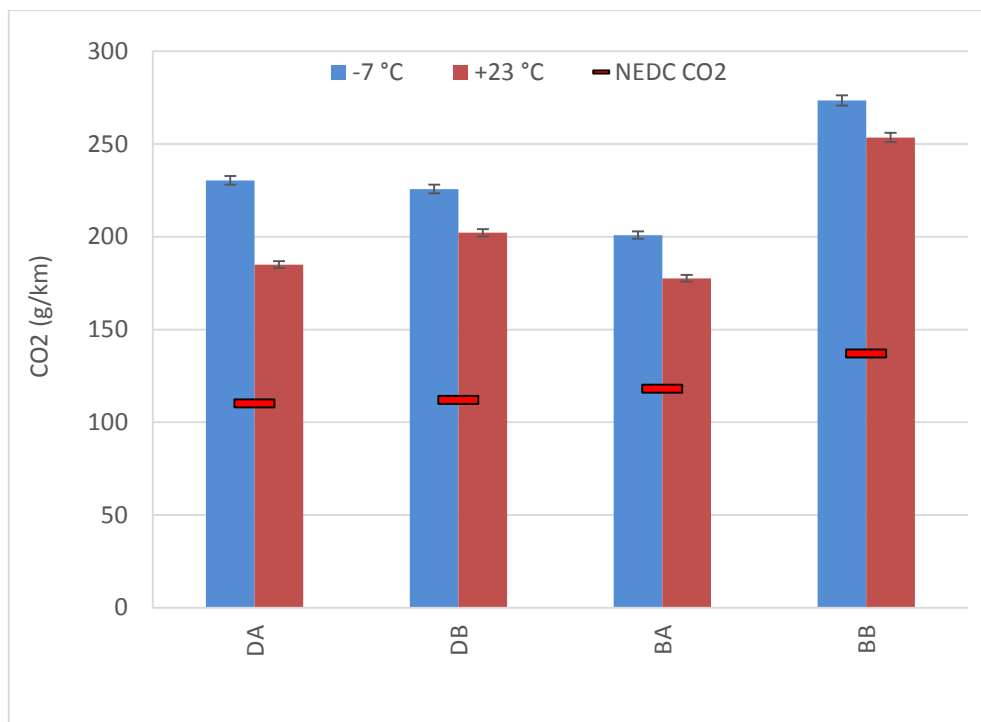


Figure S.3: CO<sub>2</sub> emissions in g/km for the tested Euro 6 diesel cars (DA, DB) and passenger cars with petrol engine (BA, BB). The short red marker (NEDC CO<sub>2</sub>) indicates what the vehicle manufacturer has stated as the CO<sub>2</sub> emissions from the vehicle. Our emission test are performed both at -7 °C and at 23 °C, using the Helsinki city cycle.

### Emission from road traffic in the cities

Very low emission levels of PM from vehicles with Euro 6/VI technology suggests that exhaust from modern vehicles will no longer be a major source of PM in urban air. Wear of tires, brakes and asphalt will thus remain as major road traffic sources to the PM level in urban air.

Regarding NO<sub>x</sub> emissions from heavy vehicles, the introduction of modern Euro VI diesel vehicles in the vehicle fleet will contribute to lower emission levels. However, it seems as if the diesel cars do not have the same positive development. The diesel car will continue to emit significant amounts of NO<sub>x</sub> in the city environment, provided that the exhaust treatment technology in the passenger cars will not be better adapted to these driving conditions.