

Impact of new pollution control technologies on all emissions: the specific problem of high ratio of NO₂ at tail pipe downstream of certain pollution control devices

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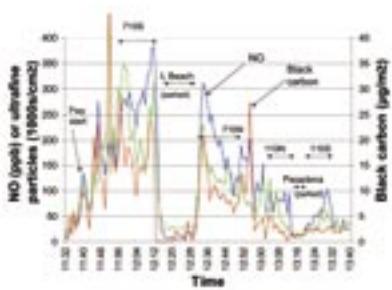
STANDARD STAKES: 0 STANDARD FOR NO₂ IN AUTOMOTIVE BUT 1 FOR AIR QUALITY MANAGEMENT

Air quality standards for NO₂

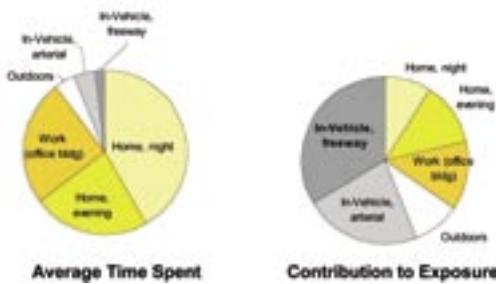
- Atmospheric air quality standard in California: 0.25 ppm during 1-hour exposure
- Air quality standards in mine in USA: 3 ppm during 15-minute exposure

REAL WORLD EMISSIONS (CALIFORNIA)

Time Series: NO, Ultrafine Particle Number, and Black Carbon



In-Vehicle Fraction of Total Ultrafine Particle Exposure



CONTRIBUTION OF NO_x TO HUMAN EXPOSURE RISKS

NO is a scavenger of O₂⁻, OH and NO₃
 NO + O₂⁻ → ONOO⁻ (Peroxynitrite) HOONO (acide peroxyinitreux)
 HOONO₂ peroxyinitric acid

NO₂ EMISSION ARE INCREASED BY Pt-BASED DPF TECHNOLOGY

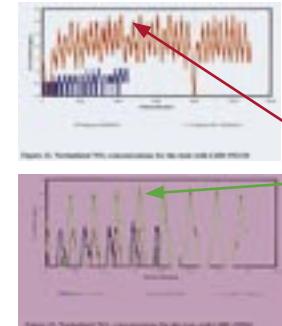
Measurements in mines: stillwater in remote gallery
 Measured in a remote gallery, the tested vehicle being alone

Table 15. Normalized concentrations of carbon monoxide (CO), carbon dioxide (CO₂), nitric oxide (NO), and nitrogen dioxide (NO₂) at downstream sampling station

Year Range	CO (ppm)	CO ₂ (ppm)	NO (ppm)	NO ₂ (ppm)
2002-03 (New York, Mine, remote gallery, 1500 ft)	11.2	5.2	0.014	0.014
2003-04 (New York, Mine, remote gallery, 1500 ft)	11.2	5.2	0.014	0.014
2004-05 (New York, Mine, remote gallery, 1500 ft)	11.2	5.2	0.014	0.014
2005-06 (New York, Mine, remote gallery, 1500 ft)	11.2	5.2	0.014	0.014
2006-07 (New York, Mine, remote gallery, 1500 ft)	11.2	5.2	0.014	0.014
2007-08 (New York, Mine, remote gallery, 1500 ft)	11.2	5.2	0.014	0.014
2008-09 (New York, Mine, remote gallery, 1500 ft)	11.2	5.2	0.014	0.014
2009-10 (New York, Mine, remote gallery, 1500 ft)	11.2	5.2	0.014	0.014
2010-11 (New York, Mine, remote gallery, 1500 ft)	11.2	5.2	0.014	0.014
2011-12 (New York, Mine, remote gallery, 1500 ft)	11.2	5.2	0.014	0.014
2012-13 (New York, Mine, remote gallery, 1500 ft)	11.2	5.2	0.014	0.014
2013-14 (New York, Mine, remote gallery, 1500 ft)	11.2	5.2	0.014	0.014
2014-15 (New York, Mine, remote gallery, 1500 ft)	11.2	5.2	0.014	0.014
2015-16 (New York, Mine, remote gallery, 1500 ft)	11.2	5.2	0.014	0.014
2016-17 (New York, Mine, remote gallery, 1500 ft)	11.2	5.2	0.014	0.014
2017-18 (New York, Mine, remote gallery, 1500 ft)	11.2	5.2	0.014	0.014
2018-19 (New York, Mine, remote gallery, 1500 ft)	11.2	5.2	0.014	0.014
2019-20 (New York, Mine, remote gallery, 1500 ft)	11.2	5.2	0.014	0.014
2020-21 (New York, Mine, remote gallery, 1500 ft)	11.2	5.2	0.014	0.014
2021-22 (New York, Mine, remote gallery, 1500 ft)	11.2	5.2	0.014	0.014
2022-23 (New York, Mine, remote gallery, 1500 ft)	11.2	5.2	0.014	0.014

courtesy of NIOSH

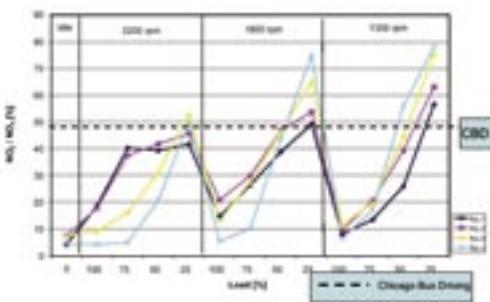
Stillwater NO₂ in remote gallery



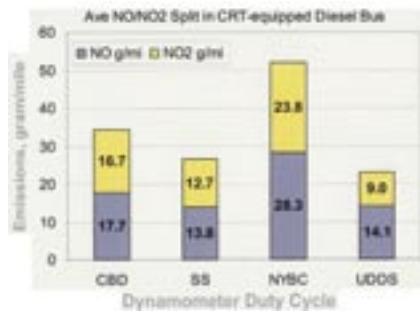
With only one vehicle equipped with commercial CDPF in a remote gallery, the limit of 3 ppm, which is the legal exposure during 15 mn, is regularly met or even exceeded.
 Engine base lines varie but for the people exposed to the emission the only valid limit is the threshold of exposure.

NO₂ EMISSION WITH CRT TECHNOLOGY (REAL WORLD)

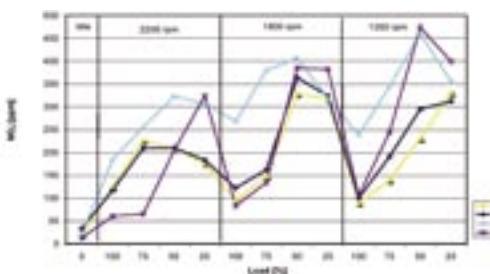
NO₂ to NOx ratio as a function of speed and load (Euro 0 and Euro 2)



NO and NO₂ emissions



Nitrogen dioxide as a function of load and speed (Euro 0 and Euro 2)



NO₂ levels are highly dependent of operating conditions (Euro 3)

Typical operating conditions

Operating Condition	NO ₂ (ppm)	NO (ppm)
Low speed, low load	0.1	0.1
Low speed, high load	0.2	0.2
High speed, low load	0.3	0.3
High speed, high load	0.4	0.4

NO₂ EMISSIONS ARE REDUCED BY DPF TECHNOLOGY WITHOUT Pt

NO₂ emissions of DPF without Pt coating

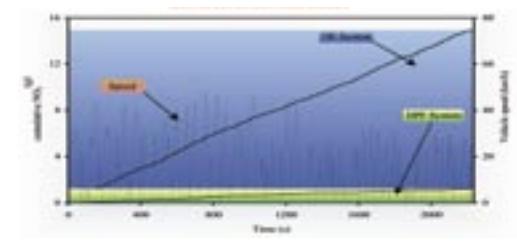
DPF type

DPF type	NO ₂ (ppm)	NO (ppm)
DPF without Pt	0.1	0.1
DPF with Pt	0.2	0.2

courtesy of VERT

Further field application of DPF + FBC

Cumulative NO₂ emissions over a city driving cycle



courtesy of ADASRA-OCTEL

In 2007, DPF will be widely implemented on new vehicles in USA. A serious risk of high exposure to NO₂ exists in certain microenvironments if Pt-based DPF technology is massively used.