

Appendix I: European emission standards

AI.1 What are Euro emission standards and why do we have them?

The major source of air pollution in cities such as London is emissions from road traffic. An effective method of reducing these emissions and improving air quality has been through emission standards legislation, which has been imposed for new vehicles sold in Europe since 1992. These standards are known as European emission standards (or Euro standards) and have been defined in a set of European Union directives. They give acceptable limits for exhaust emissions of all new vehicles that are sold in the EU, covering oxides of nitrogen (NO_x), hydrocarbons (HC), carbon monoxide (CO) and particulate matter (PM) emissions. The limits are set at different levels for different vehicle types and compliance is determined by running a vehicle's engine over a standard test cycle for a set time.

This appendix provides details of the Euro standards for heavy duty vehicles affected by phases 1 and 2 of the London Low Emission Zone scheme, implemented during 2008. Tables AI.1 and AI.2 summarise the dates the Euro standards were effective from for these vehicles and the relevant emission limits.

Table AI.1 Dates of implementation of Euro standards for HGVs and buses/coaches.

Date of first vehicle registration (or manufacture)	Euro standard
Prior to 1992	Pre-Euro
1992 – 30 September 1996	Euro I
1 October 1996 – 30 September 2001	Euro II
1 October 2001 – 30 September 2006	Euro III
1 October 2006 – 30 September 2009	Euro IV
1 October 2009 onwards	Euro V

Table AI.2 Emission standards of HGVs and buses/coaches.

Euro standard	Date	Test cycle	CO (g/kWh)	HC (g/kWh)	NO _x (g/kWh)	PM (g/kWh)	Smoke (m ⁻¹)
Euro I	1992	ECE R-49	4.5	1.1	8.0	0.61 (0.36 for vehicles >85kW)	
Euro II	1996		4.0	1.1	7.0	0.25	
	1998		4.0	1.1	7.0	0.15	
Euro III	1999	ESC & ELR	1.5	0.25	2.0	0.02	0.15
	2000		2.1	0.66	5.0	0.1	0.8
Euro IV	2006		1.5	0.46	3.52	0.02	0.5
Euro V	2009		1.5	0.46	2.0	0.02	0.5

It is important to note that the dates given in Table A1.1 refer to **new** type approvals. As Euro standards are issued over a one year period, the dates for **all** type approvals are in most cases one year later. This means that vehicles can be manufactured to meet a Euro standard prior to the Euro standard becoming mandatory. An example of this is that some Euro II and a few Euro I vehicles that were registered before 1 October 2001 have low enough particulate matter emissions to meet the Euro III emission standard without modification. This issue has implications for the London Low Emission Zone, which are discussed in subsequent sections of this appendix.

A1.2 Impact of Euro emission standards on air quality

Defra has modelled the effectiveness of introducing Euro III, IV and V emission standards between the years 2001-2010 as part of its air quality strategy. This estimated that these improvements would result in a reduction of UK wide NO_x emissions from HGVs by 128kt and PM₁₀ emissions by 5kt. Note that these estimates also take into account influences from the vehicle market and changes in fuel quality which will occur over this period.

The introduction of these tighter emission standards will obviously mean that vehicle emissions in London will decrease over time, even without schemes such as the London Low Emission Zone. But with the scheme in place, these benefits are estimated to be brought forward by two or more years. Emission projections from the London Atmospheric Emission Inventory – LAEI (2004) – that take into account EU and national legislation, as well as the scheme, estimate that road vehicle emissions could reduce by almost half by 2010 as soon in Tables A1.3 and A1.4.

Table A1.3 Road vehicle emissions of NO_x in London as estimated by London Atmospheric Emission Inventory (2004).

Vehicle type	2004 emissions (t/y)	Projected 2010 emissions (t/y)
Buses and coaches	4,079	2,997
LGVs	4,373	2,581
Rigid HGVs	9,487	5,803
Articulated HGVs	11,526	6,686
TOTAL (all road traffic)	43,393	26,907

Table A1.4 Road vehicle exhaust emissions of PM₁₀ in London as estimated by London Atmospheric Emission Inventory (2004).

Vehicle type	2004 emissions (t/y)	Projected 2010 emissions (t/y)
Buses and coaches	57	13
LGVs	415	237
Rigid HGVs	275	113
Articulated HGVs	316	132
TOTAL (all road traffic)	1,655	921

A1.3 How Euro standards are used to calculate the effect of London Low Emission Zone on emissions

In order to comply with the 2008 London Low Emission Zone scheme, vehicles need to meet the Euro III emission standard for particulates, ie they emit 0.1g of particulates per kWh or better. Transport for London (TfL) determines the Euro emission standards of vehicles indirectly using automatic number plate recognition (ANPR) cameras. These cameras capture a wealth of information on each vehicle by cross-referring the vehicle number plate with information held on the Driver and Vehicle Licensing Agency (DVLA) database, as well as related TfL sources.

For scheme monitoring purposes, two types of Euro standards are recorded; the original or 'base' Euro standard and the PM Euro standard. The base standard is determined by the date of first vehicle registration as provided in the DVLA database, according to the rules in Table A1.1. Within these dates it should be noted that vehicles of an older standard may have been sold for some period after the introduction date of a new standard. Therefore to estimate each Euro class, two date ranges are used: a high-confidence eg 'probably Euro II' and a low-confidence eg 'possibly Euro II'. Those vehicles that are 'possibly Euro II' are in fact counted as Euro I.

The original Euro standard can be further revised to a higher Euro standard, known as 'PM Euro standard' for cases where TfL has further evidence on a vehicle's emission levels. Examples of this include those older vehicles whose engine already meets the Euro III standard without modification as well as those fitted with an accredited abatement device. To comply with the scheme, these vehicles need to be tested and issued with an emission certification, either through the Reduced Pollution Certificate (RPC) or Low Emission Certificate (LEC) schemes. The vehicles resulting 'PM Euro standard' supersedes the original Euro standard in the database. Table A1.5 summarises the basis by which TfL calculate a vehicle's PM Euro standard.

Table A1.5 Method to determine PM Euro standard of vehicles for the London Low Emission Zone scheme.

Original Euro class classification (base Euro standard)	Certificate (LEC or RPC)	Resulting vehicle Euro class classification (PM Euro standard)
Pre Euro	M, P, G	Euro III
Euro I	M, P, G	Euro III
Euro II	M	Euro III
Euro II	P, G	Euro IV
Euro III	M, P, G	Euro V
Euro IV	M, P, G	Euro V

Note: M – 'eligible' engine or engine modification, P – particle trap, G – gas conversion

This information on Euro standards collected from the ANPR cameras is subsequently used by TfL to calculate emissions of vehicles driving in London using an emissions inventory. An inventory is a database that contains estimates of the amount and type of pollutants that are emitted to the air each year from all sources, such as traffic, household heating, agriculture and industrial processes.

Euro standards cannot be used directly in an emission inventory to calculate emissions from road vehicles but must be converted into emission factors (expressed in g/km). In general, vehicles of a higher Euro standard would have consistently and significantly lower emission factors than those of lower standards. These emission factors quantify the emissions of pollutants while taking into account other characteristics such as the type of vehicle, speed and type of road. This is combined with traffic activity data (ie traffic flows or vehicle kilometres travelled) in the emissions inventory to estimate emissions.

As part of the public and stakeholder consultation of the London Low Emission Zone, TfL have undertaken various phases of air quality modelling to assess the impact of the scheme on emissions and air quality. A summary of some of the most up-to-date predictions, before the London Low Emission Zone was introduced are shown in Table A1.6. This modelling was based on the London Atmospheric Emissions Inventory (LAEI) – 2003 version. This is a database of all emission sources in Greater London that is maintained by the Greater London Authority. The LAEI is regularly used by local authorities and consultants for air quality management and environmental impact assessments.

Table A1.6 Summary of emission impacts predicted for the London Low Emission Zone (for Greater London area) – phase 6 data.

LEZ scenario	Emissions of NO _x			Emissions of PM ₁₀		
	Reduction in emissions	Reduction in area exceeding annual mean objective (2010)	Reduction in population exceeding objective	Reduction in emissions	Reduction in area exceeding daily mean objective (pre 2010)	Reduction in population exceeding objective
Phase 1 and 2 (2008)	3.3%	5.1%	5.9%	2.1%	6.9%	6.3%
Phase 1,2 and 3 (2010)	4.1%	8.4%	9.3%	3.7%	8.8%*	9.5%*

* 2010 objective

For the monitoring programme, TfL will need to assess the impacts of the scheme once it is introduced. This process is explained in much detail in Section 5. To do this, TfL will use more robust data collected pre and post-implementation, which will be different to these forecasted estimates. TfL has created a 'baseline emission inventory' which estimates emissions in London before the scheme is introduced (ie in 2007). TfL will then manipulate and produce new versions of the inventory after the London Low Emission Zone is introduced from 2008 onwards to estimate the emission impact of the scheme. It is important to note that these versions of the emissions inventory will be kept separate from the Greater London Authority's version of the LAEI and will be used specifically by TfL for monitoring purposes.