



# Vehicle test cycles

Clean Fleets Factsheet (July 2014)

## 1. What is a test cycle

Before being allowed on the market in the EU, all new vehicles must be tested under laboratory conditions following a specified “test cycle”. A test cycle is a sequence of defined acceleration and braking processes designed to mirror typical driving conditions on the road. These tests are carried out to determine the fuel consumption and CO<sub>2</sub> emissions of vehicles with internal combustion engines (ICE), and to ensure compliance with the EURO emission standards, which set maximum emission levels for a series of pollutants.<sup>1</sup> The test forms part of the manufacturer's information for the approval and distribution of the vehicles.

For a cycle, boundary conditions such as start temperature, set points (cars with manual transmission), vehicle preparation (conditioning), payload, the beginning of the exhaust gas measurement are specified. For ICE vehicles emissions are measured at the tailpipe. For electric cars the consumed energy of the battery is measured.

The test cycle applied and type of test carried out depends on the size and type of the vehicle. As presented in Table 1 below, cars and light duty vehicles (vehicle classes M1, M2, N1 & N2 up to a reference mass of 2,610kg) are tested on a dynamometer, using the NEDC (New European Driving Cycle). For vehicles with a reference mass of higher than 2,610 kg, it is the engine rather than the vehicle as a whole which is tested - see separate sections below for light and heavy duty vehicles for further information.

A legally binding measurement can only be performed by EC certified testing laboratories. The results of the testing procedure are recorded in the Certificate of Conformity (CoC) which must accompany any vehicle sold on the EU market.

**Table 1 – Testing procedures for different vehicle classes**

Vehicle Class	maximum mass	reference mass	Directive
M1/N1	< 3,5t		715/2007
M2/N2	> 3,5t <12t	< 2610 kg	715/2007 (Dynamometer)
		> 2610 kg	595/2009 (Engines)
M3/N3	> 12t		595/2009

<sup>1</sup> See Clean Fleets factsheet on *EU clean road vehicles legislation & policy*: [www.clean-fleets.eu](http://www.clean-fleets.eu)



## 2. Cars and light delivery vehicles

Cars and light duty vehicles are tested according to the NEDC (New European Driving Cycle). During the type approval procedures the vehicle is placed on a chassis dynamometer and the NEDC is driven. The exhaust emissions are measured and extrapolated in g/km.

The emission values, including CO<sub>2</sub>, are recorded in the CoC Paper.

### Weakness of the NEDC

The NEDC was conceived at a time when European vehicles were lighter and less powerful. The test offers a stylized driving speed pattern with low acceleration, constant speed cruises, and many idling events. However in practice the transient accelerations are much steeper and more dynamic, in part caused by the power surplus of modern engines (the 0–100 km/h average time decreased from 14 seconds in 1981 to 9 seconds in 2007). As a result, drivers fail to achieve the certified values in practice. The increased use of ancillary units and gadgets, which tend to be fitted to modern vehicles, is also not reflected in the NEDC.

### Alternative Test cycle: ADAC EcoTest

In 2002, ADAC, Europe's largest automobile club started EcoTest, a program "designed to provide a fair, reliable and objective assessment of the environmental performance of cars. The EcoTest is based on European vehicle emission and fuel consumption test procedures but extended to include procedures and parameters to cover a wide range of real-life driving scenarios in Europe.

The EcoTest consists of 3 tests, which are then combined to provide the overall test result:

- NEDC cold: duplicating the EU type approval test, but at lower test cell temperature (22°C) and using the actual weight of the tested vehicle, instead of a usually lower test weight and discrete inertia classes
- NEDC hot: same as NEDC cold, but starting with a warm engine, and the air conditioner unit switched on (set point of 20°C)
- ADAC motorway: a dedicated cycle for driving on a motorway with speeds of up to 130 km/h

More information:

[http://www.theicct.org/sites/default/files/publications/ICCT\\_EU\\_fuelconsumption2\\_workingpaper\\_2012.pdf](http://www.theicct.org/sites/default/files/publications/ICCT_EU_fuelconsumption2_workingpaper_2012.pdf)

<http://www.adac.de/infotestrat/tests/eco-test/default.aspx>



### 3. Heavy duty vehicles

#### Current testing requirements

For heavy duty vehicles (HDVs) it is the engine rather than the vehicle which is tested during type approval and to determine whether EURO standards are achieved. The tests therefore provide data on emissions in g/kWh, rather than in km (i.e. they test emissions generated in relation to the power the engine is producing, but this is not converted into a specific distance travelled by a vehicle).

Until EURO V engines were tested on test beds following the European Transient Cycle (ETC) and the European Stationary Cycle (ESC)<sup>2</sup>:

- **ETC (European Transient Cycle):** This simulates the different transient driving conditions between urban, rural road and motorway journeys.
- **ESC (European Stationary Cycle):** This tests the engine on a dynamometer in 13 steady state modes for a certain duration.

From EURO VI onwards the updated **World harmonized transient cycle** (WHTC) and the **World Harmonized Stationary Cycle** (WHSC) is being used for type approval testing<sup>3</sup>. Unlike the ETC and ESC, these tests additionally measure CO<sub>2</sub> (also in g/kWh), but this is not then recorded in the CoC.

More information:

<http://www.car-engineer.com/the-different-driving-cycles/>

[http://www.hbefa.net/d/documents/HBEFA\\_31\\_Docu\\_hot\\_emissionfactors\\_PC\\_LCV\\_HDV.pdf](http://www.hbefa.net/d/documents/HBEFA_31_Docu_hot_emissionfactors_PC_LCV_HDV.pdf)

#### Weaknesses of the current requirements

The current testing approach does not provide an effective assessment of the fuel consumption or gaseous emissions of HDVs under real driving conditions, which in turn means the information provided does not allow vehicles' environmental performance to be compared during procurement.

Firstly, the fuel consumption and related emissions of the engine will be heavily affected by the type of vehicle it is placed in. Secondly, they will be heavily affected by the way in which the vehicle is used. This variation is far higher than for a passenger car. The following factors will all have a major impact on consumption and emissions:

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<sup>2</sup> **ETC (European Transient Cycle):** This simulates the different transient driving conditions between urban, rural road and motorway journeys.

**ESC (European Stationary Cycle):** This tests the engine on a dynamometer in 13 steady state modes for a certain duration.

<sup>3</sup> See EC Regulation 595/2009: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009R0595&rid=1>



- Vehicle mass (laden, unladen, partly laden)
- Topography
- Driving profile (urban, city, highway – only, partly)
- Driving style
- Maintenance
- Aerodynamics
- Rolling resistance
  - and many more.

All these factors mean that the theoretical fuel consumption and emissions data provided in terms of g/kWh, cannot effectively be turned into g/km for a vehicle in use.

## 4. Buses

For type approval buses are obliged to follow the same test cycles as for other HDVs (see section 3).

Unlike for other HDVs, however, alternative test cycles do exist – the SORT test cycles.

### SORT

SORT stands for Standardised on-road test cycles. It is a method developed by UITP<sup>4</sup> for measuring fuel consumption in buses and can be used to compare different bus models in a call for tender. It is a real-life test – i.e. not an engine test but a test with a full-size bus on a test track. Instead of each operator having his own cycle (Paris cycle, London cycle, Braunschweig cycle, etc.), the idea behind SORT and its motivation is to converge all those different cycles, and to end up - sector-wide - with one single measuring method.

SORT defines three different cycles:

- SORT 1 – Heavy Urban Cycle – average of 12Km/h
- SORT 2 – Easy Urban Mixed Cycle – average of 18km/h
- SORT 3 – Easy Urban Cycle – average of 25km/h

As a widely recognised and accepted industry standard, many bus manufacturers test their vehicles according to the three SORT cycles, and thus can easily provide test data to procurers.

The procurer needs to define which SORT profile corresponds to the needs of their particular usage profile, potentially combining different SORT cycles. The Clean Vehicle Portal ([www.cleanvehicle.eu](http://www.cleanvehicle.eu)) allows the user to calculate the cost of environmental emissions of a bus using the operational lifetime cost methodology outlined in the Clean Vehicles Directive (CVD).<sup>5</sup> It allows the procurer to attribute percentage values for SORT 1 to 3 to represent the

<sup>4</sup> The international association of public transport operators - [www.uitp.org](http://www.uitp.org)

<sup>5</sup> For more detailed information on the CVD and its practical application, please see the Clean Fleets Guide: Procuring Clean and Efficient Vehicles ([www.clean-fleets.eu/publications](http://www.clean-fleets.eu/publications)).



intended use of their vehicle. The calculation is then performed using the parameters stored in the database.

More information:

[http://ec.europa.eu/environment/archives/clean\\_bus/slides/etienne\\_sort.pdf](http://ec.europa.eu/environment/archives/clean_bus/slides/etienne_sort.pdf)

<http://www.sahakk.sakarya.edu.tr/hybridbus/files/SORT2.pdf>

## 5. Clean Fleets Factsheet series

The Clean Fleets project ([www.clean-fleets.eu](http://www.clean-fleets.eu)) assists public authorities and fleet operators with the implementation of the Clean Vehicles Directive and the procurement or leasing of clean and energy-efficient vehicles.

The Factsheet series aims to provide concise information on topics of relevance to clean vehicle procurement. If you wish to propose a topic for a new factsheet please email [procurement@iclei.org](mailto:procurement@iclei.org)

## Clean Fleets project partners



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Co-funded by the Intelligent Energy Europe  
Programme of the European Union

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