



Joint Research Centre

The European Commission's in-house science service

VELA

Vehicle Emissions Laboratories

VELA

The Ispra, Italy-based Vehicle Emissions Laboratory (VELA) comprises two well-equipped chemical and physical analysis labs, and seven major testing facilities capable of conducting emissions tests (including the measurement of evaporative emissions) on a variety of vehicles. These range from motorbikes to passenger cars and even large heavy-duty engines. Findings made at these facilities have provided scientific support for the development of new EU Directives and the revision of older ones, as well as for the assessment of new measurement techniques and procedures. They have also provided answers to other scientific challenges, such as the toxicity of emissions from motorcycles.

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Quantitative analyses of ozone precursors from vehicles and also the CO₂ emissions have been increasingly important in view of the European legislation limiting greenhouse gas emissions. CO₂ emission analysis goes hand in hand with energy efficiency assessments of various fuel options and alternative drive-trains - including electric hybridisation and even fully electric cars in the near future. Below you will find a short description of the various activities of the VELA Laboratory.

The VELA research activities cover all environmental aspects of advanced technologies, new engines and after-treatment systems, on-board diagnostic systems, new or reformulated fuels, and bio-fuels and gaseous fuels. Chemical analysis of particulate matter and volatile organics is also carried out in the VELA facility. The analysis helps create fingerprints used for source apportionment. Further to classical combustion engine emissions testing, the staff perform cost-benefit analyses of cleaner transport technology options, and of technology foresight through a Life Cycle Analysis (LCA) of transport fuels.

Testing the energy efficiency of electrical, hybrid, hydrogen (H₂) and fuel cell vehicles completes the process. VELA, equipped with the most advanced facilities and instrumentation, is able to characterise physical/chemical and toxicological emissions from all types of transport means. Tests are conducted on various engines, in small hand-held (e.g. chain saws) and large heavy-duty machines, and on full vehicles including mopeds, motorbikes, passenger cars, 4WD (four-wheel drive) cars, heavy-duty trucks and buses. Laboratory and test bench analysis of tailpipe emissions is accompanied by innovative research into real-world emissions from combustion engines. For some time now, the JRC has been testing the so-called Portable Emission Measurement System (PEMS) on heavy-duty trucks and buses running in their normal working environment.

Similar systems will also be used on passenger cars, working machinery, ships and locomotives in the future; this will help scientists to optimise how engines and after-treatment systems function in real-world operating conditions.

VELA 1 & 2

The test cells VELA 1 and VELA 2 have the capacity to measure pollutant emissions from light duty vehicles (cars, vans, small trucks) as well as from motorcycles and mopeds. In both cells, it is possible to vary the test temperature to study its effect on emissions; in particular, it is possible to test vehicles at low ambient temperatures (down to -10 °C). VELA 2 is also equipped with a roller bench for 4WD vehicles.

VELA 3

VELA 3 is a test cell dedicated to the measurement of vehicle-generated evaporative emissions. These emissions mainly come from the evaporation of fuel in the tank and in the injection system and contribute to the total emissions of volatile organic compounds. The legislative procedure prescribes leaving the vehicle in the cell for 24 hours while the temperature is varied between 20°C and 35°C, simulating parking conditions during a summer day.

VELA 4 & 5 & 6

VELA also comprises test beds for measuring emissions generated by engines of different sizes. The engine, installed on a specific support, is coupled to an electric brake carrying a variable load, thus simulating the operating conditions of the corresponding driving cycle.

VELA 7

VELA 7 is the latest emission test cell that facilitates the measurement of emissions from heavy-duty vehicles. The dynamometer can simulate different driving cycles while the test temperature can be varied between +50°C and -30°C.

This laboratory is essential for making an accurate assessment of the emissions of heavy-duty vehicles in their actual service conditions, as well as for testing prototype vehicles. Besides the regulated pollutants (unburned hydrocarbons, carbon monoxide, nitrogen oxides and particulate matter), it is possible to measure unregulated emissions in each test cell, namely: specific hydrocarbons (e.g. benzene), aldehydes or the number and size of particles.

Planned: VELA 8 & 9 for Electromobility

New facilities will focus on electric vehicle testing, and pre-normative research. As partner laboratory to the US Argonne National Laboratory's Advanced Powertrain Research Facility, the new VELA's will test plug-in hybrid (PHEV), range-extended hybrid (REEV), and battery and fuel cell vehicles (BEV / FCEV) up to medium-duty city van size, addressing smart charging and grid-communication as well as drive-cycle and range tests at various temperatures.

VeLA 9 will carry out tests on electromagnetic compatibility (emission and immunity) of electric vehicles. Moreover, VELA 5 will be extended for testing heavy duty hybrid engines in the so-called "hardware-in-the-loop" mode. First results will feed primarily into three "client" work fields: i) The European Commission awaiting technological input for urgently needed regulations, notably on future world-wide drive-cycles and homologation; ii) the European and International standardisation organizations (CENELEC, UN-ECE, ICE) to guarantee a level playing field; and iii) the newly collaborating EU-US bodies who recently concluded agreements on directly working together on interoperability of electric vehicles with smart grids.

