Economic and Social Council

Economic Commission for Europe

Inland Transport Committee

World Forum for Harmonization of Vehicle Regulations

Amendment to Special Resolution No. 1 concerning the recommendation on market fuel quality parameters*

The text reproduced below was adopted by the Executive Committee (AC.3) of the 1998 Agreement at its thirty-fourth session. It is based on ECE/TRANS/WP.29/2011/127, not amended (TRANS/WP.29/1095, para. 136.). It contains a recommendation on market fuel quality parameters to protect vehicle emission control technologies.

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* In accordance with the programme of work of the Inland Transport Committee for 2010–2014 (ECE/TRANS/208, para. 106 and ECE/TRANS/2010/8, programme activity 02.4), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

Please recycle

Insert a new paragraph 3.5, to read:

"3.5.   References in gtrs to minimum market fuel quality parameters shall be in accordance with Annex 5."

Insert a new Annex 5, to read:

"Annex 5

Recommendation on market fuel quality parameters

1.   Purpose of the recommendation

        This recommendation has been developed to inform governments about appropriate market fuel quality that is protective of vehicle emission control technologies. The regulated vehicle emissions limits and associated market fuel qualities should be consistent with local air quality expectations.

2.   Scope of the recommendation

        This recommendation applies to key fuel quality parameters that directly affect the performance and durability of vehicle emissions control equipment. These are not the only fuel quality parameters that affect emissions control equipment (and consequently emissions) but they are acknowledged to be the most important for enabling emission control technologies and should be addressed first in any program to improve fuel quality. Although not part of this recommendation, as other parameters may have an effect on exhaust emission levels, consideration may be given to other parameters in order to meet local limits.

3.   Abbreviations

AQIRP	Air Quality Improvement Research Program
CEN	European Committee for Standardization
DPF	Diesel Particulate Filter
HC	Hydrocarbons
JCAP	Japan Clean Air Programme
OBD	On-board diagnostics
PM	Particulate matter
TEL	Tetra Ethyl Lead

4.   Introduction

4.1.   The World Forum WP.29 has acknowledged that market fuel quality is closely linked to the emissions of pollutants from motor vehicles. Locally, however, regulations and specifications of market fuel quality are not always fully aligned with the requirements of vehicle technology necessary to reduce exhaust emissions.

4.2.   This document provides guidance on the minimum fuel quality requirements to enable the proper functioning and durability of various vehicle technologies. As stated in paragraph 2 above, other fuel parameters can influence the exhaust emissions of vehicles and thus adherence to this limited list may not be sufficient to enable durable compliance to local emissions standards, which will vary from country to country.

4.3.   The parameters given are in respect of Euro 2, 3, 4 vehicle technology levels. Further revisions to this guideline will be required in the future to keep the guideline updated with technical developments.

4.4   This document includes only Euro standards but it should be noted that applicable standards in other countries such as Japan and the United States also have comparable standards that require minimum fuel quality requirements. Please consult with local officials to determine the appropriate specifications.

5.   Fuel quality to enable emissions control technology

5.1.   Gasoline quality

Gasoline parameters[1]	For Euro 2[2]	For Euro 3[3]	For Euro 4[4]	Test method
Sulphur (mg/kg)	≤ 500	≤ 150	≤ 50[5]	EN ISO 20846 EN ISO 20884
Lead[6] (g/l)	no intentional addition, with a maximum ≤ 0.013	no intentional addition, with a maximum ≤ 0.005	no intentional addition, with a maximum ≤ 0.005	EN 237

5.2.   Diesel fuel quality

Diesel fuel parameters[7]	For Euro 2[8]	For Euro 3[9]	For Euro 4[10]	Test method
Sulphur (mg/kg)	≤ 500	≤ 350	≤ 50[11]	EN ISO 20846 EN ISO 20884
Ash (% m/m)	≤ 0.01	≤ 0.01	≤ 0.01	EN ISO 6245
Total Contamination (mg/kg)	≤ 24	≤ 24	≤ 24	EN 12662

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[1] See Appendix 1 and Appendix 3

[2] See Regulation No. 83, 03 series of amendments

[3] See Regulation No. 83, 05 series of amendments (row A)

[4] See Regulation No. 83, 05 series of amendments (row B)

[5] Corresponds to the United Nations Environment Program (UNEP) decision taken at the fourth global meeting of the Partnership for Clean Fuels and Vehicles (PCFV), held on 14 and 15 December 2005 in Nairobi, Kenya

[6] Potassium-containing additives may be used in Lead Replacement Petrol (LRP). See Appendix 1, Lead.

[7] See Appendix 2 and Appendix 3

[8] See Regulation No. 83, 03 series of amendments and Regulation No. 49, 02 series of amendments (Stage II)

[9] See Regulation No. 83, 05 series of amendments (row A) and Regulation No. 49, 03 series of amendments (row A)

[10] See Regulation No. 83, 05 series of amendments (row B) and Regulation No. 49, 03 series of amendments (row B1)

[11] Corresponds to the United Nations Environment Program (UNEP) decision taken at the fourth global meeting of the Partnership for Clean Fuels and Vehicles (PCFV), held on 14 and 15 December 2005 in Nairobi, Kenya

Annex 5 - Appendix 1

Gasoline properties

1.   Sulphur

1.1.   Sulphur occurs naturally in crude oil. Sulphur has a significant impact on vehicle emissions because it known to reduce the efficiency of vehicle emission control systems. Sulphur is known to poison or reduce the effectiveness of vehicle emission control technologies for petrol vehicles, resulting in increased vehicle emissions. For petrol vehicles, it has been proven that lowering sulphur in petrol will enhance three-way catalyst operation and thereby reduce HC, CO and NO_x emissions[1]. Finally, reductions in sulphur will provide immediate reductions of exhaust emissions from all catalyst-equipped vehicles.

1.2.   Extensive testing has been done on the impact of fuel sulphur level on vehicle emissions. Studies such as those performed by Air Quality Improvement Research Program (AQIRP) in the United States of America, Auto-Oil programme in Europe and Japan Clean Air Programme (JCAP) in Japan have shown that significant exhaust emissions reductions will be observed with different vehicle technologies as the fuel sulphur content is reduced.

1.3.   Meeting stringent emission regulations, combined with long-life compliance requirements, requires extremely efficient and durable exhaust after-treatment systems. On-board diagnostic (OBD) systems are increasingly used to ensure that this performance is maintained over the life of the vehicle. The fuel sulphur content will negatively affect the performance of advanced OBD systems.

2.   Lead (Tetra Ethyl Lead (TEL))

2.1.   Lead alkyl additives have been used historically as inexpensive octane enhancers for gasoline.

Concerns over health effects associated with the use of these additives, and the need for unleaded gasoline to support vehicle emission control technologies such as catalytic converters and oxygen sensors, have resulted in the elimination of leaded gasoline from many markets. As vehicle catalyst efficiencies have improved, their tolerance to lead contamination is very low, so that even slight lead contamination can irreversibly poison the oxidation catalyst and oxygen sensor. As catalyst-equipped vehicles are increasingly introduced into developing countries, unleaded gasoline should be available. Unleaded gasoline also reduces vehicle hydrocarbon emissions, even from vehicles without catalytic converters. A lead-free market worldwide is therefore essential, not only for emission control compatibility, but also because of the well-known adverse health effects of lead from exhaust emissions.

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[1]   See: Opening the Door to Cleaner Vehicles in Developing and Transition Countries: The Role of Lower Sulphur Fuels; Report of the Sulphur Working Group of the Partnership for Clean Fuels and Vehicles (PCFV); http://www.unep.org/transport/pcfv/PDF/SulphurReport-Vrsn2.pdf

Annex 5 - Appendix 2

Diesel properties

1.   Sulphur

1.1.   Sulphur naturally occurs in crude oil. Sulphur poisons or reduces the effectiveness of emission control technologies for diesel vehicles, resulting in increased vehicle emissions of carbon monoxide (CO), hydrocarbons (HC), nitrogen oxide (NO_x) and particulate matter (PM). Sulphur in diesel fuel can have a significant effect on emission system durability, as well as on engine life. As sulphur levels decrease, engine life can improve as a result of lower corrosion and wear of the engine's components. Additive technology is frequently used to ensure adequate fuel lubricity as the sulphur levels are reduced.

1.2.   The efficiency of exhaust emissions control systems is generally reduced by sulphur and some emissions control technologies can be irreversibly damaged through blockage by sulphates. The impact of sulphur on particulate emissions is well understood and known to be important. Fuel sulphur is oxidised during combustion to form SO_2, which is the primary sulphur compound emitted from the engine.

1.3.   For vehicles that are not equipped with oxidation catalysts, the conversion of SO_2 into sulphates is limited. However, in catalyst-equipped vehicles, the conversion of SO_2 to sulphates (SO_4) dramatically increases. The sulphates and associated water coalesce around the carbon core of exhaust particulates, which increases the mass of the particulate matter (PM). Thus, higher fuel sulphur levels can have a significant impact on the measured PM emissions. This can significantly increase the PM emitted from the vehicle and have a significant impact on the efficiency and durability of the vehicle's after-treatment system.

1.4.   Diesel Particulate Filters (DPF) allow vehicles to achieve very low particulate emissions levels and DPFs are widely applied to meet stringent emissions requirements. Especially in DPF systems that are catalytically-regenerated, the fuel sulphur can reduce the performance and durability of the DPF system. Sulphates can also gradually block the filter, causing the back-pressure over the filter to rise, and thus negatively affect the performance and durability of the filter.

2.   Ash

2.1.   Fuel and lubricant derived ash can contribute to coking on injector nozzles and will have a significant effect on the life of DPFs. Ash-forming metals can be present in fuel additives, lubricant additives or as a by-product of the refining process.

2.2.   Metallic ash constituents are incombustible, so when they are present in the fuel, they remain in the exhaust and become trapped within the DPF. Thus, the presence of ash-forming materials in the fuel will lead to a premature increase in backpressure and vehicle operability problems. Non-fuel solutions have not been found to be satisfactory. Larger filters would reduce backpressure build-up but otherwise would be unnecessary and may be infeasible (for example, in smaller vehicles). Increased in-use maintenance or, in extreme cases, replacing the DPF may not be allowed in some markets.

3.   Total contamination

3.1.   Fuel injection equipment manufacturers continue to develop fuel injection systems to reduce emissions and fuel consumption and to improve performance. Fuel injection pressures have been increasing; currently, they have passed 200 MPa (2,000 bars) and even higher levels are expected in the future. Higher injection pressures demand smaller orifice sizes and component clearances. Small amounts of inorganic particles, which may be

carried into these engine parts, are potential sources of excessive wear, leading to premature component failures and higher emissions. Excessive diesel fuel contamination (both from inorganic and organic particles/sediments) can also cause premature clogging of the fuel filters, leading to operational disturbances and higher service costs.

Annex 5 - Appendix 3

Housekeeping

1.   Some problems encountered by vehicles from fuel quality can be caused by adulteration of the fuel in the fuel distribution system, after the fuel has left the refinery gate. Failure to invest in adequate pipeline and storage facilities and failure to maintain the equipment can lead to volatility losses, fuel leakage, and contamination by particulates and water. These, in turn, can lead to many of the vehicle problems mentioned previously. Poor maintenance practices at the service station, such as too infrequent replacement of fuel dispenser filters or "dipping" of tanks to check for water, can magnify these problems, including corrosion problems within vehicles. CEN has issued a useful guideline document on good practice for fuel housekeeping: CEN TR/15367[1]."

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[1] CEN TR/15367-1: Part 1. Automotive Diesel Fuels
    CEN TR/15367-2: Part 2. Automotive Petrol Fuels
    CEN TR/15367-3: Part 3. Prevention of Cross-contamination