Transmitted by the expert from IPIECA

Informal document **GRPE-62-04**
(62nd GRPE, 9 – 10 June 2011,
agenda item 10)

Proposal for a guideline on market fuel quality to be added to the Consolidated Resolution on the Construction of Vehicles

Introduction and background

This informal document responds to the OICA proposal, documented in ECE/TRANS/WP.29/GRPE/2011/14 for a guideline to be added to the Consolidated Resolution on the Construction of Vehicles.

IPIECA respectfully recalls and brings to the attention of the experts at GRPE, that the rationale for the Informal Group on Fuel Quality – the outcome of which we are now discussing - was the 20th September, 2006 letter from OICA Chairman Prof. Bernd Gottschalk to the Chairman of WP.29 and the Director of the UNECE Transport Division, highlighting the problem of compatibility of worldwide market fuel quality with vehicle emissions control equipment. Recognition by both OICA and IPIECA that this was an issue that deserved consideration led to their participation in the Round Table on Fuel Quality and in turn to the formation of the Informal Group on Fuel Quality (FQ).

IPIECA also recalls the outcome of previous FQ discussions, minuted in Working Paper No. FQ-02-06 (2nd FQ meeting, 4th June, 2008) in which the expert from the EC *"suggested considering, in a first step, a reduced number of fuel parameters which have a direct influence on the engine emissions, such as lead and sulphur"* and in which the expert from the United States of America suggested that "*the fuel quality parameters should be limited to those fuel controls deemed necessary to enable the corresponding emission limits of the motor vehicle engines (e.g. sulphur, lead)*". The minutes show that at that meeting, experts from Canada, China, India Switzerland, Romania, the Netherlands, Belgium, the Czech Republic, France, Germany, Hungary and Italy supported the above.

Discussion

In contrast to the initial attempts to control vehicular pollution in Europe, which focussed on technical standards for new vehicles, the advent of the European Auto-Oil programme marked a new approach in European policy because it included, *inter alia*, the Environmental requirement for action, i.e. the setting of rational and objective emissions goals based on air quality standards that were believed to be protective of European health and environment.

The learnings from this process were incorporated in Auto-Oil II, including more extensive work carried out on the emissions base case and air quality modelling, including an empirical assessment of future air quality in most large European cities.

The fundamental point from the above is that to be both cost-effective and scientifically justifiable, emission limits need to be designed on the basis of local air quality needs, as it was in Europe. These limits should be set and enforced by governments – in the context of WP.29, these are the contracting parties. The corresponding argument that has been advanced during the FQ process, i.e. that because European specification vehicles are exported to developing countries, the emissions regulations and emissions enabling fuels in those countries should be changed to mirror that of Europe, is, in IPIECA's view, indefensible.

The foregoing suggests that while there are certain basic parameters (e.g. Lead and Sulphur) on which there is widespread agreement regarding their ability to compromise emission control devices and which could form part of a guideline, it should be the responsibility of the contracting parties to set standards for other fuel/emissions parameters based on their local air quality conditions and requirements. In these cases, setting a global numeric standard is potentially misleading, as it may not necessarily be cost-effective for the countries concerned to adopt it, depending on their local air quality issues.

The way forward

Three years have elapsed since the June 2008 meeting and in that time, despite best efforts, IPIECA and OICA have been unable to agree numeric values for any more than the basic parameters of the guideline. During that same period, the Partnership for Clean Fuels and Vehicles of the UN Environment Program has worked diligently to facilitate the removal of Lead from gasoline in developing countries to the point where only six countries currently add Lead to motor gasoline (down from over one hundred in 2001). Further delay in publishing this guideline risks rendering it irrelevant, and IPIECA therefore proposes that the guideline is published to the extent that IPIECA and OICA have been able to agree on the parameters to date, and which also correspond to the views expressed by many countries at the June 2008 FQ meeting.

Revised text on this basis is therefore suggested below.

Proposal

Insert a new Annex 4, to read:

Annex 4: Key parameters for market fuel quality

Note: This chapter contains recommendations for minimum market fuel quality in respect of certain basic fuel quality parameters.

1. Purpose of the recommendation

This recommendation is intended 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 and should be addressed first in any program to improve fuel quality.

3. Definitions and abbreviations

[As necessary]

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 section 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.

5. Fuel quality recommendations

5.1. Gasoline quality

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

5.2. Diesel fuel quality

Diesel fuel parameters[7]	*Euro 2 emissions enabling fuel*[8]	*Euro 3 emissions enabling fuel*[9]	*Euro 4 emissions enabling fuel*[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

[1] See Appendix 1 and Appendix 3
[2] See Regulation No. 83.03
[3] See Regulation No. 83.05 (row A)
[4] See Regulation No. 83.05 (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 and R. 49.02 (Stage II)
[9] See Regulation No. 83.05 (row A) and Regulation No. 49.03 (row A)
[10] See Regulation No. 83.05 (row B) and Regulation No. 49.03 (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

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 exhaust system oxidation catalysts. Sulphur also adversely affects heated exhaust gas oxygen sensors. 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.

Appendix 2

Diesel properties

1. Sulphur

1.1. Sulphur naturally occurs in crude oil. Sulphur in diesel fuel can have a significant effect on emission system performance and 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.

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[12]."

---

[12] 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