OCE draft gtr – Section A text – Tokyo meeting April 2008

A. Statement of Technical Rationale and Justification

1. Introduction

Traditionally, vehicle emissions have been regulated by the use of standardised laboratory-based test cycles. Emissions which occur under conditions not well represented by the laboratory-based test cycles are called off-cycle emissions. The objective of this Global Technical Regulation ("gtr") is to establish a harmonized regulation which ensures that off-cycle emissions from heavy-duty engines and vehicles are appropriately controlled over a broad range of engine and ambient operating conditions encountered during normal in-use vehicle operation.

The gtr is designed to be applicable to engines certified or type approved under the test procedures of the World-Harmonized Heavy-duty Certification (WHDC) gtr. The intent behind this gtr is to control emissions during engine and ambient operating conditions that are broader than those covered in emissions testing using the two components of the WHDC, the World-Harmonized Transient Cycle and the World-Harmonized Steady-state Cycle.

This Off-cycle Emissions (OCE) gtr includes two components. First, it contains provisions that prohibit the use of defeat strategies. Second, it introduces a methodology, termed the World-Harmonised Not-to-Exceed (WNTE) methodology, for limiting off-cycle emissions. The WNTE includes harmonized off-cycle emissions factors, applicable under a broad range of engine and ambient operating conditions. When the emission factors are applied to the emission limits in force in a specific region, the resulting WNTE emission limits provide a level below which emissions from the tailpipe shall remain.

It is important to note that the WHDC gtr is being implemented as a global test procedure without emission limits as a first step towards the world harmonization of cycle-based emission certification requirements for heavy-duty engines. During this first stage, Contracting Parties are expected to introduce the WHDC test procedures into their individual regional legislation. However, it is anticipated there will continue to be a range of WHDC-based emission limits in effect in the various regions until such time that world-wide emission limits are adopted as part of the WHDC gtr. This being the case, the WNTE-based emission limits defined in this gtr relate directly to the emission limits to which a specific engine has been certified based on the WHDC test procedures. This structure enables regional authorities to implement a common approach to establishing WNTE-based emission limits, even in the period where global WHDC emission limits are not set out in the WHDC gtr. The eventual adoption of global WHDC-based emission limits will enable world harmonized WNTE emission limits to be set.

It is also important to note that the WNTE does not cover all vehicle and ambient operating conditions. Therefore, Contracting Parties may wish to implement additional requirements and/or test procedures to address off-cycle conditions not represented adequately by the WNTE. These requirements could be set in regional legislation or by future amendments to this gtr.

2. Background on Off-cycle Emissions

The basic regulatory approach historically utilized by a number of countries to reduce exhaust emissions from heavy-duty engines was to use a combination of an emissions certification test cycle with an emissions limit (or standard) and a prohibition against the use of defeat strategies.

The test cycle for heavy-duty engines, while different among various countries, had a number of common characteristics. The test cycle was based on an engine test, performed in a laboratory, under a limited range of ambient conditions, and the test cycle contained a pre-defined set of

speed and load points always run in the same order. The prohibition against the use of defeat strategies generally required that the engine could not operate differently in-use in a manner which reduced the effectiveness of the engine's emission control system.

Heavy-duty vehicles are driven over a wide variety of operating conditions (e.g. starts, stops, accelerations, decelerations, steady cruises) and under varying ambient conditions (e.g. temperature, humidity and barometric pressure). The establishment of the WHDC gtr will result in a laboratory based test cycle which reflects world-wide on-road heavy-duty engine operation. However, as with any standardized test cycle, the wide variety of real world driving conditions cannot be fully incorporated within the WHDC.

Heavy-duty engines have progressed over the past decade to include very sophisticated electronic and mechanical systems. These systems are capable of controlling the performance of heavy-duty engines over a wide variety of driving conditions. A central aspect of this sophisticated engineering is the capability to continuously monitor a wide range of operating parameters, including engine rotational speed, vehicle ground speed, and intake manifold pressure and temperature, and to modify the performance of the engine and its emission control systems in real-time in response to the monitored data.

Defeat strategy provisions have not generally provided a quantified numerical emissions limit and associated test procedure for conditions not encountered on the regulatory test cycles. This has often resulted in the need for case-by-case decision making during the certification and type-approval process regarding whether a particular element of design constitutes a defeat strategy. These design-based reviews have become increasingly difficult as the engines and the emission control technologies have grown more complex.

The approach contained in this OCE gtr may reduce the reliance on case-by-case design reviews by requiring emission compliance during a wide range off-cycle operation. The provisions of this gtr supplement the prohibition against defeat strategies and can allow for a more efficient and objective performance-based means for evaluating off-cycle emissions behavior.

When considered as a whole, the WHDC gtr and this OCE gtr promote global harmonization of regulations that reduce air pollution from heavy-duty vehicles and engines.

3. Procedural Background and Development of GTR

This gtr was developed by the GRPE informal working group on Off-cycle Emissions (the OCE Informal group). A full report of the work of the OCE Informal group, its deliberations and conclusions is provided in the group's Technical Report, TRANS/WP.29/GRPE/xxxxx.

The work to develop this gtr began with the establishment of the OCE Informal group. The OCE Informal group had its first meeting in December 2001.

As required by the 1998 Global Agreement, a formal proposal for the establishment of a gtr was proposed to the Executive Committee for the 1998 Agreement (AC3) by the United States. At its session on 13th March 2005, the proposal from the United States was approved as a gtr project by AC.3 (TRANS/WP.29/AC.3/13).

The following is a summary of the key issues that were discussed and resolved during the development of this gtr by the OCE working group. Additional discussion of these issues can be found in the Technical Report.

WNTE Control Area
Ambient Operating Conditions (e.g. Temperature, Humidity, Altitude)
Definition of Defeat Strategy and related items

One of the key issues discussed during the development of the OCE gtr was the scope of the gtr with respect to in-use, on-vehicle emissions testing. After considerable debate by the OCE working group, it was decided the OCE gtr would not include specifications for in-use, on-vehicle emission measurement. However, the OCE gtr was developed with the specific intent of enabling the testing of compliance with the WNTE during in-use on-road operation. Therefore, it may be appropriate in the future to consider the development of a gtr which would include harmonized test procedures for in-use on vehicle emissions measurement.

The WNTE method originated as a concept that was enforced using in-use, on-vehicle testing. In order to provide flexibility to Contracting Parties as how to implement the gtr into regional legislation, additional provisions were included so that the WNTE methodology could also be applied as a laboratory based test procedure.

4. Technical and Economic Feasibility

The OCE gtr has been developed with the input and expertise from a large number of stakeholders, including regulatory authorities, type approval authorities, engine and vehicle manufacturers, and independent technical consultants. The gtr has built upon the experience of many organizations and individuals with expertise in addressing off-cycle emissions.

The gtr has been designed to improve the control of off-cycle emissions, and the WNTE requirements specified in the gtr are based, in-part, on the approaches which exist in some Contracting Parties' existing legislation.

The WNTE requirements in this gtr are a function of the laboratory-based test cycle limits, specifically emission limits associated with the WHDC gtr's transient test cycle (the WHTC). However, the WHDC gtr does not currently contain any limit values. For this reason, no formal analysis of the technical and economic feasibility of the WNTE limits in this OCE gtr has been undertaken. It is recommended that Contracting Parties consider the technical and economic feasibility of the OCE gtr when they adopt this regulation into their national requirements.

5. Anticipated Benefits

This gtr is expected to result in a number of benefits, including: improved emissions control, more efficient certification or type approval methods, and reduced costs for engine and vehicle manufacturers.

The addition of harmonized defeat strategy provisions and OCE requirements to the certification testing regime (e.g. the WHDC test cycles) will more adequately ensure that an appropriate control of emissions is achieved in-use, under a wide range of operating conditions. As a result, it can be expected that the adoption of this gtr by Contracting Parties will result in an improved level of emissions control.

The gtr may reduce the need for time consuming case-by-case design reviews and provide a more efficient and objective performance-based means for evaluating off-cycle emissions.

Finally, heavy-duty engines and vehicles are often produced for the world market. It is economically more efficient for manufacturers to design and produce models which meet emissions objectives specified in a common Global Technical Regulation rather than developing products to meet a wide array of different and potentially conflicting regulatory requirements in individual countries and regions. This in turn may allow manufacturers to develop new models more effectively at a lower cost.

6. Potential Cost Effectiveness

A formal cost-effectiveness analysis of the OCE gtr has not been performed for the reasons discussed in Section A.4.

However, it is fully expected that this information will be developed, generally, in response to the adoption of this regulation in national requirements and also at the time the WHDC gtr develops harmonized limit values, and the future corresponding amendments to this gtr. For example, each Contracting Party adopting this gtr into its national law will be expected to determine the appropriate level of stringency associated with using these new test procedures, with these new values being at least as stringent as comparable existing requirements. Also, experience will be gained by the heavy-duty engine industry as to any costs and cost savings associated with using this test procedure. The cost and emissions performance data could be analyzed as part of a possible future amendment to this gtr to determine the cost effectiveness of the test procedures along with the application of any future harmonized WHDC limit values. While no formal cost-effectiveness has been done, the belief of the GRPE experts is that there are clear benefits associated with this gtr, as discussed in Section A.5.