Transmitted by de expert from the Netherlands

Working Paper No. **HDH-02-05**
2nd HDH meeting, 7 june 2010

NL proposal for modifications of the draft TOR (HDH-02-02) and draft text of the development of a test procedure for HD hybrid vehicles (HDH-02-03)

The modifications were deemed necessary as gtr No. 4 (WHDC) can not be amended for CO_2 emissions and for hybrid vehicles as was proposed because these amendments are outside the scope of this gtr:
The scope of gtr No. 4 (WHDC) is limited to gaseous and particulate pollutants and does not include CO_2 emissions. Furthermore the scope of this gtr is limited to engine test procedures and does not include powertrains/transmissions, vehicle mass, electric motor, batteries, driver models etc.

Consequently it seems better when the informal group would establish a separate gtr under the 1998 Global Agreement dealing with heavy duty hybrid vehicles.

Another very important point to consider is the development of the test procedures like: which vehicle cycle should be used, how the pollutant emissions should be calculated, which metric, SOC etc. These discussions may greatly delay the development of the gtr.

It is therefore proposed to restrict the task of the group to the development of the test methods themselves and more specific the HILS method. The group would also do further research on the verification and validation of this new HILS method by considering vehicle/chassis dyno test procedures.

The development of the test procedures and legislation can then first be discussed outside of the gtr activity and possibly taken on board later by the informal group when this more fundamental discussion is further finalized in the countries of the 1998 Agreement.
This will fasten the development of this gtr and make the ambitious time table easier to meet. On the other hand it is envisaged that quick results of the gtr development will also facilitate the discussion regarding the necessary legislation.

As a result of the above considerations we propose to modify the two HDH draft documents on Terms of Reference (HDH-02-02) and emissions test procedure for HD hybrid vehicles (HDH-02-03) .

Attached are the two modified documents:

Annex I HDH-02-02
Annex II HDH-02-03

Annex I (HDH-02-02)

Proposal for the Terms of Reference of the Informal Group on Heavy-Duty Hybrids (HDH)

1. The objective of the informal group on HDH (Heavy-Duty Hybrids) is to establish a Global Technical Regulation (gtr) with respect to pollutant emissions and CO_2 emission from heavy duty hybrids under the 1998 Global Agreement.
2. The informal group will investigate the HILS (Hardware-in-the-Loop) approach, which starts from a vehicle speed pattern (cycle) and simulates powertrain and vehicle components to result in a hybrid specific engine cycle for emissions testing and which allows using the test cell environment, data evaluation procedures and emissions calculations specified in gtr No. 4.
3. The informal group will consider a vehicle/chassis dyno test procedure, as a verification procedure for HILS or an alternative to HILS, including new requirements with respect to test cell environment, data evaluation procedures and emissions calculations, which are currently not covered within gtr No. 4.
4. As a first step the group will restrict itself to the development and description of the test methods themselves.
5. As a second step the group may consider options for test procedures, including cycle choice/development, eventual brake energy recovery compensation methods, CO_2 emission measurement etc.
6. The informal group shall submit the milestones, the roadmap and the necessary budget for step 1 of the future work program to GRPE for consideration, at its 61st session in January 2011.
7. The informal group shall submit the final report of the investigation on HILS for consideration to GRPE at its 65th session in January 2013.
8. The target completion date for the work of the informal group on HILS shall be the 163rd session of WP.29 in June 2014.
9. This target completion date and the necessity of a second step will be reviewed by WP.29 at its 160th session in June 2013 taking into account the assessment by GRPE of the final report on HILS.

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Proposal for Rules of Procedure

1. The informal group is open to all participants of GRPE. A limitation of the number of participants from any country and organization to participate in the informal group is actually not foreseen.
2. A Chairperson and a Secretary will manage the informal group.
3. The official language of the informal group will be English.
4. All documents and/or proposals shall be submitted to the Secretary of the group in a suitable electronic format, preferably in line with the ECE guidelines in advance of the meetings. The group may refuse to discuss any item or proposal which has not been circulated 5 working days in advance of the scheduled meeting.
5. An agenda and related documents will be circulated to all members of the informal group in advance of all scheduled meetings.
6. The work process will be developed by consensus. When consensus cannot be reached, the Chairperson of the informal group shall present the different points of view to GRPE. The Chairperson may seek guidance from GRPE as appropriate.
7. The progress of the informal group will be routinely reported to GRPE orally or as an informal document by the Chairperson or the Secretary.
8. All working documents shall be distributed in digital format. A specific HDH website will be created and the URL will be noticed to all related parties.

Annex II (HDH-02-03)

PROPOSAL FOR AN EMISSIONS TEST PROCEDURE FOR HEAVY DUTY HYBRID VEHICLES (HD-HV'S)

Note: This document contains a proposal to develop a new global technical regulation concerning the emissions of pollutants and CO_2 from heavy duty hybrid vehicles under the 1998 Agreement. It is based on the text of informal document No. GRPE-59-02 distributed during the fifty-ninth session of GRPE (ECE/TRANS/WP.29/GRPE/59, paras. 12 and 13). The document is a modified version of Working Paper No. HDH-02-03, as transmitted for the 2nd HDH meeting.

Verwijderd: annex to

Verwijderd: No. 4 (WHDC)

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Verwijderd: 1st

A. OBJECTIVE OF THIS PROPOSAL

The objective of this proposal is to establish a global technical regulation (gtr) with respect to pollutant emissions and CO_2 emission from heavy duty hybrid vehicles under the 1998 Global Agreement. Greater fuel efficiency and the reduction of CO_2 emissions are becoming an increasingly urgent issue in view of global warming and surging petroleum prices. Hybrid vehicles (HV's) are recognized as one solution for achieving lower emissions and increased fuel efficiency. Consequently, a widespread introduction of HV's has taken place during the last years, primarily for passenger cars. But also commercial vehicle manufacturers have introduced, or announced the introduction, of several hybrid concepts for urban, delivery and extra-urban operation. While testing of passenger car hybrids is covered by ECE Regulation No. 83, no provisions exist today within the ECE framework for heavy duty hybrids.

With gtr No. 4, a globally harmonized emissions testing procedure for conventional commercial vehicles has been established. Traditionally, emissions testing of conventional heavy duty vehicles involves engine testing, and the certified engine can then be installed in any vehicle independent of its application. Contrary to conventional vehicles, emissions testing and certification of HV's disregarding the vehicle application is not the optimal technical solution. Since engine speed and load cycles of HV's are indeed different from those of conventional powertrains, it is necessary to incorporate vehicle and operation related elements into the certification procedure.

If such an approach is used, engine technologies and engine calibrations can be tailored to the hybrid applications allowing engine technology to be optimized for HV operation, keeping the overall emissions performance at least equal to conventional engines and optimizing fuel consumption, CO_2 emissions and product costs.

B. DESCRIPTION OF THE PROPOSED REGULATION

The proposal aims to provide an engine based test procedure for pollutant emissions and CO_2 for certification of HV's. The test procedure will focus around the HILS (Hardware-in-the-Loop) approach, which starts from a vehicle cycle and simulates powertrain and vehicle components to result in a HV specific engine cycle for emissions testing. This allows using the test cell environment, data evaluation procedures and emissions calculations already specified in gtr No. 4. The proposal is intended to cover a wide range of HV technologies including but not limited to serial hybrids, parallel hybrids, electric hybrids, hydraulic hybrids, plug-in hybrids, range extenders and start/stop solutions. Non-tractive or Power Take-Off (PTO) operation may also be considered.

A vehicle/chassis dynamometer based test procedure will be investigated as a verification procedure for HILS or as an alternative to HILS including new requirements with respect to test cell environment, data evaluation procedures and emissions calculations, which are currently not covered within gtr No. 4.

HILS uses individual powertrain components (e.g. engine, transmission, electric motor, battery, accumulator), vehicle parameters (e.g. mass, inertia) and a driver model for creating a vehicle specific HV engine cycle. This HV engine cycle is then used for emissions testing.

HILS includes the following elements:

- The vehicle model covers running and acceleration resistance, taking into account rolling and air resistance coefficients, vehicle mass, rotating equivalent mass, speed and acceleration, etc.;
- The MG (motor-generator) model represents the electric motor, the generator or other regenerative braking system whose input data are generated from component testing;

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Verwijderd: as much of the benefit associated with the use of hybrid technology is associated with the use of recovered energy for extended PTO operation.

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Verwijderd: It is proposed to use the vehicle speed pattern of the World Harmonized Vehicle Cycle (WHVC) developed under the WHDC mandate as base cycle for the HILS method. Similar to the original WHDC approach, where a standard gearbox model was used for converting the WHVC into the standard engine cycle WHTC,

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Verwijderd: A certain HV vehicle standardization will be incorporated to accommodate a powertrain system in a range of similar vehicles.

- The transmission model represents clutch and gearbox, the gear ratios and efficiencies;
- The battery, capacitor and accumulator models express the conditions of the battery/capacitor/accumulator, state of charge (SOC), capacity, resistance, charge and discharge power, etc.
- Driver model
- Energy storage state of health (SOH)
- Component testing

General emissions testing and measurement provisions will be based on gtr n°4 (WHDC).

Verwijderd: In order to take the overall vehicle operation into account, application for the emissions test of subsets, or combinations of subsets, of the WHVC (urban, rural, motorway) in combination with appropriate weighting factors will be investigated.

The following ambitious timetable is proposed:

Item	**Time**
1st IG meeting	19/05/2010
2nd WG meeting	07/06/2010
GRPE & WP.29 approval	06/2010
3rd WG meeting (timing & budget)	10/2010
Report to GRPE	01/2011
2 years work program	
WG final report to GRPE	01/2013
GRPE adoption	01/2014
WP.29 adoption	06/2014

C. EXISTING REGULATIONS AND INTERNATIONAL STANDARDS

Japanese Regulation:
Kokujikan No.60 of 30 June 2004, “Measurement Procedure for Exhaust Emission from Electric Hybrid Heavy-Duty Motor Vehicles”;

Kokujikan No.281 of 16 March 2007, “Measurement Procedure for Fuel Consumption Rate and Exhaust Emissions of Heavy-Duty Hybrid Electric Vehicles using Hardware-In-the-Loop Simulator System”

Kokujikan No.282 of 16 March 2007, " Test Procedure for HILS System Provisional Verification for Heavy-Duty Hybrid Electric Vehicles"

SAE Standards:
SAE J 2711 "Recommended Practice for Measuring Fuel Economy amd Emissions of Hybrid-Electric and Conventional Heavy-Duty Vehicles"

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