

**Report of the 62<sup>nd</sup> session**  
**Electric Vehicles and the Environment Informal Working Group (EVE IWG)**

Location: Hybrid – Rue de Grand Pré 66, Geneva, Switzerland

Permanent Delegation of the European Union to the United Nations Office and other international organizations in Geneva

5<sup>th</sup> floor – Room C

Date: May 30, 2023

Time: 09:30 – 12:30 CEST

Chairs: Mr. Michael Olechiw (United States of America)  
Ms. Panagiota Dilara (European Commission)

Vice-Chairs: Ms. Chen Chunmei (China)  
Mr. Hisakazu Suzuki (Japan)

Secretariat: Mr. Leeson Guay (Canada)

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Day 1 – May 30, 2023, 09:30 CEST

**1. Introduction, review of agenda, and meeting recap**

Documentation

- EVE-61-27e
- EVE-62-01e

Context

The EVE IWG co-chairs addressed members and welcomed everyone to the hybrid meeting, while outlining the in-person logistics including, security procedures, microphone testing and location of various amenities.

The co-chairs presented the meeting agenda to EVE IWG members, which can be seen below. The agenda was reviewed and adopted by the EVE IWG prior to beginning discussions.

Day 1 – April 25, 2023, 09:30 EDT

- Introduction, review of agenda, meeting recap
- HDV GTR – Updates from metrics discussion and drafting session
- HDV GTR – OICA presentation on energy/capacity throughput and current/voltage measurement
- HDV GTR – China presentation on roadmap of future HDV UBE testing and motivation for chassis dynamometer testing
- HDV GTR – Japanese presentation on HDV UBE measurement testing and techniques
- UN GTR 21 – China proposal for K1 and K2 factors
- UN GTR 21 – Draft text update on proposed family definition and test conditions
- UN GTR 21 – Discussion on GTR subgroup creation
- Action item review

The EVE IWG secretary briefly reviewed the *Report of the 61<sup>st</sup> EVE IWG session*, highlighting action items and key decisions from the discussions, held in-person in Ann Arbor, Michigan, U.S.A on April 25-26, 2023.

#### Discussion

Organisation Internationale des Constructeurs d'Automobiles (OICA) confirmed their understanding of the submission deadline for United Nations Global Technical Regulation (UN GTR) 22 comments, due on June 30, 2023. OICA explained that there is an item that remains open on virtual mileage (V2X) verification methods, which is being discussed internally and may require slightly more time, beyond the June 30, 2023, deadline.

The Japanese delegation shared that they are in the process of preparing a concrete text proposal concerning V2X, which will be provided before the end of June to the drafting coordinator.

OICA stated in relation to the electrified heavy-duty vehicle (eHDV) battery performance and durability UN GTR, that they recall a commitment by members to investigate whether the United Nations Regulation (UN-R) 85 provisions would address the need for power determination provisions and provide further insights into the questions surrounding the need for an electrified heavy-duty vehicle power determination UN GTR. The co-chairs expressed that although they may have expressed interest in reading into the UN-R85 to better understand what it may be targeting, there was no commitment made and this remains an open issue for the moment.

#### Action Items

- Japan to provide concrete text regarding V2X in GTR 22 to the drafting coordinator, for consideration, before the end of June 30, 2023.

#### Decisions

## **2. HDV GTR – Updates from metrics discussion and drafting session**

#### Documentation

- EVE-62-02e
- EVE-62-03e

- EVE-62-04e
- EVE-62-05e

### Context

The co-chairs and drafting coordinator provided an overview on the results from the discussions surrounding eHDV metrics, which was held on May 10, 2023, as well as the drafting session on the eHDV battery performance and durability UN GTR, which took place on May 15, 2023.

The overview of discussions on eHDV metrics included a current state of matters, the scope of discussions, some initial possibilities and considerations going forward. The co-chairs explained that a decision on the metrics used for the eHDV UN GTR is crucial for regulation development, as it will drive most of the decisions and technical work moving forward. The co-chairs stressed that a decision on eHDV metrics needs to be made soon.

The overview of discussions on the eHDV drafting group session outlined a summary of main points coming out of the meeting, as well as items that were proposed and mutually agreed upon, through discussions.

### Discussion

The Japanese delegation commented that they are considering various approaches and are hesitant about adopting energy throughput as a metric due to difficulties with how to go about doing so. The American delegation requested clarification from Japan on whether they prefer to have two metrics. Japan mentioned that if they adopt energy throughput there may not be a need for a mileage metric, however, until that point in time, it may be best to keep years and mileage. The American delegation stated that it seems conflicting to put everything into a mileage metric when a vehicle may be using all or most of its battery energy for a non-traction related purpose and another metric seems appropriate. The European Commission (EC) expressed that they share Japan's concerns and that they have issue with the verification of the throughput counters. The drafting coordinator stated that the group has considered having all three metrics as alternative options, but this remains an open issue.

OICA asked whether it would be helpful for them to try and provide data on energy consumption metrics from power take-off (PTO) applications in HDVs. This could offer further analysis capabilities and capacity to draw some conclusions, while enabling the Japanese delegation to gain a positive indicator on the energy throughput approach. The co-chairs expressed that it would be helpful, having data to speak to these points of discussion and for future mechanism reference. The American delegation stated that it may also be possible, in the future, to use this information to develop various conversion metrics, such as kW-hr / mile and using this to look at the distance travelled to energy throughput. Ideally, they would like to treat the energy throughput equally for the mileage. It may also be possible to look at a conversion where manufacturers gain credits and the standard is work specific; converting work specific emissions to work specific mileage or total emissions. For example, distance travelled and converting to a lifetime energy throughput.

The co-chairs requested clarification on whether a monitoring phase may be appropriate. The drafting coordinator expressed that this may be required as the group does not know what the corresponding values might be.

The co-chairs requested clarification on whether a single pack may be changed in eHDVs. OICA clarified that yes it should be possible to change out a single battery pack especially for maintenance related purposes. Typically, in HDV, however, several packs will be replaced at a time.

The drafting coordinator reminded EVE IWG members to provide comments on the eHDV UN GTR prior to the next meeting. It was also expressed that a drafting session may be appropriate and will be coordinated after the meeting, if desirable.

#### Action items

- OICA to provide and present data on energy consumption from HDV PTO applications at 63<sup>rd</sup> EVE IWG session.
- EVE IWG members to provide comments on the eHDV UN GTR prior to the next meeting.

#### Decisions

### **3. HDV GTR – OICA presentation on energy/capacity throughput and current/voltage measurement**

#### Documentation

- EVE-62-06e

#### Context

This item was set aside in the agenda to allow OICA to further support their throughput proposal, presenting additional information on an energy or capacity approach as well as its measurement using current or voltage.

#### Discussion

OICA expressed that they have no comments from a light-duty vehicle perspective. Regarding eHDV, OICA stated that they have some promising first results on the energy throughput evaluation. The result addresses current versus voltage as well as charging and discharging cycles, however, there is not yet enough different and supportive measurements, so further testing is required to gather a larger test sample of data in order to support their position.

OICA expressed that they do not have a presentation for this session but will look to present their findings at the next EVE IWG session in July.

#### Action Items

- OICA to present energy/capacity throughput and current/voltage measurement results at the 63<sup>rd</sup> EVE IWG session.

#### Decisions

#### **4. HDV GTR – China presentation on roadmap of future HDV UBE testing and motivation for chassis dynamometer testing**

##### Documentation

- EVE-62-07e

##### Context

The Chinese delegation presented a proposal indicating their recommendation to utilize the operating condition method instead of a constant current method. It was expressed that the purpose of the regulations is to regulate in-vehicle battery decay and verify this for aging vehicles. In-vehicle battery decay includes power attenuation and capacity decay. Either of them will influence the battery durability and consumer experience. Verifying attenuation and capacity decay together is therefore necessary, however, the constant current method for UBE testing is unable to verify these two attenuations together, as the operating condition method can.

##### Discussion

The co-chairs mentioned that power fade was an item that was previously discussed, in early development of the UN GTR, but it is unclear why this may have been set aside, and the information that has been presented in the Chinese presentation is intriguing. The co-chairs asked the Chinese delegation if this proposed testing can be done using only a chassis dynamometer or if there is a possibility of utilizing standalone battery testing. The Chinese delegation clarified that the testing must be done on a chassis dynamometer for whole vehicle testing.

The American delegation commented that it is understood that full vehicle testing can provide power and capacity results, but the procedure comes with the complexities of requiring full vehicle instrumentation and testing. The main challenge was expressed to be the availability of facilities capable of doing chassis dynamometer testing. The American delegation provided the example of the United States of America, where the notice of proposed rulemaking (NPRM) for low nitrous oxides (NOx) emissions suggested full powertrain testing but came with the same issue of locating adequate facilities.

The co-chairs asked the Chinese delegation whether the power-fade and capacity-fade contain a strong correlated relationship. The Chinese delegation clarified that the battery and associated systems are very complex. Some batteries express power decay while others may not be able to due to the existence of capacity decay. Overall, there is no strong correlation because of the complexity of the chemistries, package configurations, and other characteristics. It is the Chinese delegation's opinion that these two metrics should be the focus of the eHDV GTR.

The co-chairs expressed that what the Chinese delegation is proposing seems to be the most robust solution for the measurement scope of the eHDV UN GTR; however, there is a practicality issue because of the limited availability of chassis dynamometers, at least relative to China. Perhaps this proposal may be incorporated as an option in the future, as this seems to be what the group is

looking to achieve; the ability to measure vehicles on a cycle test with repeatable results. The Chinese delegation acknowledged the testing difficulty, but they feel it is overall the best test for the eHDV UN GTR objectives.

The co-chairs asked EVE IWG members, whether the Chinese methodology may be supported and whether there are any issues of access to chassis dynamometers. The co-chairs also reindicated to the group that they are supportive of a potential alternative, keeping in mind that an equivalency method needs to be developed, in support. The French delegation commented that they have access to chassis dynamometers with a 5.5 ton maximum and there is available capacity to do the testing. The Swedish delegation indicated that they also have capacity but there are limitations on the dynamometers, not allowing them to be able to test the biggest and highest-powered vehicles.

The American delegation raised that there may also be further challenges, if considering the incorporation of the Chinese proposal, regarding the appropriate vehicle drive cycle, which may vary depending on the eHDV application. The co-chairs mentioned that the world harmonized test cycle may be an option and was discussed at the previous EVE IWG session, but perhaps not the most appropriate.

Japanese delegation highlighted that for battery durability requirements, the key element is to perform in-service testing and physically test the vehicles. The Japanese delegation indicated that they are considering alternatives and other test procedures. If the error is known, an alternative solution may be developed. In addition, a drive cycle for eHDVs is required, as well as an equivalent test procedure.

The co-chairs stated that the utility of the vehicle will be impacted by capacity and power fade. If a chassis dynamometer cannot be used, the solution that is developed needs to capture all of the durability conditions, otherwise the implementation may not be meaningful. Even when using a dynamometer solution, there needs to be a full understanding of how the system works together. Perhaps we will continue to develop ideas and China may support through continued testing.

The United Kingdom indicated that perhaps this is a similar issue to UN GTR 22, where a solution was realized using state of certified energy (SOCE) and state of certified range (SOCR). In the UN GTR on battery performance and durability of eHDVs, perhaps a solution may be to incorporate a state of certified power (SOCP) and state of certified capacity (SOCP).

#### Action Items

#### Decisions

### **5. HDV GTR – Japanese presentation on HDV UBE measurement testing and techniques**

#### Documentation

- EVE-62-08e

### Context

Japan delivered a presentation outlining responses to questions raised at the previous EVE session concerning their progress on HDV UBE measurement testing. Japan clarified these main questions and presented some next steps, including further analysis and development of proposed concrete text for the eHDV UN GTR.

### Discussion

The EC thanked the Japanese delegation for responding to questions previously raised. The EC suggested that through the incorporation of a complete discharge prior to starting the test, this could help to improve testing results. The EC expressed that they have also discussed this method with the Chinese delegation and requested whether China could provide similar style testing results using this discharge approach. Based on what Japan has presented, it appears that the charge and discharge test could be a valid option.

The co-chair requested clarification on whether the concrete text outlined in the next steps section of Japan's slides has been incorporated into the eHDV UN GTR text to this point. The drafting coordinator stated that the concrete text has been provided and included in the text as square brackets, as it remains under discussion and addresses open issues.

The co-chairs requested clarification on whether the c-rate indicated on the slides was the effective c-rate of the test cycle. The Japanese delegation clarified that the c-rate is the average c-rate at constant power. The Chinese delegation commented that perhaps a constant c-rate is difficult to solve for a different battery or battery management system (BMS). Maybe it would be better to use a different discharge c-rate or perhaps this decision cannot be made, as every battery has its own characteristics. The co-chairs stated that it would not be appropriate to use the same c-rate for every application because of the BMS variability. The drafting coordinator indicated that within the draft text, the objective was to keep the c-rate at a normal power and discharging value and not use the super-fast or fast speeds. Focus should be on the size of the battery and not necessarily the characteristics of the battery. A single, one-size fits all, c-rate value is therefore not being considered. The Japanese delegation indicated that they have found the appropriate c-rate for their test vehicle but wondered if a specific c-rate range might be more appropriate. The Japanese delegation stated that they would conduct further analysis and provide a proposal on c-rate at the next EVE IWG meeting. OICA mentioned that very high or low capacities should not be forgotten about, and c-rates should be fitted to the manufacturers' requirements, as it could otherwise damage the vehicles. The American delegation commented that a constant c-rate of 0.2 – 0.5 for testing seems to be the best representative range. A suitable constant c-rate is attempting to be determined, but there will be challenges either way.

OICA requested clarification on the presentation slide four, green bar metrics. OICA asked why the vehicle battery has aged 10 % after 4 years and 3, 000 km. The Japanese delegation clarified that the vehicle they were using is a test vehicle and so they have conducted a lot of charging and discharging tests. OICA added that there also appears to be a lot of charging and discharging powers, which could then also indicate a lot of cycles that may not have necessarily been considered in the analysis.

### Action Items

- Japan to give presentation on c-rate at the next EVE IWG session.

### Decisions

## **6. UN GTR 21 – China proposal for K1 and K2 factors**

### Documentation

- EVE-62-09e

### Context

The Chinese delegation gave a presentation on the influence of K1 and K2 factors on highly integrated electric drive systems, from the power determination test procedures outlined in UN GTR 21. The presentation indicated that a small variation in the K1 and K2 factors can significantly influence the power determination, in addition to instrumentation and measurement challenges that exist with the different electric drive system (EDS) types. The Chinese delegation proposed,

1. If it is not convenient (still possible) to implement external transducers, CAN data can be used to read the actual power. However, the manufacturer needs to supply a validation report showing the comparison of testbed results and CAN data.
2. For oil cooled highly integrated EDS where it is impossible to directly acquire data via external transducers, the efficiency of the assembly can be used instead.

### Discussion

The drafting coordinator expressed that the presentation seems reasonable and timely but will require a closer look. Going forward there will be an increasing number of complex drive mechanisms on the market. In order for UN GTR 21 to remain relevant, amendments will need to be made to address this situation. When looking at the proposal, we need to define when it would not be convenient, and if you have testbed and controller area network (CAN) data, it should be possible to determine efficiency. We could then compare the CAN data to that efficiency. When the driving system is in the vehicle it is very difficult and expensive to instrument. For the oil cooled EDS, it might be necessary to find another layout schematic with everything integrated but it is unclear whether the current UN GTR 21 definitions would cover this. Overall, it is believed that these topics need to be addressed going forward to allow UN GTR 21 to remain relevant. This could require extensive changes, but it will need to be evaluated further.

The co-chairs asked whether the drafting coordinator was supportive in amending UN GTR 21 to reflect the Chinese delegation's proposal. The drafting coordinator stated that this should be a question for the larger EVE IWG group. Does the EVE IWG wish to conduct a simple modification or a comprehensive solution that requires an adjustment in scope to the current UN GTR 21 text and does this fit the current timelines.



OICA commented that the presentation given by the Chinese delegation is very similar to a presentation OICA gave previously, regarding intake manifold pressures. Ultimately the CAN bus data of the vehicle is always a good enough solution from OICA's perspective and if vehicles are unable to be instrumented, then reliance on this CAN bus data should be warranted. OICA recognized that a written proposal/amendment for October might be challenging but the current amendments to UN GTR 21 that are scheduled for the January Working Party on Pollution and Energy (GRPE) session are needed, so no delay would be possible.

The co-chairs acknowledged the points made and requested the group take an action item to look into the Chinese proposal and decide whether the group is supportive of including this proposal in the UN GTR 21 amendments for October 2023, or have 2 separate deliverable dates for the various topics.

#### Action Items

- The EVE IWG to decide whether to address the Chinese proposal in this UN GTR 21 round of revisions or to postpone it to a later amendment.

#### Decisions

- The EVE IWG to keep the amendment schedule for UN GTR 21, including amendments that have been incorporated by the drafting coordinator and will add second amendment to UN GTR 21 at a later date.

### **7. UN GTR 21 – Draft text update on proposed family definition and test conditions**

#### Documentation

#### Context

The drafting coordinator presented amendments to UN GTR 21 which reflected discussions from the previous EVE IWG sessions, including items put forward by Japan on family definitions as well as OICA on intake manifold pressure accuracy and readings.

The drafting coordinator reiterated that it appears there is appetite to make use of electronic control unit (ECU) data from the CAN bus when available on difficult to instrument vehicles, so this may need to be thought about moving forward.

#### Discussion

#### Action Items

#### Decisions

### **8. UN GTR 21 – Discussion on GTR subgroup creation**

#### Documentation

#### Context

The purpose of this item was to act as a placeholder for a discussion on whether the development of sub-groups for UN GTR drafting is necessary moving forward.

#### Discussion

A representative from industry started the conversation outlining the background and asked whether there are intentions to organize side-meetings for the upcoming UN GTR amendments, considering that there is appetite to conduct more significant amendments in the future. The co-chair asked the representative if they were supportive of the current plan. The representative explained that they are supportive, and given that the current approach is working, subgroups are not needed. However, if larger changes are being made in the future, then perhaps the consideration of subgroups for drafting purposes may be appropriate. The co-chairs stated that we will proceed with the current structure and will leave it to the drafting coordinators to organize subgroup drafting sessions or discussions to address larger changes and proposals.

#### Action Items

#### Decisions

- Drafting coordinators for UN GTRs to organize subgroup sessions, if and as needed.

### **9. Action item review**

#### Documentation

#### Context

This item is set aside to review the recorded action items and for members of the EVE IWG to communicate whether other action items may be necessary or have been missed.

This item was skipped due to time limitations.

#### Discussion

#### Action Items

#### Decisions