Submitted by the EVE Secretariat

Informal Document EVE-64-18e
64th EVE IWG session: September 19-20, 2023

Report of the 64th session
Electric Vehicles and the Environment Informal Working Group (EVE IWG)

Location:	Virtual – Webex
Date:	September 19 – 20, 2023
Time:	05:30 – 08:00 EDT
Chairs:	Mr. Michael Olechiw (United States of America) Ms. Panagiota Dilara (European Commission)
Vice-Chairs:	Ms. Chen Chunmei (China) Mr. Nobunori Okui (Japan)
Secretariat:	Mr. Leeson Guay (Canada)

Day 1 – September 19, 2023, 05:30 EDT

1. Introduction, review of agenda, and meeting recap

   Documentation

   - EVE-63-12e
   - EVE-64-01e

   Context

   The EVE IWG co-chairs addressed members and welcomed everyone to the virtual meeting.

   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. Modifications to the agenda occurred and have been reflected in EVE-64-17e.

   Day 1 – September 19, 2023, 05:30 EDT

   - Introduction, review of agenda, meeting recap
   - HDV GTR – Review of draft text and discussion of open items
   - HDV GTR – Position on UBE measurement
   - HDV GTR – Proposal on c-rate during heavy-duty UBE measurement
   - HDV GTR – First measurement results on charging vs. discharging and UBC vs UBE.
   - HDV GTR – Planning and prioritization

Day 2 – September 20, 2023, 05:30 EDT

- Introduction, review of agenda
- HDV GTR – Updated proposal on UBE-UBC measurement
- HDV GTR – Review of draft text and discussion of open items
- UN GTR 21 – Proposals to expand the application of system bench
- UN GTR 21 – Finalize proposed changes
- UN GTR 22 – Comments on draft text
- UN GTR 22 – Proposal on battery swapping
- UN GTR 22 – Finalize proposed changes
- EVE IWG Terms of Reference review and renewal
- Action item review

The EVE IWG secretary briefly reviewed the *Report of the 63rd EVE IWG session*, highlighting action items and key decisions from the discussions, held virtually, on July 18-19, 2023.

Discussion

The co-chairs reminded members that the targeted timeline is to have a completed draft of the United Nations (UN) Global Technical Regulation (GTR) on battery performance and durability of electrified heavy-duty vehicles (eHDV) after the 65th session of the EVE IWG, which will take place in Ottawa, Canada on October 11-12, 2023. Recognizing this timeline, the primary goal for this EVE IWG session, and subsequent sessions, will be to work through and resolve the outstanding items for the draft eHDV UN GTR.

The secretariat reminded participants that in order to participate in the 65th EVE IWG session in-person, in Ottawa, Canada, a reservation must be made directly to the secretariat in advance of the event. The deadline to reserve has been set as Friday, September 22, 2023.

Action Items

- EVE IWG members to contact the secretariat directly to register for the 65th EVE IWG session, if attending in-person.

Decisions

2. HDV GTR – Review of draft text and discussion of open items

Documentation

- EVE-64-02e
- EVE-64-03e
- EVE-64-04e

Context

- The drafting coordinator began by walking participants through the draft eHDV GTR, providing updates and indicating changes that were made as per the last drafting group session, held on

September 14, 2023, as well as offering an overview of some of the topics that were discussed during the meeting.

Discussion

The co-chairs requested clarification on the method equivalency for the eHDV UN GTR test procedures and whether one methodology would be decided upon or if there might be several options on the table. The drafting coordinator indicated that yes, the EVE IWG will decide on one test procedure method and revisit the other methods in a future amendment. The co-chairs also sought clarification from the secretariat of the Working Party on Pollution and Energy (GRPE), who was in attendance, regarding whether a universal method was required for the GTR and whether allowing alternative methods if they offer equivalent results, is appropriate. The secretary of GRPE stated that the 1998 Agreement requires that minimum changes be made through amendments to UN GTRs, and as a result, harmonization is key and good correlation of alternative test methods is important. The secretary mentioned that one test procedure method is required and having an alternative test method may be allowed if a single method cannot be agreed upon. Organisation Internationale des Constructeurs d'Automobile (OICA) reiterated this, stating that one test method is necessary and alternative test methods are therefore supported, if necessary. The co-chairs questioned whether OICA was suggesting that one test method may not be possible, and stated that a common method approach allows for harmonization of the regulation whereas having several test methods does not. The suggestion of several test methods is fit for regional regulations and if this multiple method approach is taken, then there is little value in a UN GTR and each region might as well develop their own regulations. The co-chairs indicated that the EVE IWG needs to finalize a single test procedure and will then look to other equivalent options if necessary and possible.

The co-chairs requested further clarification on the test procedures and the concerns surrounding batteries not being able to reach full state of charge (SOC) and whether this is due to the age of the battery or manufacturer protections that have been put in place. The drafting coordinator clarified that the battery in these vehicles goes into protection mode and decreases the charging rate as the SOC of the battery approaches 100%, usually occurring in the last 5%. There was some thought of having provisions accounting for this in the test procedure, so that a test is not failed unnecessarily, resulting in the need for a retest, which is highly intensive. The American delegation offered support for this idea and indicated that it should have a negligible effect in the test procedure. OICA added that this tapering effect on the charge rate is normal for vehicles that make use of lithium-ion batteries and is done to protect the battery make-up. Without itthe lithium-ion material could be absorbed and increase degradation.

OICA requested substantiation from the American delegation of whether bi-directional charging will be standard in the United States (U.S.). The American delegation stated that they are not looking into the technology specifically and their rule making is not based on bi-directional charging technology, although they are aware that it is a future technology, to ensure the regulations are feasible.

The co-chairs expressed that there is a definite need to have the most robust results from each test and not a list of tests that allows manufacturers to decide which they wish to follow based on favourable results.

The European Commission (EC) communicated that if one test procedure was required for the eHDV GTR, they would be in favour of bi-directional charging but are also open to other options. OICA commented that, unlike light-duty vehicles (LDV), eHDVs cannot be used in smart grid scenarios because they need to travel more than 500 kilometers per day. So, when these vehicles are parked, they require charging because they are almost exclusively work vehicles, so bi-directional technology does not make sense in these vehicles. Because of the huge variation in eHDV applications, a common minimum performance requirement (MPR) and test procedure may not be valid, also considering the limited availability in data. In general, OICA feels that the approach needs to remain open. The EC commented that perhaps bi-directional charging technology could be installed in the vehicles for testing purposes only. If the testing procedure is based on the charging event only, then there is a problem of only being able to verify the energy input and not the energy output. The American delegation was also not supportive of a charging metric for the test method, stating that it is important to focus on the metric that matters to customers and operators. The American delegation also suggested another test procedure that focuses on the battery pack level. The Chinese delegation showed support for three different test methods and communicated that the most important thing is the declared limit of the battery. The co-chairs expressed that they were hoping to limit the test procedures to two methods at most, with consideration for adding the chassis dynamometer testing in the second phase of the eHDV GTR due to the determination of equivalency to the other methods. The co-chairs also mentioned that MPRs may be required for each test unless evidence is provided that the metrics are equivalent. Based on experience, the co-chairs stated that typically regulation drives technology and it is not fully clear whether forcing bi-directional charging onto eHDVs would fall into that category. If there is a strong feeling for bi-directional charging, maybe we need to consider this in decision making. In general, there appears to be a preference for solutions that measure the usable battery energy (UBE). OICA commented that it is good to have alternatives and they are not opposed to the bi-directional charging method, but it should not be the only test method given the required technology. Moreover, the constant speed test could prove to be a challenge due to test track availability and requirement for the testing conditions to be identical for all the preformed tests. The EC responded to this point stating that the constant speed testing could be done at the manufacturers proving grounds or by a third-party contractor, and so availability would likely not be a critical consideration.

Action items

Decisions

3. HDV GTR – Position on UBE measurement

Documentation

- EVE-64-05e

Context

The Japanese delegation presented a document outlining their position on eHDV UBE and useable battery capacity (UBC) measurement techniques. The Japanese delegation stated that they have no strong position on whether to apply UBE or UBC, but that the final decision should not enable UBC or UBE to be selected as an option, to avoid the selection of a metric to benefit testing measurements. The Japanese delegation also expressed that they have no concern regarding the inclusion of chassis dynamometer testing as an option.

Discussion

Action items

Decisions

4. HDV GTR – Proposal on c-rate during heavy-duty UBE measurement

Documentation

- EVE-64-06e

Context

The Japanese delegation presented a proposal on the applicable charge/discharge current rate (c-rate) during UBE measurement, outlining that they prefer cycle repetition under the world harmonized vehicle cycle (WHVC) conditions with constant c-rate phases.

Discussion

The Japanese delegation stated that due to the ongoing discussions during the EVE IWG session, they have since changed their mind on this approach, as it focuses more on UBE measurements. The Japanese delegation stated that, if the testing procedure is changing to another method, they will need to reconsider the associated approach.

Action items

Decisions

5. HDV GTR – First measurement results on charging vs. discharging and UBC vs UBE.

Documentation

- EVE-64-07e

Context

Representatives from OICA offered a presentation on measurement results for charging versus discharging in addition to a proposal on their stance for the adaptation of GTR 22 for heavy-duty applications. The main conclusions from the presentation included,

1. Energy throughput has a higher correlation to state of certified energy (SOCE) than with mileage due to more diverse vehicle applications in eHDV.
2. Loss of active material is the dominating driver of cell aging for all metrics (energy, capacity, charging and discharging).
3. On road tests (reproducibility of capacity and energy amount) can be highly influenced by track profile, load and overall test conditions. Consistent conditions can be realized more easily during the charging test.
4. Keep flexibility regarding test procedures as regional abilities and testing schemes are very diverse.

Discussion

The co-chairs sought clarification on the presentation, specifically with respect to the SOCE and energy throughput correlation, and whether it was OICA's recommendation to not have any mileage requirement. OICA clarified that they are requesting throughput as the only metric.

The EC commented that combining energy throughput with only a charging procedure could be problematic and indicated that they have a strong interest in an approach that makes use of a charging and discharging procedure.

The EC requested that OICA provide data to substantiate and provide context for their results, including metrics such as the average c-rates for charging and the different driving modes for discharging, as these are required to properly evaluate the results. OICA offered to provide the necessary metrics and driving profiles to EC, as needed.

Action items

Decisions

6. HDV GTR – Planning and prioritization

Documentation

Context

This item was set with the objective of ensuring EVE IWG members are all aligned on current state of progress and future planning, with regard to the draft UN GTR on eHDV battery durability.

Discussion

The co-chairs offered a quick recap, suggesting that we maintain the cycle test, focusing on UBE, for vehicles that allow it. Vehicles that do not have bi-directional charging would make use of the UBC option. The third option would be chassis dynamometer testing as an alternative method, with the understanding that equivalency with the other test procedures needs to be determined. We then can eliminate constant speed testing from the list of options. The EC stated that they do not feel that constant speed testing should be taken out as an option because there is a need to somehow discharge.

The co-chairs expressed that a decision needs to be made on whether there is desire to regulate UBC or UBE and this will need to be discussed internally first.

The drafting coordinator mentioned that, given the data presented by OICA and Japan, the EVE IWG can start on test procedure decisions, noting that c-rate was seen as critical based on the Japanese results. The drafting coordinator stated that a one-page summary will be prepared for day 2 outlining the testing procedure options and that they will begin to look at the OICA data results more carefully.

The co-chairs reiterated that they would like to select one methodology and not leave too many options. The co-chairs suggested modifying the agenda and continuing the discussion on eHDV for the first half of day two of the 64th EVE IWG session.

Action items

- Drafting coordinator to develop one-page summary of discussions and test procedure options for second half of the 64th EVE IWG session.

Decisions

Day 2 – September 20, 2023, 05:30 EDT

1. Introduction, review of agenda

Documentation

- EVE-64-01e

Context

The EVE IWG co-chairs addressed members and welcomed everyone to the virtual meeting.

The co-chairs presented the meeting agenda to EVE IWG members. The agenda was reviewed and adopted by the EVE IWG prior to beginning discussions. Modifications to the agenda occurred and have been reflected in EVE-64-17e.

Discussion

Action items

Decisions

2. HDV GTR – Updated proposal on UBE-UBC measurement

Documentation

- EVE-64-16e

Context

The Japanese delegation offered a revised position regarding outstanding items of the eHDV UN GTR, based on discussions from the first day of the 64th EVE IWG session. The Japanese delegation also included, in their document, comments and feedback on the presentation from OICA, EVE-64-07e.

Discussion

Action items

Decisions

3. HDV GTR – Review of draft text and discussion of open items

Documentation

- EVE-64-15e

Context

This item was a continuation of the previous day, regarding discussions on the draft text of the UN GTR on battery durability for eHDVs. The drafting coordinator presented a one-page summary of the eHDV UN GTR discussions and an outline of the alternative methods, for verifying battery durability monitor for eHDVs, currently under consideration.

Discussion

The Japanese delegation requested confirmation of the EC's position on testing procedures for verifying the battery durability monitor in eHDVs. The EC confirmed that they are interested in using UBE as a metric and a discharging method. The Japanese delegation communicated that they are in agreement with a discharge procedure as it may be more appropriate, however, they expressed flexibility. The American delegation expressed that they share a preference for UBE as a metric, as it is more representative and also measures both components (voltage and current) of degradation, which is desirable. The Japanese delegation stated that they prefer the UBE metric.

OICA questioned the contracting parties, stating that measurements are always done on the battery and on existing vehicles, so what will happen in the future as eHDVs integrate their batteries into the chassis and structure of the vehicle. The drafting coordinator indicated that they were aware of this possibility and have been considering mandating an inspection point for increasingly complex systems, which could also include a derivation box.

The Japanese delegation communicated that from the presentation by OICA the day prior, measuring voltage could prove to be extremely difficult. Perhaps there is an option to make use of onboard measuring, as long as equivalency is demonstrated with an external device, however the onboard system may not be accurate enough. OICA stated that, in these considerations what is missing is the effort required to conduct each of the different tests. As the Japanese delegation indicated, voltage is challenging to measure so maybe UBC is a good option to consider.

The co-chairs stated that based on these discussions UBE or UBC needs to be decided on by the EVE IWG. Regarding future vehicle technology, if an access point is required, perhaps it should be stated in

the regulation to ensure that vehicles will possess an access point to the batteries in the future. The co-chairs also communicated that the group needs to be careful not to develop a UN GTR that is addressing the lowest common denominator of vehicles. Moreover, the measurement procedure and parameters are important in the Part A definitions of the eHDV UN GTR, not mixing and matching.

The American delegation sought clarification on whether the group wanted to continue discussing charging versus discharging procedures. The drafting coordinator mentioned that based on the discussions of the first day of the 64th EVE IWG session, the group was in favour of discharging. The American delegation agreed with this decision.

The co-chairs proposed removing method 1d, due to preference for a discharging procedure, and method 1c due to the need for measurement equivalency. The EC stated that they are not confident in method 1c. OICA stated that Japanese manufacturers may want this because it relates to their market. The Japanese delegation confirmed that they are not in favour of method 1c and that is why they have not proposed the procedure. The co-chairs expressed that on-board data can only be used if compared against another equivalent value. The co-chairs also indicated confusion regarding how something could be proved through the type-approval process but not through market surveillance or other activities. This is why access points on the vehicle are necessary to measure voltage and current.

OICA commented that if focusing on UBE and discharging methods, then there is a requirement for precise boundary conditions, temperatures, loads, track conditions so that there are identical loading profiles on the vehicle, and the results may already differ due to battery aging. If utilizing a method with the UBC metric, it allows for reproducibility and the ability to discharge, which may offer a good compromise. The co-chairs stated that all contracting parties have expressed they prefer the use of UBE as a metric and although OICA may prefer UBC, it can pose its own specific challenges. The EC mentioned that certain issues will arise with the different methods and the EC is not opposed to a charging procedure. If measuring UBE with a charging procedure, the deterioration could result in adverse effects on the battery. The same thing could be said about the UBC metric and a charging procedure, it could display its own problems. The reason why the contracting parties want the UBE metric is because it is the most telling. The Japanese delegation stated that they do not have confidence in the OICA test results, as it may possess variability because there is variation only occurring for UBE and not UBC. Using non-accurate voltages to measure UBE could lead to this variability, which then indicates that the test results

may not be reliable. The Japanese delegation expressed that it is dangerous to consider these results alone and UBE cannot be disregarded because of this data.

The co-chairs requested comments from the EVE IWG regarding how complicated it is to accurately measure voltage of a vehicle. OICA stated that it is possible but measuring the capacity of the battery is the most accurate method. OICA requested continuing this conversation at the 65th EVE IWG session. The EC mentioned that in order to measure voltage, they typically install a derivation box and use that to measure all the metrics. The Canadian delegation offered insight, stating that they have measured LDV and HDV voltage on several occasions and do so without manufacturer support but have robust procedures in place to ensure safety. A voltage divider is used to ensure that any wiring exiting the vehicle to the power analyzer is carrying a voltage between zero to ten volts, maximum.

The EC stated that if the voltage is being measured onboard, then it may be appropriate to mandate the installation of measurement points and if it is installed at the outset this would lower safety concerns. OICA requested that the topic on standardized access points on the vehicle also be delayed until the 65th EVE IWG session. OICA communicated that when designing a regulation, there should be an emphasis on ensuring it does not require more work than what is necessary and overburden the industry. Regarding voltage tap locations on the vehicle, the Canadian delegation has tested vehicles that have voltage taps built into their electric powertrain, which are easy to access despite the battery pack itself being highly integrated into the chassis. Overall, the Canadian delegation indicated support for standardized measurement points on vehicles.

The co-chairs expressed that they would like to hear comments from the Japanese and Chinese delegation on methods 1a, 1b and the alternative chassis dynamometer testing. The Japanese delegation indicated that they would need to consider these options further and speak with manufacturers. The Chinese delegation communicated that they were supportive of the chassis dynamometer testing. The co-chairs mentioned that perhaps China can speak further at the 65th EVE IWG session on chassis dynamometer equivalency with the other proposed test methods.

<u>Action items</u>

- Discussion of UN GTR on battery durability of eHDV to continue at the 65th EVE IWG session to resolve outstanding issues and address topics related to UBE and UBC, standardized measurement points, and chassis dynamometer equivalency.

Decisions

4. UN GTR 21 – Proposals to expand the application of system bench

Documentation

- EVE-64-08e

Context

The Japanese delegation offered a presentation on a proposal to expand the system bench measurement technique to all vehicle types. Accompanied with the presentation was concrete text for the UN GTR 21, as well as an outline of the necessary system configurations for the testing.

Discussion

The co-chairs requested clarification on whether this proposal was being offered as an alternative method to the current UN GTR method. The Japanese delegation stated that yes, it is to be an alternative method. The co-chairs expressed some confusion, outlining that the presentation seems to indicate that this method would be applied to all vehicle types as an additional option and not simply to vehicles that exceed the power limits of a dynamometer.

The Chinese delegation stated that the objective of UN GTR 21 is to obtain easy measurements, and because of this, system bench testing is not a good choice. The Chinese delegation also mentioned that they agree with the sentiment that a chassis dynamometer may not be suitable for high-speed testing and this would be better handled by the hub dynamometers for these high-powered hybrid vehicles. The Chinese delegation indicated that the hub dynamometers should be sufficient and there is no need for a system bench measurement.

OICA stated that they are supportive of the Japanese proposal to open up the possible measurement methods to provide more options, as long as they remain equivalent.

Action items

Decisions

5. UN GTR 21 – Finalize proposed changes

Documentation

- EVE-64-09e

Context

This item was set with the objective of finalizing UN GTR 21 amendments for submission at the 90th GRPE session in January, 2024.

Discussion

OICA offered a quick comment regarding the UN GTR 21 text found in Table 2 of the *Test Conditions* section, indicating that the remark and reference to the *ISO 1585:1992* standard on intake manifold pressure accuracy does not permit charging pressure and only suction pressure. OICA therefore suggested eliminating the text and reference under the remark column all together.

The co-chairs indicated that due to time constraints of the meeting, perhaps further discussions should be delayed until the 65th EVE IWG session.

Action items

- EVE IWG to continue discussion at the 65th EVE IWG session and finalize UN GTR 21 amendments for the 90th GRPE session in January, 2024.
- Drafting coordinator to update UN GTR 21 to reflect comment from OICA on intake manifold pressure remark column, in Table 2 of the *Test Conditions* section.

Decisions

6. UN GTR 22 – Comments on draft text

Documentation

- EVE-64-11e
- EVE-64-12e

Context

The Japanese delegation provided a presentation of their comments on the current text of UN GTR 22, in addition to some text proposals for consideration prior to finalizing the UN GTR 22 amendments.

Discussion

The co-chairs expressed that they had no initial reaction to what Japan has presented and will need to digest it further.

OICA indicated that they were in agreement with the Japanese comments and proposals and they offer their general support.

Action items

Decisions

7. UN GTR 22 – Proposal on battery swapping

Documentation

- EVE-64-13e

Context

The Chinese delegation presented a proposal on swappable batteries in electric vehicles. The proposal included requirements needed to implement swappable battery text into UN GTR 22.

Discussion

OICA indicated that it was interesting to see the proposal from the Chinese delegation and stated that UN GTR 22 is used for vehicles not for the batteries, so this proposal seems a little unclear on its implementation. OICA also mentioned problems with the traceability aspect of swappable batteries in the case of non-compliance. The co-chairs agreed with OICA's concerns and stated that it is unclear how this will work with the regulation and is currently an item that is on the outside of the EVE IWGs scope, at this time. The co-chairs expressed that in order to address the durability of swappable batteries, the development of a new UN GTR may be required.

Action items

Decisions

8. UN GTR 22 – Finalize proposed changes

Documentation

- EVE-64-10e

Context

This item was set with the objective of finalizing UN GTR 22 amendments for submission at the 90th GRPE session in January, 2024.

Discussion

The co-chairs indicated that due to time constraints of the meeting, perhaps further discussions be delayed until the 65th EVE IWG session.

Action items

- EVE IWG to continue discussion at the 65th EVE IWG session and finalize UN GTR 21 amendments for the 90th GRPE session in January, 2024.

Decisions

9. EVE IWG Terms of Reference review and renewal

Documentation

- EVE-64-14e

Context

This item was set with the objective of presenting the draft Terms of Reference (ToR) document for the EVE IWG. The ToR requires renewal in January, 2024 and will be presented to the GRPE at its 90th session to extend the EVE IWG's mandate.

Discussion

The secretary indicated that a draft version of the document has been posted on the EVE IWG wiki page.

The co-chairs asked EVE IWG members to review the ToR document and asked that comments be directed to the secretariat for consideration and discussion at the 65th EVE IWG session.

Action items

- EVE IWG members to review and provide comment to the secretariat, regarding the EVE IWG ToR, for discussion at the 65th EVE IWG session.

Decisions

10. Action item review

Documentation

Context

This item was set with the objective of reviewing the recorded action items and for EVE IWG members to communicate whether other action items may be necessary or have been missed.

Due to time constraints of the meeting, this item was omitted.

Discussion

Action items

Decisions