



EVE IWG 70th session

May 07th-08th 2024

11:30h – 14:00h CET

- online-



Request to EVE IWG 1/2

Additional questions from EVE IWG 69th session:

- **Request to China & CATL to provide information on:**
 - their statistics (battery replacement, battery swap, installed battery energy, energy consumption histogram)
 - individual vehicle (unsigned) data excludes the replaced batteries vehicles and swapped battery vehicles.
- **As for “alternative methods”**, OICA understood that they were to be considered in Phase 2, along with “Class O and battery replacement methods”
- **The definition of "alternative method"** is unclear. If the "alternative method" refers to chassis dynamometer measurements, the details of the test contents cannot be discussed yet. It won't be in time for July's WD. OICA believes that the priority should be to deepen the discussion on "MPR".



Request to EVE IWG 2/2

Additional questions from EVE IWG 69th session:

- **Pilot phase:**

- **If cp's members could join a measurement on-site of OICA oems prepises instead of sending vehicles to cps**
- Set-up could look like: CPs rep + technical service rep. + OEM rep. Guiding through and witnessing the test
- **Timeline: results 2 weeks before submission of IWD July 22nd**



Request to China & CATL

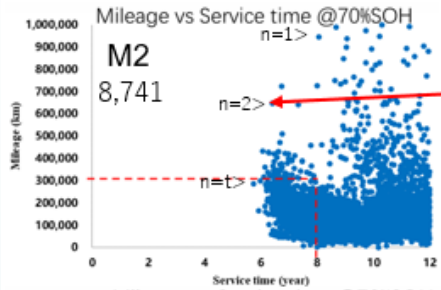
- Regarding the BEV-HDV market data presented by China at the EVE-69th-23e, **we support to consider MPR by obtaining detailed data on mileage, year, Energy Throughput, and cycle of each vehicle.**
- Note: It seems that some vehicles in this data have had their batteries replaced, so it is important to divide that data. (Replacement battery issue is next step.)

OICA will cooperate in the analysis.

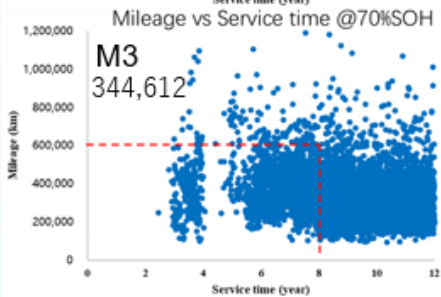


Request to China & CATL

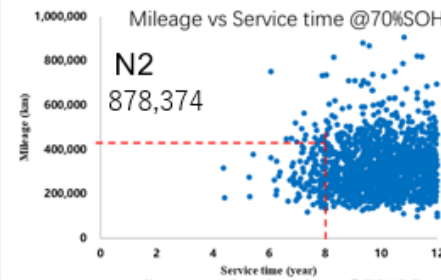
As an example, I read the distance and Year from the graph. (approximate)



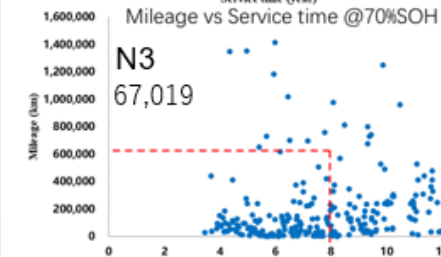
M2		SOH70%		
Sample	years	mileage	Energy throughput	Cycle number
1	8.7	950,000		
2	6.2	620,000		
-	-	-		
t	5.9	290,000		
-	-	-		
-	8,741			



M3		SOH70%		
Sample	years	mileage	Energy throughput	Cycle number
1				
-				
t				
-				
-	344,612			



N2		SOH70%		
Sample	years	mileage	Energy throughput	Cycle number
1				
-				
t				
-				
-	878,374			



N3		SOH70%		
Sample	years	mileage	Energy throughput	Cycle number
1				
-				
t				
-				
-	67,019			

Comments

- Regarding sample 1 (n=1>), the mileage is long compared to the age of the vehicle, so it is assumed that the battery would be replaced (not swapped).
- It is necessary to exclude (separately) consider vehicles such as sample 1 which the battery is considered to be replaced (not swapped).



Request to JRC on TEMA model

Assumption and inputs to JRC TEMA for e-HDVs

- Development HDV scenarios for 1 2 vehicle battery durability based on 2019/1242/EU and VECTO:
 - 3 Vehicle groups, mission profiles, annual kilometer driven (for mission profile and vehicle group), energy consumption (for mission profile and vehicle group), average speed...
- 4 Assumption of battery size for vehicle group and mission profile based on ICCT report and VECTO,
- New recharges strategies introduced in JRC TEMA for e-HDVs
 - lunch break ultra-fast charging, depot over-night slow charging, mixed of the previous two ones (lunch break ultra-fast charging, depot over-night slow charging) ...
- 5 Battery architecture scenarios from literature
- 6 Same performance based models used for LDVs GTR 22, i.e., NCM-LMO
- Assessment of the battery ageing at Euro7 proposed thresholds and at EoL (80% remaining energy capacity)

*ICCT: The European Heavy-Duty Vehicle Market Until 2040: Analysis of decarbonization pathways <https://theicct.org/publication/hdv-europe-decarb-costs-jan23/>

Comments

OICA request discussions and information on the following items

1. Average annual kilometer
2. Energy consumption
3. Assumption of battery size
4. Battery architecture
5. Performance based models



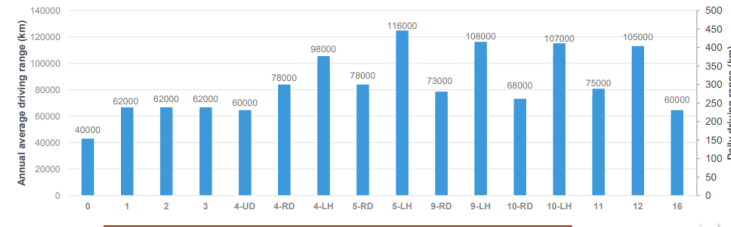
Average annual kilometer

Vehicles

Regulation (EU) 2019/1242 of the European Parliament and of the Council of 20 June 2019 setting CO2 emission performance standards for new heavy-duty vehicles and amending Regulations (EC) No 595/2009 and (EU) 2018/956 of the European Parliament and of the Council and Council Directive 96/53/EC (Text with EEA relevance) <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019R1242-20190725&qid=1687367974495>

ICCT: The European Heavy-Duty Vehicle Market Until 2040: Analysis of decarbonization pathways <https://theicct.org/publication/hdv-europe-decarb-costs-jan23/>

Average annual and daily driving range per truck group



EVE IWG 68th, Web-meeting
February 28th-29th, 2024



6

Comments

- Average annual kilometer is not the only representative reference in the assessment of battery aging, daily operation should be considered.
- In the reference ICCT reports, it shows that eg LH subgroup could reach up to 1000km for daily operation and significantly impact the truck battery size, operating strategy and thus battery aging behavior

Table 2. Long-haul sub-groups share segmentation based on the daily driving range

VECTO long-haul subgroups	< 500 km	500-800 km	> 800 km	Total
4-LH	1.92%	1%	0.11%	3.02%
5-LH	38.57%	20.09%	2.23%	60.89%
9-LH	6.34%	3.3%	0.37%	10.01%
10-LH	1.91%	0.99%	0.11%	3.01%
Total	48.74%	25.38%	2.82%	76.94%

Energy consumption & Battery architecture

- OICA would like to **understand** more the values used in the TEMMA simulation for **energy consumption and battery architecture**



Assumption of battery size based on ICCT report

Table A10. Truck battery and hydrogen storage tank size between 2022 and 2040.

Group	Battery size (kWh)			Hydrogen tank size (kg)		
	2022	2030	2040	2022	2030	2040
0	120	100	100	6	4	4
1	180	150	150	9	7	6
2	190	160	160	9	7	6
3	240	200	200	11	9	8
4-UD	260	200	200	12	8	8
4-RD	360	270	270	17	12	11
4-LH (500 km)	680	520	520	34	25	23
4-LH (800 km)	1,110	830	830	54	40	37
4-LH (1,000 km)	1,390	1,040	1,040	68	49	46
5-RD	450	330	330	21	14	13
5-LH (500 km)	800	590	590	40	28	27
5-LH (800 km)	1,300	940	940	63	45	42
5-LH (1,000 km)	1,650	1,190	1,190	79	56	53
9-RD	340	260	260	16	11	10
9-LH (500 km)	670	520	520	34	25	23
9-LH (800 km)	1,090	830	830	54	40	37
9-LH (1,000 km)	1,380	1,040	1,040	67	49	46
10-RD	400	310	310	18	13	12
10-LH (500 km)	810	620	620	40	30	28
10-LH (800 km)	1,310	1,010	1,010	64	48	45
10-LH (1,000 km)	1,670	1,270	1,270	80	59	56
11	380	300	300	17	13	12
12	580	460	460	27	19	18
16	280	210	210	13	9	8



Comments

- Battery size has a direct impact on the aging result
- In the ICCT assumption, the battery size could potentially be up to 1650kWh
- The current battery technology doesn't have extremely high energy density today (Wh/kg power to weight ratio)
- In reality, the vehicle can not install so many batteries as it will be extremely heavy up to ~10t
- The assessment of battery aging is not valid if such a product is not realistic.
- assessment of battery aging is not valid if such a product is not realistic.



Performance based models

- Different chemistry in HDV compared to LDV, which has different aging performance
- Complicated aging behavior when considering several packs in the HD vehicle
- Diverse applications and usage in HD sector compared to the homogenous usage for LD sector
- The performance model is not a good reference for HDV aging assessment



Open Point: Summary

e-HDVs tests: open questions EVE IWG 69th

Open points of the draft HDV GTR:

- Proposal to merge Method 1a and Method 1b (OICA proposal EVE IWG 66): to be discussed; in Japan method 1b is not applicable. If merged, only Method 1a will remain. OICA to verify internally the proposal. To keep both ✓ agreed
- Vehicle selection type approval and for Part A verification (Japan proposal EVE IWG 66): to be discussed
- Driver breaks: km vs time based: time based favourable ✓ JPN: should be confirmed no conflict with RDE ✓ agreed
- Run-in HD-PEV and HD-OVC-HEV: draft in the text ✓ JPN supports draft GTR description ✓ agreed
- Break-off criterion: For HD-PEV, speed or power not kept any longer. ✓ For HD-OVC-HEV draft proposal next slide
- Cruise control use: possible to be used ✓ EU, Japan, US EPA ok to use it ✓ agreed
- Verification and qualification of the on-board data (voltage) (OICA proposal): see next slide (current and voltage) ✓
- Steps of the test procedure (schemes and text in the draft GTR): updated schemes and text in the draft ✓ agreed
- Temperature, road grading/slope, acceleration to the target speed,...Method 1a & 1b: to be discussed
- Alternative method: draft text added in the GTR
- Test repetitions: Removed ✓ agreed
- MPR and metric: to be discussed

- EVE IWG 69th: Four items to report to EVE IWG 70th
 - Temperature
 - Road grading/slope
 - Break-off criterion for HD-OVC-HEVs
 - Alternative method

Comments

- We do understand that "Alternative method" is no "open question" of WD for submission.
- See also added draft text
- HD-OVC-HEV may face complex challenges by running in charge depleting mode: perhaps pure electric mode (where possible) shall be followed
- Another example: trailers – they don't have a certified odometer, nor counting mileage. Age would not be enough here.



Metric and MPR

e-HDVs tests open questions: Metric and MPR

- To be discussed
- JRC presentation as overview
- Japan proposal
- China proposal
- OICA proposal
-

Comments

- We strongly recommend to follow an additional energy throughput metering which has to be respected for any MPR
- **Virtual mileage has still a big issue: e.g. m- & e-PTOs (any kind of electrical power take off energy) during driving will lead to an underestimation of cycled battery energy by dividing energy throughput total / driving**




Family definition

e-HDVs tests: open questions EVE IWG 69th

Open points of the draft HDV GTR:

- Part A family definition ✓ agreed as it is
- Part B family definition ✓ agreed as it is
- Part C family definition placeholder: to be discussed
- Part C Verification of reported virtual distance: to be discussed; updated for both virtual distance concept and En-throughput; to be revised for HDVs scenario
- Part A: Statistical Method for Pass/Fail decision for a sample of vehicle ✓ agreed as it is
- Parameter A statistic to be revised in case due to voltage oscillation during measurement: data needed
- Revision of the definitions in the draft GTR

- 
- **EVE IWG 69th: Four items to report to EVE IWG 70th**
 - Temperature
 - Road grading/slope
 - Break-off criterion for HD-OVC-HEVs
 - Alternative method

Comments

- Ok as is
- Got first feedbacks from technical services that Part B family concept could add too much complexity



Temperature

e-HDVs test open questions: **temperature** ✓?

- Pre-conditioning, soak and charge to be carried out in a test room/soak area, [23 °C ±5; ± 7 °C] [25 °C ±7; ± 10 °C] → **25 °C ±5**;
- If test room/soak area not available, not applicable..., allowed to use pre-warming of the battery in cold environment with internal designed functional systems with measurement of the energy

➤ from RDE moderate conditions (0 to 35 C)

Japan: to improve practical test execution, propose RDE moderate conditions (0 ~ 35 C). based on technical justification, OK to expand the 5% tolerance in case of outside range from 18 ~ 30C.

PLUS THIS REQUIREMENT ON EXTERNAL SYSTEM

- Not allowed the pre-warming of the battery with an external system

To provide your views
Decision expected at EVE IWG 70th

- **EVE IWG 69th: Four items to be reported to EVE IWG 70th**
 - **Temperature**
 - **Road grading/slope**
 - **Break-off criterion for HD-OVC-HEVs**
 - **Alternative method**

Comments

- Pre-con: 25±5K is ok
- RDE: 5% is based on chassis-dyno, hard to achieve for HDV on RDE – expanding is required!
- Reference on temperature window
- Boundary conditions already defined in the draft text
- Monitoring data needed to support accuracy requirements
- Pilot phase will show dynamics affecting any tolerance (on pass/fail criteria fulfillment)



Acceleration, road gradient/slope

e-HDVs tests open questions: acceleration, road grading/slope ✓ ?

Japan:
to improve practical test execution, propose to apply same conditions as RDE requirement means that “the cumulative elevation gain” shall be less than 1,200m / 100km

- Road grading/slope, accuracy on UBE to add?
- Effect of the acceleration to the target speed with road grading/slope
- Effect on the last portion of the test: grading, payload, speed, power request ... near the break-off point

PROPOSAL TO CONSIDER

- Proposal to apply same conditions as RDE requirement on all the route/test: “the cumulative elevation gain” shall be less than 1,200m / 100km
- Effect on the last portion of the test: slope at the end of the test to be reported
- No conditions for method 1b as per method 1a

To provide your views
Decision expected at EVE IWG 70th

- **EVE IWG 69th: Four items to be reported to EVE IWG 70th**
 - Temperature
 - Road grading/slope
 - Break-off criterion for HD-OVC-HEVs
 - Alternative method

Comments

- Ok with Japan’s comment
- 1b test method requires wider tolerances than 1a due to external factors as road condition, route selection, local availabilities, traffic, weather



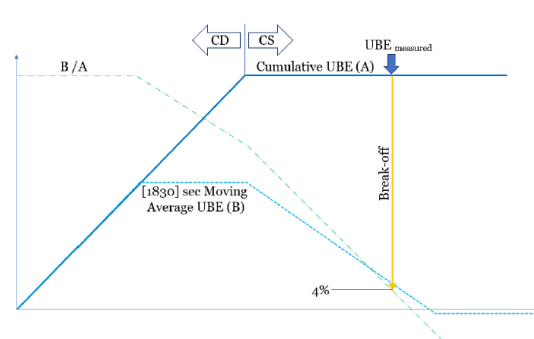
Break-off criterion PEV

e-HDV's tests open questions: Break-off criterion

Break-off criterion Method 1a, 1b:

- For HD-PEV speed or power not kept any longer ✓ 4 sec rule agreed
- For HD-OVC-HEV draft proposal in the text based on LDV-OVC-HEV

- [In case of HD-OVC-HEVs the charge depleting vehicle test operation mode shall be selected. The break-off criterion is reached when ...].



ALTERNATIVE TO CONSIDER

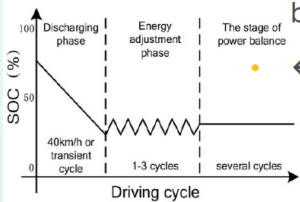
favourable

- [the vehicle cannot drive in pure electric mode for [4] consecutive seconds or more without recuperation from the engine operation]
- [the $|\Delta E_{REESS,dt}|$ in the last xx dt of driving is equal to or less than xx per cent of the total nominal energy capacity of the battery **cumulative UBE**. The manufacturer shall provide evidence to the responsible authority after the test that this requirement is fulfilled.]
- [For HD-OVC-HEV, the end of the charge-depleting test is considered to have been reached at the end of the energy adjustment phase when the break-off criteria is reached for the first time in the stage of power balance.]

- ← China proposal

Japan: at least 1500sec ?
 JEO5 : 1830 sec
 WLTP 4 : 1800 sec
 WLTP 3 : 1477 sec

Japan: 4 per cent of
 cumulative UBE



EVE IWG 70th, Web-meeting
 May 7th-8th, 2024



Comments

- If 4 sec rule does inflict challenges in RDE, Phase 2 shall be open for revision back to “break-off criterion: according to manufacturers specifications, in alignment with approval authority”
- 1b: based on road and slope condition, vehicles may end the measurement before the 4 sec rule (slope, load, low ambient temperatures) – openness to discharge battery with auxiliary equipment after alignment with type approval authority
- Driving in RDE 1b, vehicle shall be driven in controlled conditions before depleting fully due to road safety reasons; ref. Annex III, 2.1.2.2.7.

Annex III, 2.1.2.2.7: [In the case in which the auxiliary systems are used to complete the battery discharge[JRC1] [JRC2] , the break-off criterion is reached when a warning indication appears on the vehicle dashboard in accordance with vehicle manufacture.]



Break-off criterion HEV

e-HDVs tests open questions: Break-off criterion

□ Break-off criterion **Method 1a, 1b:**

- For HD-PEV speed or power not kept any longer ✓ [4 sec rule agreed](#)
- For HD-OVC-HEV draft proposal in previous slide

To provide your views
Decision expected at EVE IWG 70th



- **EVE IWG 69th: Four items to be reported to EVE IWG 70th**
 - Temperature
 - Road grading/slope
 - **Break-off criterion for HD-OVC-HEVs**
 - Alternative method

Comments

- If HEV follows pure electric mode, same criteria as for PEV shall apply
- If not, more discussions necessary





Break-off criterion PEV Chassis-Dyno

e-HDV tests open questions: Break-off criterion

□ Break-off criterion **Alternative method**:

- For HD-PEV speed or power not kept any longer ✓ 4 sec rule agreed
- For HD-OVC-HEV draft proposal in the text based on LDV-OVC-HEV
 - [the relative electric energy change, REEC in the last xx dt of driving, as defined in the following equation, is less than ~~[4]~~ **[5]** percent.

$$REEC_{dt} = \frac{|\Delta E_{REESS,dt}|}{E_{cycle} \times \frac{1}{3600}}$$

E_{cycle} is the total energy demand E for the whole cycle ...]

same
criterion
as
Method
1a/1b?

- [the $|\Delta E_{REESS,dt}|$ in the last xx dt of driving is equal to or less than xx per cent of the ~~total nominal energy capacity of the battery~~ **cumulative UBE**. The manufacturer shall provide evidence to the responsible authority after the test that this requirement is fulfilled.]
- To refer to regional regulations for HD-OVC-HEV dyno testing, if available (i.e. REEC)

Comments

- Alternative method should be considered Phase 2





Break-off criterion HEV Chassis-Dyno

e-HDV's tests open questions: Break-off criterion

□ Break-off criterion **Alternative method**:

- For HD-PEV speed or power not kept any longer ✓ 4 sec rule agreed
- For HD-OVC-HEV draft proposal in previous slide

To provide your views
Decision expected at EVE IWG 70th



- EVE IWG 69th: Four items to be reported to EVE IWG 70th
 - Temperature
 - Road grading/slope
 - Break-off criterion for HD-OVC-HEVs
 - Alternative method

Comments

- Alternative method should be considered Phase 2





C-rate

e-HDVs tests open questions: Steps of the test procedure ✓

- Agreed as reported in the following slides ✓
- Soak and charge temperature [25 °C ±5 °C] if in a test room ✓ agreed
- Soak and charge for a minimum of 6 hours and a maximum of 36 hours ✓ agreed
- ~~With a C-rate in the range of [C/6 or less, C/2]~~ to remove this requirement since there is already the requirement on the speed ✓
- If on-board system are used to complete the REESS depleting due to safety reason(method 1a and 1b) , c-rate? (Typically is automatically set). Criterion for stopping the test?
- To revise the text about having the same boundary conditions in certification and ISC, if declaring of UBE is allowed

Comments

- OICA believes that "With a C-rate in the range of [C/6 or less, C/2]" is a requirement for "Method 2".



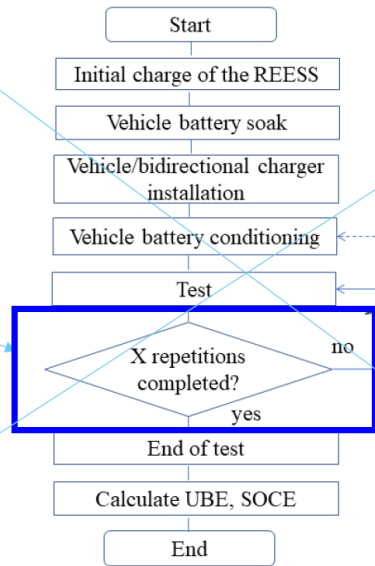
Test repetition

e-HDV tests open questions: test repetition ✓

- Method 1a
- Method 1b
- Method 2
- Alternative Method

EVE-68-08e
Repetition of RTE test criterion :
1.000±0.050 @Ah

OEM Declaration value±0.050@kWh
for UBE_{certified}



EVE IWG 69th
➤ Decision to remove it ✓ agreed

Japan: proposal to delete
Then two possible scenarios

#1
no repetition without any
additional tolerance
(can be handled as a part
of statistical analysis
process)

#2
no repetition with
the additional
tolerance based on
ambient temperature

Comments

- Ok and support on 1 and 1b
- Method 2 should have repetitions (no data available to confirm that the omission of repetitions is necessary or feasible). Necessary repetitions shall be monitored for phase 2 adjustments



REESS (voltage) measurement

e-HDVs tests open questions: REESS voltage measurement ✓

- Verification and qualification of the on-board data (voltage) (OICA proposal)
- Draft text:
- Measurement of the voltage and current
- Possibility to use on-board-data

EVE IWG 69th
➤ Agreed ✓

OK with this

- [As an alternative to the use of voltage measurement devices, use of on-board measurement data is permissible if the accuracy and frequency of these data is demonstrated to the responsible authority to meet the minimum requirements for accuracy and frequency described in [paragraph 2.2. of this annex].
- [The on-board measurement data of the voltage can be used during the in-service testing only when the accuracy of on-board measurement data is confirmed during the Type Approval Test and a safe inspection point is made available for the direct measurement verification]

and frequency

➤ Possibility to use on-board data during ISC but to retain the ability to measure the voltage

- ~~{External REESS voltage measurement (GTR No. 15)~~
 - ~~The REESS voltage shall be measured with the equipment and accuracy requirements specified in paragraph x.x. of this annex. To measure the REESS voltage using external measuring equipment, the manufacturers shall support the responsible authority by providing REESS voltage measurement points and safety instructions.~~
- ~~Vehicle on-board REESS voltage data (GTR No. 15)~~
 - ~~As an alternative to the external REESS voltage measurement specified in paragraph x.x. of this annex, the manufacturer may use the vehicle on-board REESS voltage measurement data. The accuracy of these data shall be demonstrated to the responsible authority.]~~

Comments

- Agree, OICA will come up with a electrical current monitor verification in addition to that voltage criteria
- Pilot phase has the potential to show the feasibility and complexity of any verifications



Chassis Dyno

e-HDVs tests open questions: **Alternative method**

- Draft text added in the draft HDV GTR to be revised and completed

propose to allow the additional cycle as a CP option.
(please refer “15_13-03-2024-GTR HDV battery durability working draft GTR - v15_JPN.docx”

- To revise the text and refer as much as possible to regional regulations ✓

To provide your views
Decision expected at EVE IWG 70th

- **EVE IWG 69th: Four items to be reported to EVE IWG 70th**
 - Temperature
 - Road grading/slope
 - Break-off criterion
 - **Alternative method**

Comments

- “Alterative method” should be considered Phase 2.





Battery Replacement

e-HDVs tests open questions: **Battery Replacement?**

Comments

- It should be considered Phase 2, right.



Trailers/Semi-Trailers

e-HDVs tests open questions: Vehicle group O trailers and semitrailers ?

Comments

- We don't want "poor" trailer battery battery influencing the PEV or HEV tractor batteries health
- CPs may consider that and put MPRs on trailers accordingly



Advancement

e-HDVs GTR: where are we?

- **Draft HDV GTR text** (open or revised elements are in track changes)
 - Rational under development
 - MPR and metric (including En-throughput and eventual virtual distance discussion if needed)
 - Family concept: Part A, Part B and if needed Part C ✓
 - Vehicle selection type approval and for Part A verification (Japan proposal EVE IWG 66)
 - Part A Statistical method pass/fail decision ✓
 - Part B Pass/Fail Criteria for the battery durability family
 - Part C Verification of reported virtual distance
 - Annex 1 dynamic charging technology (vehicle exclusion from Part A ?)
 - Annex 2 Values to be read from vehicles
 - Annex 3 EVE-68-04e
 - Vehicle speed definition in Method 1a and Method 1b
 - Recording frequency of the measurements: 20Hz during discharge, 0.033Hz during recharge
 - Break-off criterion OVC-HEVs
 - Alternative method draft text
- **e-HDVs test procedures:** Open Item List EVE-68-04e, EVE-69-07e
- **MPR and metric:** EVE-68-11e, EVE-69-06e, EVE-69-10e, EVE-69-23e

Comments

- We made huge progress so far and OICA appreciates the always constructive and positive atmosphere within EVE IWG
- We would like to put focus on a possible pilot phase and the results on the main points identified until today of the whole EVE IWG group
- **E.g. pass/fail criteria were taken over from LDV but do not necessarily fit to HDV (different methods and boundary conditions for tests + Battery sizes)**