EVE IWG 69th session

HDV GTR Draft v15

General feedback in terms of feasibility

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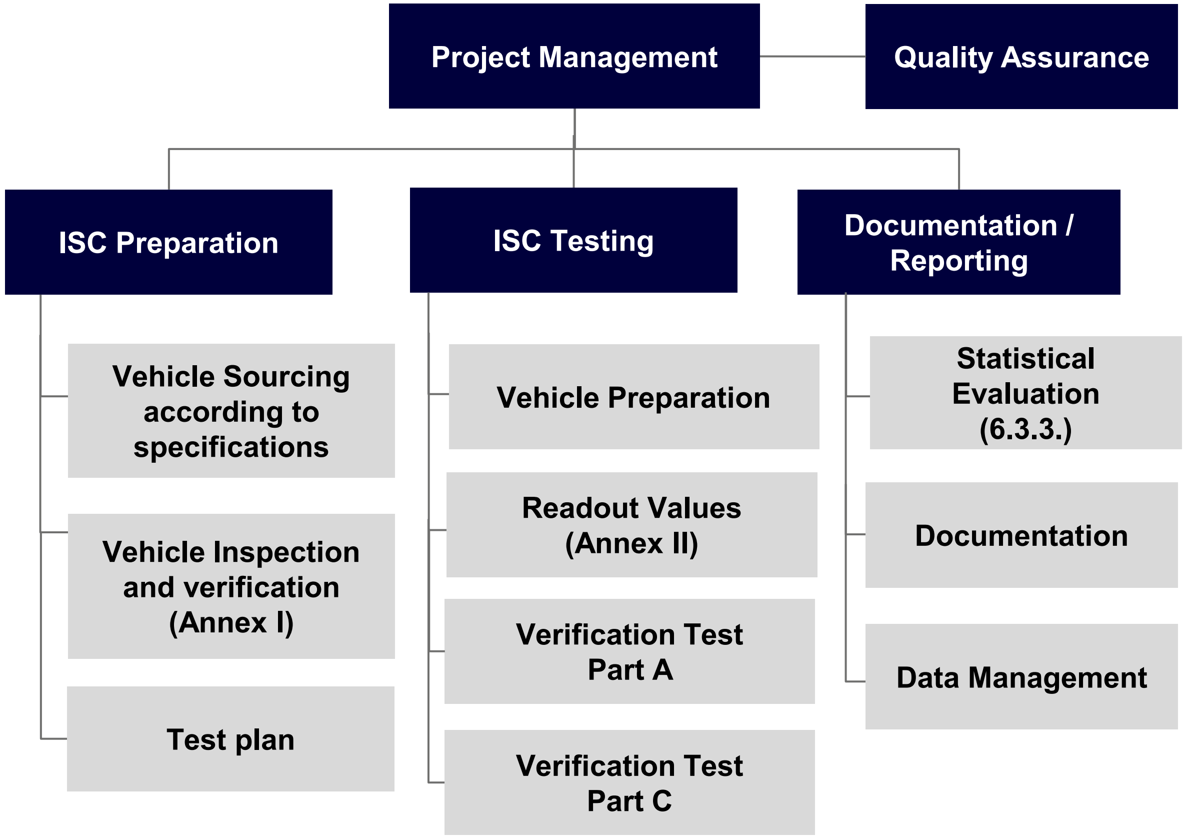
ISC Organisation @ TÜV NORD



- As a Technical Service with an own testing laboratory we could gain experience for both Type Approval and In-Service Conformity Testing.
- In order to identify challenges for the execution of future tests we analysed the current draft.
- Our focus was on the detailed evaluation of the test methodologies in terms of feasibility.
- For conducting the test we need a robust GTR with a necessary degree of freedom, but also secure comparability of test methods during all stages of a vehicle life and test locations.

General Comments

Extract as an example

Article	GRPE proposal, regulation text	proposal, regulation text (proposals in blue)	TÜV NORD comments	
2.	**Scope** *Vehicle classes comparable to European class "O" (semitrailers & trailers) which may be electrified too in future. (Maybe to be considered for Phase 2).*		Alignment with progress of UN ECE-R100 necessary • New family definitions and adjustment of test procedure shall follow.	
3.	***Definitions***			
3.3	*"Rechargeable electrical energy storage system" (REESS) means a propulsion energy storage system that stores electrical energy and which is rechargeable. A battery whose primary use is to supply power for starting the engine and/or lighting and/or other vehicle auxiliary systems is not considered as a REESS. The REESS may include the necessary ancillary systems for physical support, thermal management, electronic controls and casing and eventually V2X and/or PTO.*	"Rechargeable electrical energy storage system" (REESS) means a propulsion energy storage system that stores electrical energy and which is rechargeable. A battery whose primary use is to supply power for starting the engine and/or lighting and/or other vehicle auxiliary systems is not considered as a REESS. The REESS may include the necessary ancillary systems for physical support, thermal management, electronic controls and casing. ~~and eventually V2X and/or PTO.~~	• PTO is not part of a REESS and should therefore be deleted. V2X can be understood as an additional electronic control feature if included in REESS.	

- The draft v15 is a very good starting point for discussions but needs further improvements.
- We believe that the overall framework and decribed test methods need to be performable in a reproduceable manner.
- Based on LDV and HDV testing experience comments were made in order to highlight challenges/obstacles in the current draft.
- Besides clarifications in the wording we identified obstacles for a successful test implementation.

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General Comments

Family Definitions

- Family definitions must be verifiable at Type Approval
- Highest normal charging power needs to be defined in more detail as it is used in Annex 3
- Some of the family criteria may lead to many seperate Part A & B families
- Part C family criteria to be defined to reduce test burden.
- Identification of relevant vehicles of one/more families has to be supported with information in vehicle documentation (e.g., CoC)

Test methods

Test procedure evaluation

- Every test method shall be executable in a similar way at Type Approval and ISC and must be feasible for different vehicles of the same type
- Test duration and measurement burden shall be kept on a reasonable level
- Identical requirements could be merged into one generic chapter (e.g., precon & soak, charging for 1a, 1b (and 2)) to prevent redundancies
- Documentation and description of test setup is highly important for a transparent and reliable test approach.
- Use of on-board sensors could significantly simplify measurement setup

Most critial pain points

Method 1a

- Break-off criterium and following steps not easy to realise (60 s to standstill)
- Issues with safety relevance (e.g. deactivation accelerator control)

Method 1b

- Acceleration and deceleration requirement very difficult to implement
- Break-off criterium is inappropriate for public road testing

Method 2

- specific vehicle test mode will be required, but has to be equal to driving operation window
- De-rating must be allowed in both directions

Backup

1) Overview of TÜV NORD Mobility, Institute for Vehicle Technology and Mobility, Department Powertrain & Emissions
2) Detailed comment sheet of Draft v15 from a laboratory perspective

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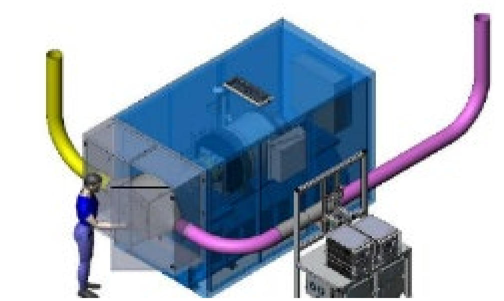
Overview MIFMPE

Locations / Laboratory



Essen

- 60 FTEs, of which
  36 authorised signatories in the TS
- DIN ISO 17025
- 3 exhaust roller test benches
- 1 SHED chamber
- 2 engine test benches
- 8 PEMS (LDV+HDV)
- (2 brake particle test stands)
- Driving resistance determination
- Examination support
  Stuttgart area

Wolfsburg

- 6 FTE, thereof 3
  authorised signatories in the TS

Bietigheim-Bissingen/ UT

- 3 FTEs, of which
  1 authorised signatory in the TS
- Test supervision Stuttgart area

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Products

Type approval / ABE
In own
test facilities

Type testing
on/with external test
equipment

Conformity of Production

In-Service Conformity
In-service Monitoring

Market Surveillance

In-Service Verification

Expert activities

Type approval related /
free market activities

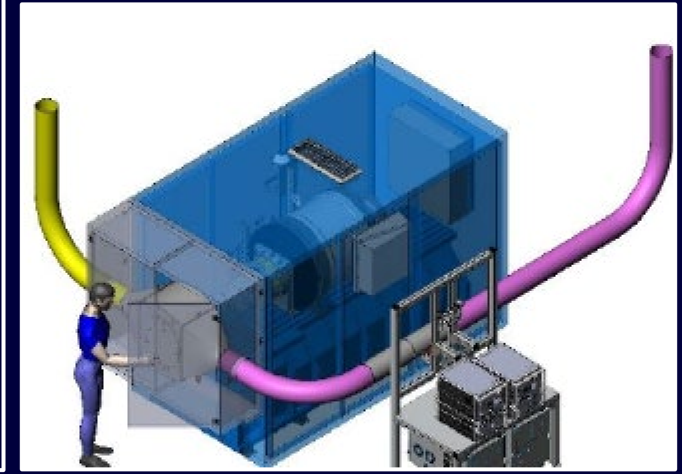
Consultancy / Research

Chassis Dyno

Exhaust emissions, range, OBD, fuel consumption, evaporative emissions, brake particle emissions

Testing of cars, light commercial vehicles and motorbikes under different climatic conditions

- Type testing in the EU/ECE/TRIAS jurisdictions
- Assessment of emission reduction strategies with regard to conformity
- CoP, market surveillance, In-Service Conformity, (In-Service Verification)
- R&D test runs, e.g. fuel comparisons
- Expert reports
- Homologation consulting



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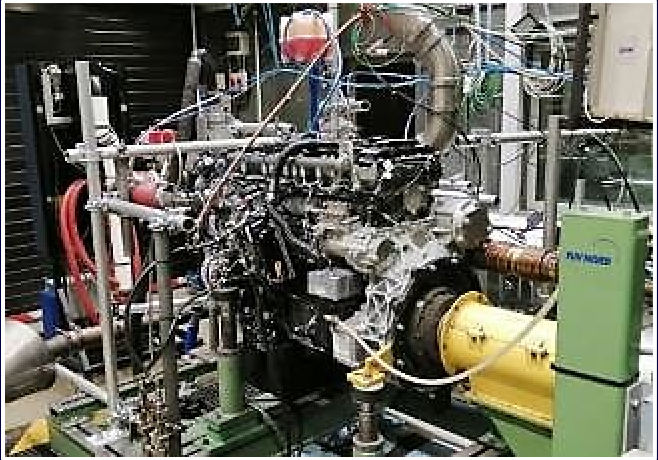
Engine Dyno

Exhaust emissions, OBD/NCD/PCD, fuel consumption, efficiency and engine performance



Testing of engines and drive components for commercial vehicles and NRMM:

- Type testing in the EU/ECE and US EPA/Carb jurisdictions (self-certification)
- Determination and verification of VECTO simulation input variables
- Assessment of emission reduction strategies with regard to conformity
- CoP, market surveillance, In-service monitoring
- R&D test runs
- Homologation consulting

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Mobile Testing

Exhaust emissions , Driving resistance

Testing of passenger cars, light and heavy duty vehicles and NRMM under real driving conditions:

- Type testing in the EU/ECE legal area and Japan TRIAS
- Determination and verification of VECTO simulation input variables
- CoP, In-Service Monitoring/ Conformity/ Verification
- Market surveillance
- R&D test runs
- Homologation consulting

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Date 28.03.2024

Extracts for Proposal for a new UN GTR on In-vehicle Battery Durability for Heavy Duty Electrified Vehicles

Article	GRPE proposal, regulation text	proposal, regulation text (proposals in blue)	TÜV NORD comments	
2.	**Scope** *Vehicle classes comparable to European class "O" (semitrailers & trailers) which may be electrified too in future. (Maybe to be considered for Phase 2).*		**Alignment with progress of UN ECE-R100 necessary** • New family definitions and adjustment of test procedure shall follow.	
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Article	GRPE proposal, regulation text	proposal, regulation text (proposals in blue)	TÜV NORD comments	
3.3	*"Usable Battery energy (UBEdischarge)" means the energy supplied by the battery from the beginning of the test procedure used for certification until the applicable end of test criterion of the test procedure as defined in Annex 3 of this GTR.*		• Change of numbers 3.3 to 3.4 necessary (presumably done after finalization). • We suggest further clarification in wording that the total number of batteries with the purpose as a traction battery is meant as reference and not a single battery.	
3.4	*"Certified usable battery energy" (UBEcertified) refers to the UBE that was determined during the certification of the vehicle, according to Annex 3 of this GTR.*		• How is this value going to be declared? From our point of view it is helpful to add the $UBE_{certified}$ to Annex 2, if not easily received from vehicle documents. • Is the declared UBE in future vehicle documents identical to $UBE_{certified}$?	
3.12	*"State of charge" (SOC) means the available electrical charge in a REESS expressed as a percentage of its rated capacity.*		• Definition identical to R100 regulation, but the reference to its rated capacity only works for new, not aged batteries. • This SoC definition is not adequate for aged batteries.	
3.21	*"Energy throughput" is the total amount of energy in kWh discharged from the battery, which needs to be provided according to Annex 2.*	*"Energy throughput" is the total amount of energy in kWh* **charged and** *discharged from the battery, which needs to be provided according to Annex 2.*	• Adjustment to include every energy flow, both charged and discharged.	

Article	GRPE proposal, regulation text	proposal, regulation text (proposals in blue)	TÜV NORD comments	
3.22	*"Energy throughput counter" means the system including eventual hardware and software that records the amount of energy in kWh during all discharge events.*	•	• At this point for testing reasons not necessary, placeholder for Part C procedure and Part of Annex 2.	
3.28	*"Maximum charging power" means the highest available charging power for the considered Part B family.*	"Maximum **normal** charging power" means the highest available charging power for the considered Part B family.	• To be aligned with wording in 6.1.2. "Declared highest normal charging power or C-rate". • It is unclear how to determine the "Maximum normal charging power" and which boundary conditions are set. Do those relate to temperature ranges or average performance over a defined SOC Swing or both? • Normal charging power has no predominant effect on battery ageing.	
3.29	*"PTO-operation" means Power Take-Off, i.e., any energy throughput during stand still or motion of the vehicle for operational purposes other than motion.*		• To be defined more precisely to have a differentiation to V2X and publish a whitelist of devices/consumers, whose energy consumption can be included in the calculation. • Any power take-off, that leads to energy throuhput during stand still or motion of the vehicle, which is not related to V2X use cases and not related to traction of the vehicle. • Clarification in energy flow diagram necessary for comparison TA vs. ISC and measurement strategy for Part C verification.	

5.	***Requirements***			
5.1	*The manufacturer shall update the on-board SOCE with sufficient frequency as to maintain the necessary degree of accuracy during all normal vehicle operation.*		• Is there a need to trigger the on-board algorithm or check latest timestamp to verify frequency? • Reference to Annex 2 in Part A flow chart with 50% SoC swing could be understood that this may be the algorithm activation threshold.	
5.1	*The on-board SOCE shall have a resolution of at least 1 part in 100 and be used for the purposes of verification as the nearest whole number from 0 to 100.*		• If a manufacturer chooses to give a more precise number with one decimal place, it would be beneficial in terms of accuracy. It shall not be a necessity of rounding to the next whole number. The measured value will be reported anyhow in contrast with three decimal places (chapter 7).	
5.1	*The manufacturer shall make available the most recently determined values of the on-board SOCE via the OBD port and optionally over-the-air (OTA).*		• The way of access to readable over-the-air data shall be described and as simple as possible. • Reference to be made to SAE J1979	

5.1	*For the purposes of consumer information, the manufacturer shall make easily available to the owner of the vehicle the most recently determined value of the SOCE monitor via at least one appropriate method. The resolution and method for the customer values shall be determined in agreement with the authorities. For example:* *(a) dashboard indicator;* *(b) infotainment system;* *(c) remote access (such as via mobile-phone applications).*		• Do those values have a significance for Part A validation or are they completely ignored as for the purpose of verification we choose OBD (and OTA)? • Does the laboratory/TS have to check/document those used methods for consumer information and cross-check values for compliance? We´d support that.	
5.2	*A manufacturer may elect to declare a Declared Performance Requirement (DPRi) having an SOCE value that is higher than that of the corresponding MPR. The DPRi shall then replace the MPRi for the purposes of determining compliance by that manufacturer.*		• DPRi are declared in vehicle documents as a reference to specific Part B families? • Are those DPRi accessible by consumers and 3rd parties (e.g. laboratories)?	

6.	***In-Use Verification***			
6.1	*Vehicles having the same characteristics with respect to their evaluation under Part A or Part B below shall be grouped into vehicle families for the purpose of compliance verification.*		• Vehicle family could be read as a conjunction of Part A and Part B family. This would lead to a vast number of families. • Those vehicles with regard to their family propositions have to be seamlessly identified on the market. • If characteristic is understood as a design criterion and not including th intended usage/mission profile of the vehicle, it is possible to identify a worst-case configuration, but it is not representative for others.	
6.1	*Families with the same characteristics with respect to compliance verification shall be defined as follows:*		• This must be verifiable at TA and transposed into something analog as PEMS family.	
6.1.1.	*For Part A: Verification of the Monitor*		• Monitor families are set through elements with high influence on proper functionality of SOCE monitors.	
6.1.1.	*(a) Algorithm for estimating on-board SOCE;*		• SW version in description sheet may not match version in a specific point in lifetime. • Manufacturers´ declaration and approval by TS/TAA. • Is an update through an official callback a change in Part A families?	

6.1.1.	*(b) Sensor configuration (for sensors used in determination of SOCE estimates);*		• Sensors used in (a) on a qualitative measure or is the number of sensors relevant? This could be redundant with number of packs in (f). • Different accuracies may lead to many families. • Sensor configuration is highly important for the usage of on-board sensors for measurement.	
6.1.1.	*(c) Characteristics of battery cell which have a non-negligible influence on accuracy of monitor;*		• Same cell chemistry and dimension, but different cell supplier may have an influence on ageing characteristics. • Validation done by cycle performance test of cells?	
6.1.1.	*(e) Declared highest normal charging power or C-rate.*		• Motivation of this item not clear. Highest normal charging only as a parameter for Annex 3 or to reflect different ageing mechanism and uncertainty of sufficient accuracy of monitors. For ageing this could be neglected, and a specific range of average charging power would be more suitable. • As a parameter for Annex 3 it may be allowed to have a range like above as well.	

6.1.1.	*(f) Type of battery (dimensions, type of cell, including format and chemistry, capacity (Ampere-hour), nominal voltage, nominal power, different/several battery configuration (number of cells in series and mode of connection) or different number of battery packs;*		• For different ageing characteristics it is important to differentiate between cell chemistries. • Batteries age dependent on C-Rate at charging and discharging. The algorithm needs to cover both high and low stress and therefore a high and low demanding configuration could be addressed in a worst and best (like VL and VH for passenger cars).	
6.1.1.	*(g) Test procedure for vehicle type*		• Since there is no conversion factor existing, this is a must have. • Driving cycle and boundary conditions as similar as possible.	
6.1.2.	*For Part B: Verification of Battery Durability*		• Elements with significant influence on battery performance deterioration.	
6.1.2.	*(a) Declared maximum charging powerDeclared highest normal charging power or C-rate.. Type and number of electric machines, including net power, construction type (asynchronous/ synchronous, etc.), and any other characteristics having a non-negligible influence on battery durability;*		• Construction type may be deleted. • Number of machines leads to potentially higher consumption and recuperation of energy, which could then affect battery durability.	
6.1.2.	*(b) Type of battery (dimensions, type of cell, including format and chemistry, capacity (Ampere-hour), nominal voltage, nominal power;*		• Always on the whole vehicle level including all traction batteries. Manufacturer must confirm that cells of different suppliers have similar ageing characteristics.	

6.1.2.	*(c) Battery management system (BMS) (with regards to battery durability monitoring and estimations);*		• HW and SW Version or comparison of functional design?	
6.1.2.	*(d) Passive and active thermal management of the battery;*		• Easy to detect and important to distinguish.	
6.1.2.	*(e) Type of electric energy converter between the electric machine and battery, between the recharge-plug-in and battery, and any other characteristics having a non-negligible influence on battery durability;*		• How is the non-negligible influence to be evaluated and confirmed?	
6.1.2.	*(f) Operation strategy of all components influencing the battery durability;*		• This is hard to validate as the strategy can be judged from many perspectives in a different manner. Operating strategies can differ in separate driving modes. This would then be the default strategy?	
6.1.2.	*(g) Declared highest normal charging power or C-rate..*		• Highest normal charging power may be the wrong element to address durability. A single maximum charging power could result in a great number of families but is more adequate than “normal”. • We would suggest a certain range of 30 min charging power or average charging power between 10 to 80% SOC or within 45 minutes (e.g., 150-300 kW).	

6.1.3.	*Part C family to be defined if needed*		• Necessary to reduce test burden. V2X systems with same characteristics could be validated at Type Approval. Criterion could be sensor configuration (location and characteristics) and if postprocessed SW version/algorithm.	
6.2	*annual report on relevant warranty claims; and annual statistics on repairs for both batteries and other systems that might influence the electric energy consumption of the vehicle.*		• This would be helpful for Test laboratories in terms of vehicle search and survey assessment.	
6.3	***Part A: Verification of SOCE monitor***			
6.3.1.	*The manufacturer shall complete the procedure for in-use verification for Part A with a frequency agreed with the authorities, [until 5 or 8 years] as defined in paragraph 5.2. after the last vehicle of each monitor family is sold and report the results of the verification to the authorities*		• For us as a Laboratory it will be important to have a manageable way of vehicle sourcing. • Frequency shall be aligned with market penetration. • Initial measurement for every monitor family during TA according to Annex 3 1.3? This must be elaborated further.	

6.3.1.	*With the agreement of all Contracting Parties involved, the verification of Part A for vehicles in the same monitor family may be combined between different Contracting Parties. In such cases the relevant Contracting Parties shall be considered as a single authority for the purposes of this verification.*		• First-time approach across different CPs / legal entities. Maintaining comparability is challenging. Individual market requirements for vehicle type/use vary significantly in some cases. Not yet implemented in other regulations. Due to differences in the test procedure (characteristic regional speed, payloads), comparability cannot necessarily be guaranteed.	
6.3.2.	*Verification procedure*			
6.3.2.	*In order to verify the SOCE monitor, the value for the usable battery energy shall be measured at the time of the verification and the related value from the monitor shall be collected before the verification test procedure*		• Value to be read before precon? This should be defined more precisely to get the correct reference value. Figure 1 may lead to that assumption.	
6.3.2.	*In cases where $UBE_{measured}$ is higher than the $UBE_{certified}$, the SOCEmeasured shall be set to 100 per cent.*		• Boundary conditions and system thresholds are as identical as possible at certification and in-use verification. Could the declared $UBE_{certified}$ be artificially worsened and $UBE_{declared} < UBE_{certified}$? Items of family criteria must be kept the same and frozen, unless approved by TS/TAA.	

6.3.2.	*The vehicle selected during type approval to verify the SOCE monitor shall be a vehicle corresponding to the lowest cycle energy demand configuration within Part B family.*		• The monitors are already verified during Type Approval? This is a difference to GTR22 for passenger cars but would be beneficial to have an initial conformity of monitors. • Highest cycle energy demand would be benefitial as it should shorten testing time. For $UBE_{certified}$ measurement we need to have every Part A family covered (e.g. (f) is critical). We assume to have possibly more than one Part B family in every Part A family but to reduce the test burden only one Part B family within the Part A family is selected for testing for Type Approval.	
6.3.2.	*In the case in which the number of tests is less than the number of the categories, then "more than one vehicle selection is not allowed from the same category". In the case in which the number of tests is equal to or greater than of the number of the categories, then "at least one vehicle shall be selected from each category"*		• Again, we see challenges in vehicle sourcing and need supporting documents like a Part A family declaration in CoC or Transparency List to simplify vehicle procurement.	

6.3.3.	*An adequate number of vehicles [(at least 3 and not more than 16)] shall be selected from the same monitor family for testing following a vehicle survey (see Annex 1) which contains information designed to ensure that the vehicle has been properly used and maintained according to the specifications of the manufacturer.*		• This can be a good start for discussion. The number of vehicles in use will be much lower compared to passenger cars. If a specific number of vehicles is required to complete test plan, then those vehicles must be available on the market and usable for ISC.	
6.3.3.	*For each N tests 3 ≤ N ≤ 16, one of the three following decisions can be reached, where the factor A shall be set at 5:*		• Consequence in terms of test size and procedure tolerances to be covered.	
6.4.	*Part B: Verification of Battery Durability*		• No relevance from a test laboratory view • No further comment	
6.5	*Part C: Verification of reported virtual distance*			
6.5.1.	*A verification of the reported virtual distance is only required if the manufacturer is requesting to apply the equivalent virtual distance option.*		• This must be documented somewhere. Is this determined at Type Approval or could this be requested during market rollout? Depending on the process it may be needed to have a digital data verification.	

6.5.1.	*In order to verify the virtual distance read from the vehicle, a test shall be performed with adequate and representative use of the vehicle in V2X or non-traction purposes/PTO, if applicable, to verify whether the increase in virtual distance reported is accurate.*		• Adequate and representative use of the unique vehicle at laboratory or with a presumed usage behavior by the manufacturer. This is strongly dependent on mission profile of the vehicle. We need at least some information about the work and its ratio the vehicle is supposed to do incl. energy flow chart for measurement points.	
6.5.1.	*The total discharge energy during this use shall be measured in order to calculate the measured virtual distance.*		• For PTO we may look at both charged and discharged energy or understand charged energy from PTO as "recuperation".	
6.5.1.	*The verification procedure use case (including the minimum amount of discharged energy corresponding to at least 50 km virtual distance.*		• Suggestion to choose another metric. The conversion to 50 km could be avoided to facilitate the procedure. Small percentage of total energy may be sufficient and measured energy shall be compared with delta of value 6 of Annex 2. Conversion to virtual distance (value 5, Annex 2) can be done as paperwork with selected conversion factor (kwh/km) like GTR22 or calculation acc. step 4 of table 4	
Figure 1	*Flow Chart Part A* *Exclude from sampling* ***Or update the monitor by procedure in vehicle survey***		• Update of monitor is only applicable for vehicle survey item "Was the vehicle not charged adequately* for the last month".	

Annex 1	*Vehicle Survey*			
Annex 1	*Is the vehicle either HD-PEV or HD-OVC-HEV?* *If no: the vehicle cannot be selected*		• This is a family criterion and shall be checked and reported as well although we have no hard position on that.	
Annex 1	*Energy capacity and type of battery*		• This item needs to be documented adequately in vehicle documentation (total rated energy capacity).	
Annex 1	*Was the propulsion battery changed or repaired?* *If yes, the vehicle cannot be selected for testing, but information should be collected*		• Only vehicle survey information or read-out and documentation of SOCE monitor? This may not be worth anything as one does not know whether it still works accurately.	
Annex 1	*Was any dynamic charging technology, such as, wireless power transfer, ground-rail, overhead trolley, overhead pantograph used to charge the vehicle?* *If yes, the vehicle cannot be selected.*		• Why would this be an exclusion criterion if max. power is comparable classic conductive charging? • If a conductive DC charging plug (e.g., CCS) is usable, the test can be performed.	

Annex 1	*Was the vehicle not charged adequately* for the last month?* *If the vehicle was not charged adequately for the last month (as evidenced by values read from the vehicle under point 9, Annex 2) and the tester wishes to use it for testing, then it has to be conditioned by driving the vehicle no less than 50 km and in a manner that results in discharge of at least 50 per cent of the usable capacity of the battery, followed by a full recharge.* *Note: * Adequately in this sense means that the vehicle was not charged in a manner that would lead to an accurate SOCE*		• 50 km and at least 50% SoC swing won´t fit to HDV. Is it allowed to use PTO during driving to decrease driving distance to discharge the battery?	
Annex 2	*Values to be read from vehicles:*		• As understood those values are unique vehicle values and no values to facilitate the confirmation of any family criterion to be sure to have the right vehicle.	
Annex 2	*3.Date of manufacture of the vehicle*		• Is this item also to be found in vehicle documents?	

1	*Part A Test procedure and determination of performance parameters*			
1.1	*Vehicle selection*		• For TA: Comment @6.3.2 • For ISC: Reg (EU) 2018/1832, Article 5.7.: Selection of vehicles for ISC Testing, this can be an orientation as experience is quite good.	
1.2	*Measurement requirements (A3/1)*			
1.2	*Electrical voltage*		• Accuracy and Resolution is similar to ECE-R154. • To measure the voltage with external measuring equipment we need, ideally provided by the manufacturer, measurement breakout boxes to have predetermined measurement points. An overview of energy flow, safety instructions and provisions where those measurement point were at Type Approval. • Calibration interval shall be defined additionally	
1.2	*Electrical current*		• Same as voltage, but additionally the manufacturer must provide information about de-shielding of cables in a preferably non-destructive way.	
1.21.2 new	*Wind velocity*		• From RDE provisions (method 1a, 1b)	

1.3	*Determination of $UBE_{certified}$* *The UBEcertified is the usable REESS energy determined according to the paragraph 2. of this Annex. The same battery discharging test must be applied at type approval and during in-service testing.]*		• We need to know whether the $UBE_{certified}$ is the measured UBE at Type Approval or may be adjusted with factor or the manufacturer may declare a lower UBE as the measured value. • At this point we don´t see enough evidence to be able to convert $UBE_{certified}$ from method 1a to method 1b. This is why we would also stick to the wording, that the procedure must be kept the same. • The value itself must be declared. We don´t have UBE in vehicle documentation so far. • The manufacturer may choose to apply more than one method for certification to get flexibility for in-service testing.	
2.	*If a bidirectional charging system is not available on board of the HD-PEVs or HD-OVC-HEVs Method 1a and Method 1b shall be applied*	Replace “and” with an “or”	• Both test procedures need to be applied or is it possible to choose either one of them?	
2.	*If a bidirectional charging system is available on board of the HD-PEVs or HD-OVC-HEVs Method 2 shall be applied .*		• This would mean that the default test procedure would be Method 2 for vehicles with V2X functionality. If this is defined as the pre-chosen procedure, we´d suggest allowing to choose another suitable test procedure (like 1a or 1b), in discussion with TAA.	

2.	*The cycles test method by using HD chassis dynamometer is an alternative method proven given on the equivalency of the results with the other methods .*		• How shall this be proven and who is responsible for the evidence? • Without technical evidence we would not confirm that methods 1a, 1b and 2 are equivalent to each other.	
Table A3/2	*"and charge" for 1a and 1b*		• This is obviously needed to be able to recover the vehicle, but is this necessarily a part of the test method? • Due to intended repetitions this would be the same charging procedure as before the test.	
Table A3/2	*HDV Dyno testing with similar driving characteristics*		• Similar driving characteristics can only be transferred from 1a, but method 1b has many uncertainties, that come with performing the test. Depending on the charging/discharging profile method 2 and its specific c-rate progression could be recreated on a HDV CD.	
2.1 Method 1 HD-PEVs or HD-OVC-HEVs without bidirectional charging system available				
2.1.1.	*Method 1a Discharge by standard average speed with tolerances on test track*		• Delete annotation "with tolerances on test track". This shall be covered within description or test sequence figure.	

2.1.1.1.	*[The test track road surface shall be flat, even, clean, dry and free of obstacles or wind barriers that might impede the measurement of the UBE, and its texture and composition shall be representative of current urban and highway road surfaces, i.e. no airstrip-specific surface].*		• We have similar requirements for AirDrag (2017/2400, 2022/1379) 3.1.8. • "free of obstacles or wind barriers" shall be described more detailed like in Reg (EU) 2022/1379.	
2.1.1.1.1.	*The total trip distance as calculated from the corrected GPS data shall deviate by no more than 4 % from the reference.*		• Probably fine enough. For PEMS we have 2% as a requirement and therefore 4% is achievable.	
2.1.1.1.1.	*(c) the ECU; if vehicle speed is determined by the ECU, the total trip distance as determined by the ECU can be compared with a reference distance obtained from a digital road network or topographic map. The total trip distance determined by the ECU shall deviate by no more than 4 % from the reference.*	GPS should be the master to which the test speed should refer.	• We recommend a comparison between the ECU and GPS. If the speedometer deviation is large, it makes a big difference whether the vehicle is travelling at 88 or 92 km/h.	

2.1.1.1.2.	*Test room*		• Not every proving ground has a separate test room for lorries, even if they are usually not conditioned to have a constant temperature. • Temperature threshold limitation [16-30°C] is probably wide enough to stay within for most of the time during a year in Germany. For other climatic regions it might be challenging. Considered test time is very long (soak, precon, soak+charging, test execution) and may lead to challenges.	
2.1.1.1.4	*Soak area*		• Same as for test room	
2.1.1.1.6	*• Battery cell temperature normally distributed with average temperature at Y C and variance <Z*	• For the average value, the cell temperature of the coolest/hottest cell would also be interesting, as this normally influences the performance of the battery.	• Those values are not required for conducting the test. The mentioned values (temperature, SOC, DoD) can be helpful for the interpretation of failed families, but then should be part of the vehicle survey.	
2.1.1.1.7.	*[The test vehicle shall be instrumented with measurement devices for measuring the necessary input values for the UBE calculation (voltage and electrical current).*		• Measurement accuracy requirements are mentioned in 1.2, but calibration interval shall be defined additionally.	

2.1.1.1.7.	*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 1.2. of this annex].*		• Contracting Party/TAA must define a process for the validation of on-board measurement data. • This can be similar to an OBD acceptance test, where the accuracy of the measurement signals must be checked. • Demonstration that the equivalence is given for new vehicles (TA) and aged vehicles with SW-update history (ISC).	
2.1.1.2.1.	*Having more than one driver is permitted to comply with the short resting time needed to maintain the conditioning of the batteries.*		• May not be that critical on a private test track. There are maybe separate requirements by proving ground rules, but for on-road testing it is highly important.	
Table A3/3	*Shall be based on the manufacturer's recommendation or regional authority*		• Value, which is lower, shall be chosen.	

2.1.1.2.4.	*[For HD-PEVs and HD-OVC-HEVs, prior to or during vehicle soak (paragraph 2.1.1.2.5. of this annex), the REESS shall be charged/discharged to an initial SOC equal or less than [10%] as declared by the manufacturer. At the request of the manufacturer, with the approval of the responsible authority and with appropriate technical justification, the manufacturer may specify a different initial SOC of the REESS].* *The initial charge/discharge of the REESS shall be conducted at an ambient temperature [of 23 ± 7 °C] if performed in a test room or soak area.*		• The initial setting of REESS must be conducted once and not in case of test repetitions. • A temperature-controlled hall with additional DC-charging station could lead to difficulties (Fire protection could become critical depending on battery size and facility requirements).	
2.1.1.2.5.	*The vehicle shall be installed for the preconditioning, if the battery discharge will be performed by driving in a test room.*		• This can only be performed on a Heavy Duty Chassis dyno in a test room. • Availability of proving grounds with a HDV chassis dyno is a problem.	

2.1.1.2.5.	*The break-off criterion is reached when the vehicle exceeds the driving speed tolerance for 4 consecutive seconds or more. The accelerator control shall be deactivated.*		• Vehicle speed for both segments (100%-10%, < 10%) need to be defined to execute the test. • Criterion for switch to driving on target speed not fully described (<10% SOC only in Figure A3/1). • Break-off criterion for first segment (e.g. at max. speed of 90 km/h) must not be met with SOC higher than 10%. • Deactivation of accelerator control could be safety relevant. We suggest a similar approach to method 1b with discharging below a certain SOC by using auxiliary systems.	
2.1.1.2.5.	*The vehicle shall be braked to standstill within 60 seconds.]*		• The vehicle may then still be on the test track. There should normally be enough energy left in the battery to get back to the nearby charging station, but there is no guarantee for it. • 60 seconds is short depending on track position.	
2.1.1.2.5.	*If necessary to operate properly the vehicle, the vehicle's testing operation mode shall be activated by using the manufacturer's instruction*		• Default mode or standard mode unless test sequence is not fully practicable. • Information about changes due to testing operation mode are required.	
2.1.1.2.5.	*The vehicle's testing operation mode shall not activate, modulate, delay or deactivate the operation of any part that affects the battery energy throughput under the test conditions.*		• The vehicle will most likely switch to ECO mode automatically at some point. • To do this, the manufacturer would have to provide information on which SOC level additional settings are prescribed.	

2.1.1.2.5.	*It is allowed to operate a battery internal or external pre-warming system if available, recording the energy consumption*		• Why does there need to be an external warm-up process for the vehicle if the temperature conditions are clearly regulated and within a "standardized" framework? • Why is it necessary to record the energy consumption?	
2.1.1.2.5.	*The REESS shall not be charged during the soak period.*		• The battery can be significantly discharged within 9-36 hours by auxiliary consumers (not favorable for certain battery systems) • It shall be prevented that DTCs are set due to low energy level and corrupt the test execution.	
2.1.1.2.6.	*The end of charge criterion is reached when a fully charged REESS is detected by the on-board or external instruments.*		• What about the calibration/balancing of the individual packs? There may be a small deviation between packs. • For that reason, the vehicle control shall terminate charging process and not be terminated by a single REESS voltage measured by external instruments.	

2.1.1.2.7	*Method 1a test*			
2.1.1.2.7	*[The actual test run shall start within a period of 1 hour after the disconnection of the vehicle from the grid, otherwise the preconditioning and charge shall be repeated].* *[The test shall be carried out on a test track with the regional characteristic speeds and payload per Gross Vehicle Weight (GVW) and Gross Combination Weight (GCW) in agreement with the responsible authorities.*		• Test run shall start as fast as possible, but within a period of 1 hour. • From EURO VI PEMS Regulation 582/2011: The vehicle payload shall be 50-60 % of the maximum vehicle payload. A deviation from that range may be agreed with the approval authority. The reason for such a deviation shall be indicated in the test report. The additional requirements set out in Annex II shall apply.	
2.1.1.2.7	*[During the test, the speed can be controlled manually or by cruise control system if available.]* *The acceleration and deceleration during vehicle speed change shall be smooth and accomplished within the range ± [0.5-1] km/h/sec*		• Very difficult to implement as a driver and extremely dependent on pedal characteristics. • In order to prevent invalid test sequences, the tolerance could be increased or this requirement is meant as a recommendation and not as a mandatory pass/fail criterion.	

2.1.1.2.7	*Tolerance in the UBE measured?* *Pre-warming of the battery in cold environment with measurement of the energy?* *from RDE moderate conditions (0 to 35 C) ?*		• Ohmic resistances in HV cables and electrochemical properties of the battery could have an influence on the result / measurement of UBE. • Temperature will be influenced by internal factors (thermal management, load) and not necessarily by ambient temperature.	
2.1.1.2.7	*The break-off criterion is reached when the vehicle exceeds the driving speed tolerance for 4 consecutive seconds or more. The accelerator control shall be deactivated.*		• Vehicle speed for both segments (100%-10%, < 10%) need to be defined to execute the test. • Criterion for switch to driving on target speed not fully described (<10% SOC only in Figure A3/1). • Break-off criterion for first segment (e.g., at max. speed of 90 km/h) must not be met with SOC higher than 10%. • Deactivation of accelerator control could be safety relevant. We suggest a similar approach to method 1b with discharging below a certain SOC by using auxiliary systems.	
2.1.1.2.7	*The vehicle shall be braked to standstill within 60 seconds.]*		• When is the end of UBE measurement? Right after standstill or additional discharge by auxiliaries to be comparable to method 1b?	

2.1.1.2.7	*The REESS shall be fully charged with the highest normal charging power available [≤150kW] as defined in paragraph 6.1.1 of this GTR]. The end of charge criterion is reached when a fully charged REESS is detected by the on-board or external instruments.*		• This shall be aligned with 2.1.1.2.6. to compare both charging processes and use this procedure for repetitions. • Charging behavior with focus on balancing is expected to be similar.	
2.1.1.2.7	*[If the selected power charging does not allow to reach the full charged status of the battery due to battery protection systems, it is allowed to complete the charging by applying a slower charging* ***with/without waiting time*** *between the two charging modes.]*		• Definition of waiting time (max time limitation) including re-connection is required. • Is the change from DC to AC charging allowed? This shall be defined.	
2.1.1.2.8	*Repetition of Method 1a test*		• For the testing of one identical vehicle this should only be done for accuracy reason to examine reproducibility in early stages of the GTR application • The tolerance of ±0.050 kWh is very low and a percentage value might be more appropriate. This tolerance can hardly be maintained.	
2.1.2	*Method 1b*		• Every general comment regarding the previous method 1a is equal to method 1b apart of the comments below. • We would suggest to merge similar items instead of just creating a lot of redundancies.	

2.1.2.1.	*[The road surface shall be flat, even, clean, dry and free of obstacles or wind barriers that might impede the measurement of the UBE, and its texture and composition shall be representative of current urban and highway road surfaces, i.e. no airstrip-specific surface].*		• Those detailed general requirements are not applicable for on-road testing on public roads. • There shall be a tolerance on those prerequisites (i.e. topological structure of route).	
2.1.2.2.7.	If the battery is not completely depleting driving on road for safety reason, the battery shall be discharged by the auxiliaries system up to the warning indication on the vehicle dash board to stop the discharge.]		• Below a certain SOC percentage the vehicle wont be able to keep up the regional characteristic speed and then switch to target speed (e.g. motorway to rural/urban road). • Explanation of manufacturer needed on which SOC level the vehicle could be driven safely on a specific target speed and when limp mode or turtle mode are activated with the corresponding speed limitation and remaining driving range. • Violation of traffic safety must be ruled out. • Below a predefined SOC (maintaining target speed becomes critical) the vehicle must be stopped at charging station and the last [x] percent SOC shall be depleted by auxiliary-system. • Warning indication is corresponding with SOC level and maybe not equal to break-off criterion of method 1a. Equivalence for end of discharge criterion shall be met.	

2.1.2.2.7.	The acceleration and deceleration during vehicle speed change shall be as smooth as possible in relation to traffic conditions and safety of driving and accomplished within the range ±[0.5-1]km/h/sec. .		• Very difficult to implement as a driver and extremely dependend on pedal characteristics and traffic. • Driving assistant systems may intervene (e.g. ACC, EBA) and de-/acceleration may be higher than required.	
2.1.2.2.7.	To account for on road driving effects on the battery power request that can influence the UBE measurement, such as for example road grading,… correction factors may be applied in agreement with the responsible authorities.]		• In conflict with 2.1.2.1. regarding surface profile. • Recording altitude profile with GPS for correction in agreement with TAA.	
2.1.2.2.7.	Pre-warming of the battery in cold environment with measurement of the energy? from RDE moderate conditions (0 to 35 C) ?		• After preconditioning not necessary. • In advance of the test sequence the time for precon and soak in a temperature-controlled environment is sufficient. • During test battery pack temperature is relevant and not ambient temperature.	

2.1.2.2.7.	The end of discharge criterion is reached when the break-off criterion is met. If the battery is fully depleted by driving on-road, the break-off criterion is reached when the vehicle exceeds the driving speed tolerance for 4 consecutive seconds or more. The accelerator control shall be deactivated. The vehicle shall be braked to standstill within 60 seconds.		• Shall be deleted because it is not applicable for method 1b.	
2.2	*Method 2 HD-PEVs or HD-OVC-HEVs with bidirectional charging system available*			
2.2.1.	*A Virtual Round Trip Efficiency (VRTE) test (fully discharge –fully charge cycle) at certification and in Part A should be applied via the charging port. This can be done with a [bidirectional charging unit as per this paragraph.]] after pre-conditioning.*		• Is this going to be implemented as a separate test case in vehicle charging communication (ISO 15118)? • Especially for discharging we need a specific vehicle discharge mode without default and not customisable SoC limitations.	

2.2.1.	*[The manufactures shall guarantee that all the traction batteries installed on the vehicle are engaged during the VRTE tes t to determine the Usable Battery Energy (UBE) certified and measured.]*		• All traction batteries must perform in the same operating limits compared to driving mode.	
2.2.1.	*[A bidirectional power supply is a power converter that can convert DC and AC power bi-directionally to any power system. It supports both DC and AC by mounting a bidirectional DC/DC converter and a bidirectional AC/DC converter inside.]*		• Specifications of those converters need to be decribed. • At what voltage level shall be charged/discharged in cases where different vehicle-based voltage levels can be used. (400V vs. 800V vs …) • Energy efficiency of OBC and further EE-components to be measured or neglected?	
2.2.1.1.	*Test room* *If a test room is required to perform the tests as described in paragraph 3.1 to 3.3., the The test cell shall have a temperature set point of [23] °C. The tolerance of the actual value shall be within ±5 7 °C.*		• Makes sense to define a temperature tolerance, to keep deviation between TA and ISC low. • Testing outside or even on public ground with public charging infrastructure can´t be an option. • 23°C +-7°C seems to be legit.	
2.2.1.2.	*Cooling fan […]* *A cooling fan shall be active if required to perform the tests as described in paragraph 2.2.2.5 to 2.2.2.10, if applicable.*		• To reduce stress for Traction batteries and increase thermal management performance influenced by boundary conditions this could be helpful to keep a constant discharge performance. During charging process, we will see derating anyway.	

2.2.1.4.	*Measurement frequency* *All the items in Table A3/1 of paragraph 1.2. of this annex, unless specified otherwise in the table, shall be measured and recorded at a frequency equal to or greater than [0.033 Hz] discharging and charging.*		• Same as above in 1.2 and 2.1.1.1.7.	
2.2.1.5.	*Required information* *The manufacturer shall provide the following information required to conduct the test procedure.* *[Boundary conditions that qualify vehicle for testing* *• Battery cellcell temperature normally distributed with average temperature at Y C and variance <Z* *• Average SOC normally distributed with average value Y*% and variance <Z** *• Depth of discharge (DoD) : share of cycles with DoD >Y**% must be below Z**%]*		• If necessary this shall be included by Annex 2, if relevant for V2X. • The vehicle controls the test procedure and we don´t see the need to have this boundary conditions. The first item might be used as a reference to identify abnormal battery behavior during test.	

2.2.1.5.	*The manufacturer shall specify if a VRTE operation mode shall be set at vehicle level for performing the test.*		• This is important and the manufacturer shall present, that the operation window for bidi-discharging is identical to driving.	
2.2.1.6.	*The discharge and charge energy shall be measured at the battery to avoid combined battery-inverter efficiency and energy losses .*		• This will produce high measurement costs as we need breakout boxes for every battery. If possible, it would be beneficial to measure voltage on the common high voltage bus and current at every battery if necessary. • Charge energy only necessary for RTE, not for UBE measurement. • Same as before we do need an energy flow diagram with measurement points.	
2.2.1.6.	*[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].*		• We suggest using family definitions with certain technical evidence, that unnecessarily high measurement verification burden may be omitted.	
2.2.1.7.	*The manufacturer shall specify the normal operating range for each operational metric listed in [paragraph 2.2.2.1. of this annex].*		• Important to allow a transparent test execution. • This may also justify the need of a specific certification test mode with lower SoC thresholds for V2X. • Explanation of operational modes for battery discharge (e.g. limp mode/turtle mode) to have a common basis for a comparison with other test methods.	

2.2.2.1.	(b) battery SOC		• Battery SOC from BMS, but also dashboard SOC.	
2.2.2.2.	*[HD-PEVs shall have been run-in at least [300 km] or one full charge distance, whichever is longer.]*		• Due to formation processes within the REESS it may be beneficial to allow even more than one full charge distance if requested by manufacturer.	
2.2.2.3.	*The measurement devices shall be installed at suitable position(s) within the vehicle.*		• Measurement points shall be proposed by manufacturer and confirmed by TS/TAA.	
2.2.2.4.	*The initial charge/discharge of the REESS shall be conducted at an ambient temperature [of 23 ± 5 7 °C] if performed in a test room or soak area.*		• We don´t see an option to perform the initial REESS setting during soak outside of a room with temperature control.	
2.2.2.5.	*The REESS shall be conditioned by applying a full discharge followed by a full charge at normal charge [as defined in paragraph 6.1.1 of this GTR].*		• Constant charging at predetermined charging power may be prohibited by vehicle at high SOC levels.	
2.2.2.5.	*The REESS of the vehicle shall be discharged, left stabilised for [minimum of 9 hours] and then fully charged and left stabilized for a minimum of [30] minutes and maximum [1h]*		• Full discharge until vehicle aborts discharge or until SOC dashboard is 0%. • SOC estimation algorithm works differently for every manufacturer. As for now re-charging after stabilization is not allowed although SOC could be <100% due to recalculation. • Start of UBE measurement right after disconnection of charging plug.	

2.2.2.5.	*The manufacturer shall provide the responsible authority a list of the deactivated devices and justification for the deactivation. The bidirectional charge operation mode shall be approved by the responsible authority and the use of a bidirectional charge operation mode shall be recorded.*		• Is this also to be presented to test laboratory? • Deactivated devices may not harm SOCE estimation for the record of the SOCE after verification test.	
2.2.2.5.	*The vehicle's bidirectional charge operation mode shall not activate, modulate, delay or deactivate the operation of any part that affects the battery energy throughput under the test conditions .*		• In contrast there may be a need to manipulate the customer bidi mode to have the same SOC threshold limits for UBE determination as in driving mode.	
2.2.2.5.	*[This first battery discharge shall be performed [according to manufacturer's recommendation or given speed or C-rate]. The manufacturer will guarantee that the REESS is as fully depleted as possible by the discharge test procedure.]*		• Discharge until a predefined on-board SOC value is archieved or calculate the SOC with voltage measurement and OCV table. • Full depletion may not be equally possible with different discharge test procedure (driving vs. stationary discharge).	

2.2.2.5.	*[The end of discharge criterion is reached when the break-off criterion is met. The break-off criterion is reached when the vehicle exceeds the driving speed tolerance for 4 consecutive seconds or more. The accelerator control shall be deactivated. The vehicle shall be braked to standstill within 60 seconds.]*		• Depending on the driving speed this won´t be the fully depleted condition we are looking for. • Only possible on Chassis Dyno.	
2.2.2.5.	*the | 〖ΔE〗_(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. The manufacturer shall provide evidence to the responsible authority after the test that this requirement is fulfilled.*		• This must be simplified. Only for OVC-HEV relevant. • Duration should be quantified.	
2.2.2.5.	*It is allowed to operate a battery internal or external pre-warming system if available, recording the energy consumption.*		• This will then be added to the measured UBE during verification? External pre-warming still means vehicle own pre-warming system. Energy consumption of external systems outside the vehicle must be neglected. • Pre-warming for 9 hours soak time may reduce SOC level further than expected and may lead to OBD faults. • Internal pre-warming will probably be deactivated after reaching break-off criterion.	

2.2.2.6.	*Vehicle Charge*			
2.2.2.6.	*The battery can be recharged with the bidirectional charging system or a charging station.*			
2.2.2.6.	*[The battery shall be charged at full with the highest normal charging power available according to vehicle specification [≤150kW] [as defined in paragraph 6.1.1.] by the bidirectional charging system or a charging station. Record the charge current and voltage and the elapsed time required to reach the fully charge battery.*		• This will be hardly manageable because there will be derating at high SOC. • Charge current and voltage measurement requirement same as in 1.2 and measurement on vehicle measurement points. • Charging profile shall be provided by manufacturer.	
2.2.2.6.	*[Fully charged battery status shall be reached. If the selected power/C-rate charging does not allow to reach the full charged status of the battery due to battery protection systems, it is allowed to complete the charging by applying a slower charging with/without waiting time between the two charging modes.]*		• In one charging process this might work, but if there is more than one charging process it might be necessary to turn Ignition-off to disconnect on vehicle side or to abort charging on infrastructure side following manufacturer instructions to allow another charge on vehicle side. A new SOC calculation might be the result of that.	

2.2.2.6.	*[In the case in which the charge is performed with the bi-directional power supply the battery shall be charged at full at constant power/C-rate equal or less than C/5, according to operating limits and the highest normal charging power available according to vehicle specification [≤150kW] [as defined in paragraph 6.1.1.of this GTR].*		• This is also written above, but without the C-rate limitations equal or less than C/5. • This could be a contradiction with the value “highest normal charging power” of 6.1.1. • This paragraph might be deleted if previous paragraph is supplemented with C-Rate definitions.	
2.2.2.6.	*[Fully charged battery status shall be reached. If the battery is recharged with a charging station and the selected power/c-rate charging does not allow to reach the full charged status of the battery due to battery protection systems, it is allowed to complete the charging by applying a slower charging with/without waiting time between the two charging modes.]*	~~[Fully charged battery status shall be reached. If the battery is recharged with a charging station and the selected power/c-rate charging does not allow to reach the full charged status of the battery due to battery protection systems, it is allowed to complete the charging by applying a slower charging with/without waiting time between the two charging modes.]~~	• This is redundant	

2.2.2.7.	*Method 2 VRTE test*			
2.2.2.7.	*[The actual test run shall start within a period of 1 hour after the disconnection of the vehicle from the grid, otherwise the preconditioning and charge shall be repeated].*		• Shall start as soon as possible but within a period of 1 hour. • The Ignition of the vehicle is not activated before and during test run. This might harm the charging process. • Vehicle can´t be moved.	
2.2.2.7.	*If the same instrument is used both for charging and discharging the battery of the vehicle, the actual test run shall start within a period of 1 hour after the setting of the bi-directional charging system in the discharging mode].*		• Disconnection allowed or could it stay connected to the bi-directional charging supply? This will be influenced by vehicle behavior. • The procedure how to initiate and customize the discharge process by the vehicle must be described by the manufacturer.	
2.2.2.7.	*[The battery shall be fully discharged at constant power].*		• Constant power is not feasible over total SOC range. • CCCV discharging or other manufacturer specific profile?	
2.2.2.7.	*[The test shall be carried out with a power range or C-rate range derived from the regional characteristic speed and payload per Gross Vehicle Weight (GVW) and Gross Combination Weight (GCW) in agreement with the responsible authorities as in Method 1a.*		• This must be described more detailed. • The discharge power profile is more important for the result than the maximum normal charging power during soak. • This would lead to a complex test scheme regarding the variety of vehicles and how to validate the derived C-rate? Who will calculate the charging profile and average C-rate?	

2.2.2.7.	*[The battery shall be discharged with [a constant power or constant C-rate within the range of the characteristic regional speeds], and the system shall be able to [duplicate at least minimum and maximum speed].*		• A constant C-rate can only cover minimum OR maximum speed. • Higher C-rate results from acceleration and not constant driving.	
2.2.2.7.	*[Not to have unwanted battery behaviour the corresponding C-rate shall be in the range of [C/6 or less, C/2], otherwise the test shall be repeated.]*		• How to recognise "unwanted" battery behavior? • BMS/EMS operating strategy shall be as near as possible to driving strategy.	
2.2.2.7.	*[The same specified C-rate or vehicle speed should be used during type approval and in-service testing].*		• This has high influence on consistency the $UBE_{measured}$ and SOCE. • It might not be possible to have the same charging profile, but tolerances that come with different C-rates must be discussed and evaluated.	

2.2.2.7.	*The end of discharge criterion is reached when the break-off criterion is met.* *[The break-off criterion is reached when [an indication to stop the vehicle appears on the instrument panel], or [the system cannot maintain the set power any longer].* *[(exceeds the tolerance defined as the power corresponding at the minimum speed of Method1a or 1b for 4 consecutive seconds or more)* *[the system cannot maintain the power any longer] , [Percentage voltage drop].* *Japan: The system [(exceeds the tolerance* for 4 consecutive seconds or more) * : discharge rate @ minimum vehicle speed]*		• Voltage threshold would be one option with apredefined discharge pack voltage to end discharge on EVSE or EV side. • Another option is that the test will be terminated by EV to eliminate uncertainty on charging equipment side. • As boundary conditions are different to methods 1a and 1b, there is no absolute need to stick with 4 second criterion. • End of discharge: situation, which may be applicable to real world usage, e.g., falling below a minimum speed (reference to limp mode strategy of manufacturer). Power requirement at a minimum speed may be minimum C-rate as break-off criterion. • SOC level as a supporting, but not determining break-off criterion.	

2.2.2.7.	*The REESS shall be fully charged with a defined [constant power/C-rate] equal or less than C/5 according to operating limits and the highest normal charging power available [≤150kW] as defined in paragraph 6.1.1 of this GTR].* *The end of charge criterion is reached when a fully charged REESS is detected by the on-board or external instruments.* *[If the selected power/C-rate charging does not allow to reach the full charged status of the battery due to battery protection systems, it is allowed to complete the charging by applying a slower charging power/C-rate with/without waiting time between the two charging modes.]* *The UBEcharge is the total charged energy calculated as described in [paragraph 4. of this annex].* *The full cycle efficiency is calculated by dividing the UBEdischarge by the UBEcharge.*		• No need for these steps as UBE_{charge} is being striked out. • If repetitions are required, the same procedure as for initial charging shall be used.	

2.2.2.7.	*These two steps (discharge and charge) are performed on [new vehicles within a family] to determine the UBEcertified, defined as [UBEdischarge..]*		• $UBE_{certified}$ is defined as $UBE_{discharge}$. • There may be a difference between the UBE at different temperature sets. Lowest vs. highest temperature of test procedure to be evaluated regarding UBE to get more information about temperature influence. • Is it permitted that the declared UBE deviate from measured UBE ($UBE_{discharge}$)?	
2.2.2.8.	*[The RTE test of paragraph 2.2.2.7. of this annex shall be repeated for a total of xx repetitions as shown in Figure A3/4].*		• Repetition shall only be necessary with technical evidence. • If battery or vehicle behavior may lead to abnormalities during test procedure a repetition may performed after discussion with manufacturer and/or TS/TAA.	
2.3.	*Alternative method*		• Availability of Chassis Dynos and variability of vehicle configuration (number of axles, weight per axle, distance between axles, length of vehicles, etc.) lead to many test configurations. • The number of applicable chassis dynamometer is too low.	

2.3.1.1.	*General test requirements*			
2.3.1.1.	*[The equivalence of the method with Method 1a, 1b and 2 shall be demonstrated to the responsible authority.*		• How is this going to be demonstrated? In general, for one sample of vehicles as the reproduction of the discharge curve of Method 1a, 1b or 2? • Is this to be done for every vehicle group?	
2.3.1.1.	*The same battery discharging test must be applied at type approval and during in-service testing.]*		• Same dyno setting regarding road load and identical measurement points. • Test cycle must be identical.	
2.3.1.1.	*[A section of constant speed driving is allowed to stabilise the SOC of the battery during the depleting test]*		• Constant speed segment with characteristic regional speed is necessary to reduce testing time.	
2.3.1.1.1.2.	*The vehicle accelerates to the maximum speed on the test road, puts the transmission in neutral and coastes until the speed is less than 15km/h. Measuring the vehicle fromv2=v+Δv to v1=v-Δv, the required time t1; Where, Δv ≤5km. Repeat in the opposite direction, measuring time t2, Calculate the average of time t1 and t2, that is, time T. Repeat the above tests not less than 3 times, that is, the total number of coasting tests not less than 4 times.*		• It is important to have the harmonic mean of the speed and not the simple average values. • Coast down for HDV is challenging due to vehicle characteristics.	

2.3.1.1.1.4.	*Chassis dynamometer settings*		• F0, F1, and F2 are determined from testing and needed for chassis dyno setting. • This factors and vehicle test mass need to be declared in advance of ISC.	
2.3.1.1.1.5	*a) Having at least two hubs that can be separately coupled to the tires.*		• Why coupling to tyres? If only dynamometers will be allowed, it will be difficult for HDV. What about connecting test bench to axles or wheel hubs?	
2.3.1.1.1.5	*c) With time, speed, driving distance measurement function*		• Accuracy of measurement systems should be defined	
2.3.1.1.1.5	*e) The fan can synchronize with the speed of the car*		• From our point of view minimum requirements for the fan outlet and the maximum deviation from air velocity related to the driving velocity should be defined.	
2.3.1.1.1.6.	*a) Static calibration deviation of driving force in the scope of ±0.1%; LDV*		• The accuracy of the force transducer shall be at least ±10 N for all measured increments.	
2.3.1.1.1.6.	*b) Deviation of basic inertia in the scope of ±0.5%;*		• LDV: 0.5 % or 7.5 kg whichever is the greater for each measured base inertia and ±0.2 % relative to any arithmetic average	
2.3.1.1.1.6.	*c) Deviation of acceleration and deceleration in the scope of ±1%;*		• LDV: response time (90 % response to a tractive effort step change) of less than 100 ms with instantaneous accelerations that are at least 3 m/s^2.	

2.3.1.1.1.6.	*d) When the speed is greater than 10 km/h, the speed measurement deviation should not be greater than ± 0.5 km/h;*		• LDV: ±0.080 km/h	
2.3.1.1.1.6.	*New item*		• f) Speed difference between different rollers/hubs should be defined	
2.3.1.1.1.6.	*[The test shall be carried out in accordance with paragraph 2.3 of this Annex.*		• Either delete this or use reference to test method 2.3.1.2.	
2.3.1.1.5.	*Measurement frequency*		• Accuracy and frequency also known from passenger cars and no problem with it.	
2.3.1.1.6.	*Boundary conditions that qualify vehicle for testing*		• Comments from other test methods are valid for alternative method as well. • If those values are used to qualify the vehicle, they shall be placed at vehicle survey. • No need to have those items to conduct the test procedure.	
2.3.1.1.6.	*The manufacturer shall specify if a testing operation mode shall be set at vehicle level for performing the test.*		• This is important for more than one driven axle and the way to deal with recuperation.	

2.3.1.1.7.	*The discharge and charge energy shall be measured at the battery to avoid combined battery-inverter efficiency and energy losses.*		• Measurement points must be declared by manufacturer and an energy flow diagram is to be provided. • Measurement of voltage on high voltage bus to reduce instrumentation demand. • Measurement of current in both directions to eliminate energy due to recuperation.	
2.3.1.1.7.	*[The on-board measurement data of the current and 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.*		• If equivalency is demonstrated, this would be the most preferable way to conduct the test on customer vehicles for ISC tests. • Current measurement with shielded cables can be misleading and problematic. De-shielding cable can be necessary but difficult for customer owned vehicles as spare parts are needed. • Deviation of CAN and external measurement can be very low (experience for LDV, deviation lower than 0,01%	
2.3.1.2.	*Test sequence*			
2.2.1.2.1.	*The test shall be stopped immediately if warning indicator(s) with regard to the batteries turns on.*		• Warning indicator must be described more detailled. Required signals and thresholds for warning to be presented. This is not meant as break-off criterion but safety relevant.	
2.3.1.2.3.	*The measurement devices shall be installed at suitable position(s) within the vehicle.*		• Measurement points must be described in a suitable manner by manufacturer. • Same measurement positions for TA and ISC test.	

Until 2.3.1.2.7.			• Same comment as for method 1a and 1b	
2.3.1.2.8.2	*Figure A3/6*		• Constant driving speed for mid segment shall be higher and in relation to vehicle category and characteristic regional speed. • If speed is chosen that low the test will consume too much time.	
2.3.1.2.8.3.	*For the constant velocity segments, the speed deviation shall be controlled in the scope of ± 3 km/h.*		• With the use of cruise control this is easy to achieve. If set manually it becomes more challenging the longer the constant segment is, but still there is no problem.	
2.3.1.2.8.4	*For HD-PEVs, [when the vehicle exceeds the driving speed tolerance for 4 consecutive seconds or more. or when the dashboard displays a low battery alarm, which one is occurring first.*		• Low battery alarm is not a strong criterion and could be set at an early stage in the lower SOC area. • 4 second criterion is easy to detect and may occur later.	