Extracts for Proposal for a new UN GTR on In-vehicle Battery Durability for Heavy Duty Electrified Vehicles **2024-04-12**

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
General			**UBC** OICA explained according to many measurement results and assessments, that UBC and SOCC are better parameters in terms of: • Repeatability • Accuracy • Monitor verification **MPR** • Should be defined after/during Monitoring phase • Monitoring phase shall impact MPR value itself	

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General			Wording of Battery and REESS is not consistent in the whole document. It must be assured that the testing will be carried out on (traction) battery level (Definitions of REESS and Battery). For type approval see EVE 68th meeting discussion on pack-level type approval and in-vehicle level Part A + B verification. Declared values from TA might help, too.	
General			**MPR: years or cycles<FCE>** ▪ Should be defined after/during Monitoring phase. ▪ Monitoring phase shall impact MPR value itself MPR criteria should be reviewed too considering Energy Throughput inclusion	

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3.	***Definitions***			
3.*		*"Usable Battery capacity* (UBC)*"* means the capacity by the battery, from the beginning of the test procedure used for certification until the applicable end of test criterion as defined in Annex 3 of this GTR. It also means the difference between the capacity of driven current and the capacity of regenerated current during the discharge process.	• Add UBC definition. See OICA general comment above	
3.4	*"Certified usable battery energy"* ($UBE_{certified}$) refers to the UBE that was determined during the certification of the vehicle, according to Annex 3 of this GTR.	*"Certified usable battery capacity"* ($UBC_{certified}$) refers to the UBC that was determined during the certification of the vehicle, according to Annex 3 of this GTR.	• Change UBE to UBC. See OICA general comment above	
3.5	"Measured usable battery energy" ($UBE_{measured}$) means the UBE determined at the present point in the lifetime of the vehicle by the test procedure used for certification, according to Annex 3 of this GTR.	"Measured usable battery capacity" ($UBC_{measured}$) means the UBC determined at the present point in the lifetime of the vehicle by the test procedure used for certification, according to Annex 3 of this GTR.	• Change UBE to UBC. See OICA general comment above	

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3.6	" UBE_{charge} ~~/Edc~~" means the charging energy at the battery entry and exit points during the charging process, as defined in Annex 3 of this GTR.	" UBC_{charge} ~~/Edc~~" means the charging ~~energy~~ capacity at the battery entry and exit points during the charging process, as defined in Annex 3 of this GTR.		
3.9	*"State of certified energy"* (SOCE) means the measured or on-board UBE performance at a specific point in its lifetime, expressed as a percentage of *the certified usable battery energy.*	*"State of certified capacity"* (SOCC) means the measured or on-board UBC performance at a specific point in its lifetime, expressed as a percentage of *the certified usable battery capacity.*	• Change energy to capacity. See OICA general comment above	
3.11	*"Minimum Performance Requirement" (MPR) means the minimum durability* performance, in terms of SOCE at a specific point in the life of the vehicle, that constitutes compliance with the durability provisions of this GTR.	*"Minimum Performance Requirement" (MPR) means the minimum durability* performance, in terms of SOCC at a specific point in the life of the vehicle, that constitutes compliance with the durability provisions of this GTR.	• Change energy to capacity. See OICA general comment above	

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3.12	*"Declared Performance Requirement"* (DPR) means an SOCE value declared by the manufacturer that is greater than that of the corresponding MPR and which then becomes the minimum durability performance that constitutes compliance of that manufacturer with the durability provisions of this GTR.	*"Declared Performance Requirement"* (DPR) means an SOCC value declared by the manufacturer that is greater than that of the corresponding MPR and which then becomes the minimum durability performance that constitutes compliance of that manufacturer with the durability provisions of this GTR.	• Change energy to capacity. See OICA general comment above	
3.14	*"SOCE monitor"* means an apparatus installed in the vehicle that maintains an estimate of the state of certified energy by means of an algorithm operating on data collected from the vehicle systems.	*"SOCC monitor"* means an apparatus installed in the vehicle that maintains an estimate of the state of certified current capacity by means of an algorithm operating on data collected from the vehicle systems.	• Change energy to capacity. See OICA general comment above	
3.16	*"On-board SOCE"* ($SOCE_{read}$) means an estimate of state of certified energy produced by an SOCE monitor.	*"On-board SOCC"* ($SOCC_{read}$) means an estimate of state of certified capacity produced by an SOCC monitor.	• Change energy to capacity. See OICA general comment above	
3.18	*"Measured SOCE"* means the state of certified energy as determined by the measured usable battery energy divided by the certified usable battery energy.	*"Measured SOCC"* means the state of certified capacity as determined by the measured usable battery capacity divided by the certified usable battery capacity.	• Change energy to capacity. See OICA general comment above	

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3.19	"*V2X*" means the use of the traction batteries to cover external power and energy demand, such as V2G (Vehicle-to-Grid) for grid stabilization by utilising traction batteries, V2F (Vehicle-to-Facility) for utilising traction batteries as factory storage for local optimisation or emergency power sources in times of power failure, V2H (Vehicle-to-Home) for utilizing traction batteries as residential storage for local optimisation or emergency power sources in times of power failure, and V2L (Vehicle-to-Load, only connected loads are supplied) for use in times of power failure and/or outdoor activity in normal times.	"*V2X*" means the use of the traction batteries to cover external power and energy demand, such as V2G (Vehicle-to-Grid) for grid stabilization by utilising traction batteries, V2F (Vehicle-to-Facility) for utilising traction batteries as facility storage for local optimisation or emergency power sources in times of power failure, V2H (Vehicle-to-Home) for utilizing traction batteries as residential storage for local optimisation or emergency power sources in times of power failure, and V2L (Vehicle-to-Load, only connected loads are supplied) for use in times of power failure and/or outdoor activity in normal times.	• Should be removed as Energy Throughput to be used as MPR criteria • V2F means Vehicle-to-Facility, so the batteries shall be facility storage	
3.20	"*Total discharge energy during V2X and/or PTO*" means the total amount of energy in Wh discharged during V2X and/or PTO applications, which needs to be provided according to Annex 2.	"*Total discharge capacity during V2X and/or PTO*" means the total amount of capacity in Ahdischarged during V2X and/or PTO applications, which needs to be provided according to Annex 2.	• Change energy to capacity. See OICA general comment above	

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3.20	*"Total discharge energy during PTO"* means the total amount of energy in Wh discharged during PTO applications, which needs to be provided according to Annex 2	*"Total discharge capacity during PTO"* means the total amount of current capacity in Ah discharged during PTO applications, which needs to be provided according to Annex 2	• Change energy to capacity. See OICA general comment above	
3*		*"Capacity throughput"* is the total amount of current capacity in Ah discharged ~~(or charged)~~ from the battery, which needs to be provided according to Annex 2.	• To be Added • Energy and Capacity Throughput shall be monitored simultaneously	
3*		*"Capacity throughput counter"* means the system including eventual hardware and software that records the amount of current capacity in Ah during all discharge events.	• To be Added • Energy and Capacity Throughput shall be monitored simultaneously	
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.*	• Energy throughput refers to energy charged and discharged.	

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3.23	*3.23 deletion of "Equivalent full charge cycles" definition: no detailed explanation from JP to justify this (why FCE would be an issue vs. energy throughput as this is a normalization of energy throughput)?*	~~"Full-charge Cycles Equivalent (FCE)" means the value obtained when dividing the value of the Capacity throughput with $UBC_{certified}$ rounded according to [paragraph 7] of this GTR~~	• Shall be deleted • Focus on energy Throughput • Prerequisite: vehicle categories for different MPRs must be defined in case of HDV applications • "Verifiability": validation in Part A test at type approval. • Energy and Capacity Throughput shall be monitored simultaneously	
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.*	• See. 6.1.2. • Definition and conditions are not clear, e.g. average performance and temperature range	
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.*		• Focus on energy Throughput • "Verifiability": validation in Part A test at type approval.	

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3.4	*"Certified usable battery energy"* ($UBE_{certified}$) refers to the UBE that was determined during the certification of the vehicle, according to Annex 3 of this GTR.	*"Certified usable battery capacity"* ($UBC_{certified}$) refers to the UBC that was determined during the certification of the vehicle, according to Annex 3 of this GTR.	Change UBE to UBC. See OICA general comment above	
3.5	"Measured usable battery energy" ($UBE_{measured}$) means the UBE determined at the present point in the lifetime of the vehicle by the test procedure used for certification, according to Annex 3 of this GTR.	"Measured usable battery capacity" ($UBC_{measured}$) means the UBC determined at the present point in the lifetime of the vehicle by the test procedure used for certification, according to Annex 3 of this GTR.	Change UBE to UBC. See OICA general comment above	
3.9	*"State of certified energy"* (SOCE) means the measured or on-board UBE performance at a specific point in its lifetime, expressed as a percentage of *the certified usable battery energy.*	*"State of certified capacity"* (SOCC) means the measured or on-board UBC performance at a specific point in its lifetime, expressed as a percentage of *the certified usable battery capacity.*	Change UBE to UBC. See OICA general comment above	

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3**		"*Battery Management System* (BMS)" means the control device that controls the operation and monitors the condition of on-board propulsion battery pack. In other words, it controls the input/output power from the battery during driving and charging/discharging, and monitors the status and detects abnormalities in order to protect the built-in battery cells	Added to the definition to determine full charge and full discharge using BMS.	

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4.	SOCE State of Certified Energy	SOCC State of Certified Capacity	Change energy to capacity. See OICA general comment above	
4.		UBC Usable Battery Capacity	• Add of Abbreviation • Change energy to capacity. See OICA general comment above	

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5.	***Requirements***			

5.1	State-of Certified Energy (SOCE) monitor The manufacturer shall install a SOCE monitor that operates during the life of the vehicle. The SOCE monitor shall maintain an estimate of the state of certified energy (on-board SOCE). The manufacturer shall determine the algorithms by which on-board SOCE is determined for the vehicles they produce. The manufacturer shall update the on-board SOCE with sufficient frequency as to maintain the necessary degree of accuracy during all normal vehicle operation. 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. 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). 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	State-of Certified Capacity (SOCC) monitor The manufacturer shall install a SOCC monitor that operates during the life of the vehicle. The SOCC monitor shall maintain an estimate of the state of certified capacity (on-board SOCC). The manufacturer shall determine the algorithms by which on-board SOCC is determined for the vehicles they produce. The manufacturer shall update the on-board SOCC with sufficient frequency as to maintain the necessary degree of accuracy during all normal vehicle operation. The on-board SOCC 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. The manufacturer shall make available the most recently determined values of the on-board SOCC via the OBD port and optionally over-the-air (OTA). 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 SOCC 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;	Change energy to capacity. See OICA general comment above	

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	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).	(b) infotainment system; (c) remote access (such as via mobile-phone applications).		
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.*		Maybe an update of the process flow in Annex 2 necessary	
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 over-the-air process should be described precisely, but simply, such as access to the data. A reference to internal standards can be helpful.	
5.2	***Battery Performance requirements***			

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5.2	*Battery Performance requirements* *[A SOCE monitor shall be installed on vehicles of categories 1–2 and 2 and their values monitored in view of future amendment of this GTR.]*	*[A SOCC monitor shall be installed on vehicles of categories 1–2 and 2 and their values monitored according to monitoring phase defined in paragraph 6.4.2. in view of future amendment of this GTR.]*	• Monitoring phase requirement according 6.4.2 • Virtual distance shall not be used.	
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.*		• Is the declared SOCE value linked to a conformity document on vehicle level for the B families? • How are the values transmitted? To whom?	

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5.2	*Battery Performance requirements* *At the request of the manufacturer and for vehicles designed with V2X or PTO, the equivalent virtual distance calculated following the equation below will be reported by each vehicle.* *Virtual distance (km)=* *((total discharge energy during V2X [Wh])/(worst case certified energy consumption of PART B family [Wh/km]))*	$Virtual\ distance\ (km) = Odometer\ km \times \left(\frac{total\ discharge\ energy\ - propulsion\ propulsion\ energy}{}\right)$	• If virtual mileage is kept and no energy throughput retained then virtual distance formula shall be updated as • $Virtual\ distance\ (km) = \text{Odometer km} \times \left(\frac{total\ discharge\ energy - propulsion\ energy}{propulsion\ energy}\right)$ • But: Where is the interface? Directly on the e-axle/e-machine or before DC/DC inverters etc.	

5.2	*Battery Performance Requirements* *The battery durability requirements of this GTR are defined in terms of Minimum Performance Requirements (MPR_i), which represent minimum allowable values for SOCE at specific points in the lifetime of the vehicle. Vehicles falling under the categories of HD-OVC-HEVs and HD-PEVs shall meet both of the Minimum Performance Requirements in Tables 1 and 2 below. [The MPRs may differ depending on the category of the vehicle and type of propulsion].* *In order to address regional considerations, a Contracting Party may optionally elect to enforce only one of the two Minimum Performance Requirements (MPR_i) in each of the tables below (i.e. either the one ending at [5] years or [100,000] km, or the one ending at [8] years or [160,000] km).*	*Battery Performance Requirements* *The battery durability requirements of this GTR are defined in terms of Minimum Performance Requirements (MPR_i), which represent minimum allowable values for SOCC at specific points in the lifetime of the vehicle. Vehicles falling under the categories of HD-OVC-HEVs and HD-PEVs shall meet both of the Minimum Performance Requirements in Tables 1 and 2 below. [The MPRs may differ depending on the category of the vehicle and type of propulsion].* *In order to address regional considerations, a Contracting Party may optionally elect to enforce only one of the two Minimum Performance Requirements (MPR_i) in each of the tables below (i.e. either the one ending at [5] years or [100,000] cycles, or the one ending at [8] years or [160,000] cycles).* *Vehicles falling under the categories of HD-OVC-HEVs and HD-PEVs shall meet ~~both of the~~ Minimum Performance Requirements from start of life until years or mileage or energy throughput thresholds (whichever comes first) elected by Contracting Party in order to address regional consideration.*	• Change energy to capacity. See OICA general comment above • And MPR index changed from km to cycles . • The number of [years] and [cycles] need to be discussed. • MPR shall be set according to Contracting Parties regional consideration to group vehicles corresponding to specific customer usage. This should avoid over or under battery capacity specification and lead to relevant compromise between required durability to protect customer from excessive degradation of batteries and acceptable vehicle TCO. • For some specific applications there should still be a possibility to derogate from the MPR and replace batteries within the MPR criteria counted from the date of manufacture of the vehicle.	

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		Provisions for derogations from MPR compliance may be defined per each Contracting Party for certain vehicle categories for which application usage would lead to unnecessary large installed capacity, jeopardizing customers profitability. In that case manufacturers shall apply for a derogation to the Type Approval Authorities and shall compelled with battery replacement under warranty contract within the same criteria as for the corresponding MPR. Manufacturers shall report MPR criteria from the date of manufacture of the vehicle and continue to increment those counters after the battery replacement.		

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Table 1-5 **p11-15**	Table 1 **Battery Energy based (SOCE) MPR** *Vehicle age/km for [categories 1-1 and 1-2] in the scope of this GTR* — *HD-OVC-HEV* — *HD-PEV* From start of life to [5] years or [~~100,000~~] km ~~or~~, whichever comes first and [kWh in monitoring] — [80] per cent — [80] per cent or [] years or [] [kWh], whichever comes first Vehicles more than [5] years or [~~100,000~~] km, and up to whichever comes first of [] years or [] km and [kWh in monitoring] — [70] per cent — [70] per cent or Vehicles more than [] years or [kWh], and up to whichever comes first of [8] years or [~~160,000~~] [km]kWh] *Vehicle age/km for [category 2] in the scope of this GTR* — *HD-OVC-HEV* — *HD-PEV*		• SOCE to be changed to SOCC (tbd.) • FCE-E or FCE-C • It must be noted to what the metric refers • Km virtual distance? • kwH discharged energy, energy throughput? • We would like to suggest to use energy throuput / installed energy instead virtual distance (km). • Throughput must be connected to installed overall battery energy to represent equivalent full cycles • The classes should be clarified: EU classes or UNECE-R classes • Important to have different tables for different vehicle classes	
Table 6		[Table 6] **Battery Capacity based (SOCC) MPR for Class O (semitrailers & trailers)** *Battery capacity based MPR for Class O* — *HD-OVC-HEV* — *HD-PEV* From start of life to [8] years or [1,100] cycles, whichever comes first and [Ah in monitoring] — [65] per cent — [65] per cent Main Vehicle Lifetime: [5,000,000] km In case of the battery was replaced during the vehicle lifetime, reset the memories of the SOCC, capacity throughput and so on in the on-board vehicle's computer when brand-new battery replaces. From replacement of the new one to [8] years or [1,100] cycles, whichever comes first and [Ah in monitoring] — [65] per cent — [65] per cent	Add Tabel 6 MPR for Class O	

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6.	***In-Use Verification***			
6.1	***Definitions of Families***			
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.*		• To reduce test burden for manufacturers and authorities family grouping criteria shall be flexible (example: different number of packs for vehicles in the family) as long as it makes no difference for verification concerned.	
6.1	*Families with the same characteristics with respect to compliance verification shall be defined as follows:*		• Implementation could be carried out in the same way as for the PEMS families during type testing.	
6.1.1.	*(a) Algorithm for estimating on-board SOCE;*	*(a) Algorithm for estimating on-board SOCC;*	• Clarification with technical service sufficient? Authority approval necessary? • Change energy to capacity. See OICA general comment above, replace SOCE with SOCC	
6.1.1.	*(b) Sensor configuration (for sensors used in determination of SOCE estimates);*	*(b) Sensor configuration (for sensors used in determination of SOCC estimates);*	• Sensors with different calibrations/standards could lead to a high number of families. • Multiple sensor combinations could result from the variants of different packs. Different accuracies may lead to many families • Change energy to capacity. See OICA general comment above, replace SOCE with SOCC	

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6.1.1.	*(c) Characteristics of battery cell which have a non-negligible influence on accuracy of monitor;*		• c) "characteristics of cell" to be explained, maybe rather in the definitions section • c) "non-negligible influence" to be explained or deleted • In light of type of batteries c) is still necessary? (Same properties in shape and size as well as cell chemistry, but a different supplier could mean ageing. How is the validation of the different cells carried out?)	
6.1.1.	*(e) Declared highest normal charging power or C-rate.*			
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;*		• b) dimension should be deleted (too vague)	
6.1.1.	*(g) Test procedure for vehicle type*			
6.1.2	***For Part B: Verification of Battery Durability***			

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6.1.2.	*(a) Declared maximum charging power Declared 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;*		• As long as final MPRs are not monitored and set for HDV, points a), b), e) and f) are questionable. • Focus must be on definition for battery families not vehicle. The electric machine is irrelevant for the battery durability. Use case would be more relevant.	
6.1.2.	*(b) Type of battery (dimensions, type of cell, including format and chemistry, capacity (Ampere-hour), nominal voltage, nominal power;*	*(b) Type of battery (dimensions, type of cell, including format and chemistry, capacity (Ampere-hour), nominal voltage, nominal power;*	• Nominal voltage / power could be made up of different packs although the cells are the same. • b) dimension should be deleted (too vague) • b) leads to tight families to be reported • (b) Type of battery (Same type of cell (including format and chemistry) and cell dimensions (capacity, nominal voltage, nominal power)); format = pouch, prismatic or cylindric; chemistry = composition (…)	
6.1.2.	*(c) Battery management system (BMS) (with regards to battery durability monitoring and estimations);*		• Based on which BMS defining criteria?	

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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;*		• See general comment	
6.1.2.	*(f) Operation strategy of all components influencing the battery durability;*		• components and influencing variables of the operation strategy to be defined	
6.1.2.	*(g) Declared highest normal charging power or C-rate..*		• Proposal for simplification of families definition from OICA still valid (OICA EVE 59-08) • Tend to support removal of g)	
6.1.3.	*Part C family to be defined if needed*		• Part C family not necessary due to our position on energy throughput	
6.3	***Part A: Verification of SOCE monitor***		• Add option (Annex X) for component test at type approval for the possibility of a declaration on the vehicle level UBE/Ccertified. UBE/Cmeasured will always be done on the vehicle level.	

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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*	*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~~.*	• Removed as no MPR tables in 5.2	
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.*		• Different legal requirements, market requirements and test procedure cannot guarantee comparability, especially for different vehicle types and variance of use cases. • There is no Implementation in other Regulations. • How can a cp act as an TAA?	
6.3.2	***Verification procedure***			

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 vehicle selected during ISC to verify the SOCE monitorPart A verification shall be randomly selected. 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".*	***6.3.2.1 Vehicle Selection*** *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.* ***6.3.2.2 Determination*** *The vehicle selected during ISC to verify the SOCE monitorPart A verification shall be randomly selected. 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".*	▪ Text passages shall be put into two subpoints for better reading and understanding. Adding consistency: ▪ 6.3.2.1. Vehicle selection ▪ 6.3.2.2 . Determination ▪ Part A conditions shall be the same as certification run. • Procedure shall be defined in detail. • 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/Ccertified 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. • But still: Vehicle selection should be reviewed as no prescribed cycle (lowest energy consumption vehicle agreed with responsible authorities ?)	

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			• Random selection means huge testing burden for type approval at BOL. • Open the option for a component test at BOL and verify on a parent vehicle, declare the vehicle UBE/Ccertified	

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*	*In order to verify the **SOCC** monitor, the value for the usable battery **capacity** shall be measured at the time of the verification and the related value from the monitor shall be collected before the verification test procedure. To support future improvement of the GTR, indicator values shall be collected again after the verification test procedure. Those indicators read after the verification test procedure shall not be considered in the Part A verification.* *The measured **SOCC** value shall be determined by dividing the measured value for the usable battery **capacity** by the certified value for the usable battery **capacity**, in accordance with the procedure defined in Annex 3 of this GTR, respectively, expressed in per cent.* ***〖SOCC〗_measured=(〖UBC〗_measured)/(〖UBC〗_certified)*100*** *In cases where **UBCmeasured** is higher than the **UBCcertified**, the **SOCC** measured shall be set to 100 per cent.* *6.3.2.1 Vehicle Selection* *The vehicle selected during type approval to verify the **SOCC** monitor shall be a vehicle*	• Definition of reference value? • Cycle is not prescribed within the GTR	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
		corresponding to the lowest ~~cycle~~ energy demand configuration within Part B family. *6.3.2.2 Determination* *The vehicle selected during ISC to verify the **SOCC** monitor ùPart A verification shall be randomly selected. 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".*		
6.3.2.	*In cases where $UBE_{measured}$ is higher than the $UBE_{certified}$, the SOCEmeasured shall be set to 100 per cent.*		• Can it really happen that UBE/Cmeasured will be higher than UBE/Ccertified? Due to the same boundary conditions as well as the selection criteria of the in-service vehicles, the probability is very low..	
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."*			

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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"*		• Vehicle procurement will be a challenge. • A description of the family from Part A could be helpful to facilitate vehicle procurement. For example: Declared value in CoC?	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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 vehicle selected during ISC to verify the SOCE monitorPart A verification shall be randomly selected. 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".*	*6.3.2.1 Vehicle Selection* *The vehicle selected during type approval to verify the SOCC monitor shall be a vehicle corresponding to the lowest cycle energy demand configuration within Part B family.* *6.3.2.2 Determination* *The vehicle selected during ISC to verify the SOCC monitorPart A verification shall be randomly selected. 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".*	• Change energy to capacity. See OICA general comment above, replace SOCE with SOCC	
6.3.3	***Statistical Method for Pass/Fail decision for a sample of vehicles***		• Pass/Fail decision criteria for verification of monitor needs a monitoring period as it is based on the field vehicle data.	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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.*		• The selection of vehicles in the commercial vehicle sector will probably depend a lot on the family concept. • It must be possible to use the vehicles available on the market for ISC in order to be used for the test.	
6.3.3.	***Statistical Method for Pass/Fail decision for a sample of vehicles*** [...] For evaluating the SOCE monitor normalised values shall be calculated: $x_i = SOCE_{read,i} - SOCE_{measured,i}$ Where $SOCE_{read,i}$ is the on-board SOCE read from the vehicle *i* ; and $SOCE_{measured,i}$ is the measured SOCE of the vehicle *i*. [...]	***Statistical Method for Pass/Fail decision for a sample of vehicles*** [...] For evaluating the SOCC monitor normalised values shall be calculated: $x_i = SOCC_{read,i} - SOCC_{measured,i}$ Where $SOCC_{read,i}$ is the on-board SOCC read from the vehicle *i* ; and $SOCC_{measured,i}$ is the measured SOCC of the vehicle *i*. [...]	• Criteria for pass/fail result from the test variable as well as tolerances to be covered from the procedure. Values are more constant with capacity.	

Table 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:* *(a) Pass the family if X_tests≤A-(t_(P1,N)+t_(P2,N))·s* *(b) Fail the family if X_tests>A+(t_(F1,N)-t_F2)·s* *(c) Take another measurement if:* *A-(t_(P1,N)+t_(P2,N))·s<X_tests≤A+(t_(F1,N)-t_F2)·s* *where the parameters tP1,N, tP2,N, tF1,N, and tF2 are taken from Table 3.* Table 3 **Pass/fail decision criteria for the sample size**	*For each N tests 3 ≤ N ≤ 16, one of the three following decisions can be reached, where the factor A and the parameters tP1,N, tP2,N, tF1,N, and tF2 shall be set after monitoring phase defined in paragraph 6.4.2:* *(a) Pass the family if X_tests≤A-(t_(P1,N)+t_(P2,N))·s* *(b) Fail the family if X_tests>A+(t_(F1,N)-t_F2)·s* *(c) Take another measurement if:* *A-(t_(P1,N)+t_(P2,N))·s<X_tests≤A+(t_(F1,N)-t_F2)·s*	▪ Collection is based on data from the passenger car ▪ However, trucks are loaded differently. “Fully loaded” versus “empty loaded” would be considered. Thus, the difference is higher for trucks. Furthermore, recuperation, mass and the C-rate are different, especially with UBE. ▪ UBE is not constant/susceptible to fluctuations. ▪ Accuracy is necessary during verification. UBE is not a basis for this. ▪ Conclusion: UBE is too inaccurate to fulfill the 5% criteria pass fail ▪ Consistency with UBC i.o. UBE • Consequently A factor & tp/tf values shall be updated according ISV testing methods capabilities after monitoring phase securing a robust statistical method limiting type I and type II errors	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	

	PASS		
Tests (N)	$t_{P1,N}$	$t_{P2,N}$	$t_{F1,N}$
3	1.686	0.438	1.686
4	1.125	0.425	1.177
5	0.850	0.401	0.953
6	0.673	0.370	0.823
7	0.544	0.335	0.734
8	0.443	0.299	0.670
9	0.361	0.263	0.620
10	0.292	0.226	0.580
11	0.232	0.190	0.546
12	0.178	0.153	0.518
13	0.129	0.116	0.494
14	0.083	0.078	0.473
15	0.040	0.038	0.455
16	0.000	0.000	0.438

6.4	***Part B: Verification of Battery Durability***			

6.4.1	*Frequency of verifications* *[Data shall be collected yearly] by the authorities from a statistically adequate sample of vehicles within the same battery durability family selected randomly from a variety of climate conditions . The decision on the number of the vehicles in the sample may be taken by the responsible authority based on risk assessment methodology, [but in principle should not be less than 500].* *If the number of vehicles in the sample is less than 500, then on the request of the manufacturer and with the agreement of the responsible authority, a maximum of 5 per cent of the values may be excluded from the sample. In such a case, the manufacturer shall provide adequate information on the reason behind the exclusion for each vehicle to the authority.* *If the number of vehicles in the sample is equal to or more than 500, then all vehicles shall be included in the sample. The data*		▪ The availability of customer vehicle for ISC is highly dependent on the customer as the vehicle is their tool for the business. It is unrealistic to assume the vehicle could be selected from any climate conditions to fulfill the legislation. ▪ How should the data collection happen exactly? ▪ What does a variety of climate conditions mean exactly?	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
	read shall be those of the SOCE monitor (and other relevant data, such as those defined in Annex 2).			

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
6.4.2.	**Pass/Fail Criteria for the battery durability family** *A battery durability family shall pass if equal to or [more than 90] per cent of monitor values read from the vehicle sample are above the MPRi or DPRi.* *A battery durability family shall fail [if less than 90 per cent] of monitor values read from the vehicle sample are above the MPRi or DPRi.* *For the purposes of this GTR, the first and second sub-paragraphs shall be applied X years after its implementation in a cContracting partiesParty's lawsregulations.* *- Or -* *For the classes of this GTR, a monitoring phase of X years shall be given to collect in-vehicle data from the first electric heavy duty vehicles in the market.*	**Pass/Fail Criteria for the battery durability family** **& monitoring phase** *A battery durability family shall pass if equal to or more than limit percentage of monitor values read from the vehicle sample are above the MPRi or DPRi.* *A battery durability family shall fail if less than limit percentage of monitor values read from the vehicle sample are above the MPRi or DPRi.* *For the purposes of this GTR, the first and second sub-paragraphs shall be applied from its implementation in a Contracting Party's regulation only after a monitoring phase of 5 years allowing to set relevant MPRi and MPRi criteria corresponding to regional usage and applications and limit percentage of pass/fail threshold.* *Monitoring phase should also allow to confirm values of parameters for Part A statistical method based on a relevant sample of tests results.* *vehicles being registered within 5 years after enter into force of national regulation referring to this GTR22b are out of scope and only subject to monitoring*	• Monitoring phase is required to set relevant MPR per application in line with the regional usage of the heavy-duty vehicles. • Or "initial monitoring phase of at least 2/3 of lifetime requirement" • Or: "vehicles being registered within 5 years after enter into force of national regulation referring to this GTR22b are out of scope and only subject to monitoring"	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
6.5	***Part C: Verification of reported virtual distance***			
6.5.	*Part C: Verification of reported virtual diszance*	delete	• Virtual distance is not needed if MPR in cycles • Energy throughput should be used • There are so many diverse applications for HDV, haulage is not the main purpose. Meaningless for the customer to consider “virtual distance”. Instead, energy throughput should be used. • There is no interest to the customer at all to have the virtual milage reading function but only to fulfill the legislation. • Chapter shall be deleted	
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.*		• When exactly is the equivalent virtual distance option applied for? • How is the documentation carried out? Does this need to be defined and checked prior to type testing?.	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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.*		• "virtual distance read from vehicle" is completely unclear • See also general comments above	
6.5.1.	*The total discharge energy during this use shall be measured in order to calculate the measured virtual distance.*		• Also complete charging cycle should be considered, as recuperation also occurs with PTO. • See also general comments above	
6.5.1.	*The verification procedure use case (including the minimum amount of discharged energy corresponding to at least 50 km virtual distance.*		• See general comments on that chapter • Generic values from LDV GTR22 not feasible • Observing all the obstacles and complexities, virtual mileage is bringing, Energy/Capacity Throughput shall be recorded and used for additional MPR	
Figure 1	*Flow Chart Part A* *Exclude from sampling* *Or update the monitor by procedure in vehicle survey*		• only applicable for vehicle survey.	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
Annex 1	***Vehicle Survey***			
Annex 1	*Was the propulsion battery changed or repaired?* *If yes, the vehicle cannot be selected for testing, but information should be collected*		Important to read out and document SOCE monitor	
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.*		• For what is that information needed? Any effect on durability?	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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*		• Further conditions must be considered, e.g. energy losses, such as e-PTO operation while driving (reducing driving distance)	
Annex 2	***Values to be read from vehicles***			

	Values to be read from vehicles: *1. On board SOCE value* *2. Odometer (i.e., distance driven by the vehicle) (in km)* *3. Date of manufacture of the vehicle* *4. Total distance (sum of the distance driven as reported by the odometer and the virtual distance) [km], if applicable* *5. Virtual distance (in km), if applicable* *6. Percentage of virtual distance [in per cent], if applicable* *7. Worst case certified energy consumption of PART B family [Wh/km], if applicable* *6. Total discharge energy in V2X and/or PTO [WhkWh], if applicable* *7. Elapsed time since last Last charged by more than 50 per cent SOC swing on [DateDays]* *8. Average battery temperature while propulsion system is active, during charging and (if equipped)*	1. On board SOCC value (in %) 2. 3. 4. Total discharging operating time (sum of the time driven as reported by the odometer and the other (i.e., PTO/V2X) time) (hours] 5. Total charging operating time (sum of the hour driven as reported by the odometer and the other (i.e., PTO/V2X/charging) time) (hours) Total discharging time that C-rate was more than or equal to 0.5 (hours)	• Ways to gather and communicate this data to authorities shall be defined. • In which format does authority or technical service want to have this kind of data? (Documentation of values) • Change energy to capacity. See OICA general comment above, ○ Replace SOCE with SOCC ○ Add operating time by point 4 ○ replace point 5 with total charging operating time. Virtual distance is not needed if MPR in cycles ○ change point no 6 • delete point no 11 “Total discharge energy while driving • 8. Average battery temperature while propulsion system is active, during charging and (if equipped) during non-usage of the vehicles (i.e. non-propulsion system active, non-charging) • The battery temperature during operation should be a range. • Temperature during non-usable of the vehicle is highly dependent on the customer’s location and environment. The OEM has no way to check and verify it.	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
	during non-usage of the vehicles (i.e. non-propulsion system active, non-charging) *Maximum, minimum, average ambient battery pack temperature* the vehicle battery was exposedexperienced to during its lifetime* *9. Energy throughput , [kWh]* *10. Capacity throughput , [Ah]* *13. Total time of use of the battery* *Note: * ambient temperature to be read as daily averages*		• 11. Total discharge energy while driving [kWh]: definition missing "while driving"? Is it the energy for propulsion system? Or between certain velocities?	
Annex 3	***Part A Test procedure and determination of performance parameters***	*Test procedure for certified SOCE/C*	• Would add to much confusion if same name as Part A (in-service)	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
1	***For the calculation of the SOCESOCCmeasured, according to paragraph 6.3.2. of this GTR, the measured and certified values of usable battery capacityenergy (UBEUBC) for HD-PEVs and HD-OVC-HEVs are required:*** ***• UBEmeasured and UBEcertified***	*For the calculation of the SOCESOCCmeasured, according to paragraph 6.3.2. of this GTR, the measured and certified values of usable battery capacityenergy (UBEUBC) for HD-PEVs and HD-OVC-HEVs are required:* *• UBCmeasured and UBCcertified*	• Change energy to capacity. See OICA general comment above	
1.1	***Vehicle selection***		• Existing regulations simplify the regulation of vehicle selections and could be transferred	
	1.1 Table A3/1	Discharge rate Bidirectional charger/ bidirectional power supply/…		
1.2	***Measurement requirements (A3/1)***			

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
1.2	*Electrical voltage* Table A3 / 1 Measurement items and required accuracy Electrical voltage V ±0.3 % FSD or ±1 % of reading Discharge rate Bidirectional charger/ bidirectional power supply/…	Electrical voltage ±1% FSD or ±2 % of reading	• The measurement accuracies are adapted from the UN Regulation No. 154 - light duty passenger and commercial vehicles concerning measurement of electric energy consumption and electric range (WLTP) • Adjustment of required accuracy to use on-board measurement devices	
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.]*	*The UBCcertified 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 for SOCC monitor family concerned and during in-service testing.*	• Is *REESS* correct, or better: battery? • Open questions regarding: ○ declaration of UBEcertified ○ consideration of a factor ○ in-service testing • Not all vehicle variants of Part A family shall be tested by vehicle test (to reduce testing burden). • Hence the same test as the one used for the parent vehicle of the family tested shall be used for ISV	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
2	***Test procedure***			
2	**Test procedure** *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. If a bidirectional charging system is available on board of the HD-PEVs or HD-OVC-HEVs Method 2 shall be applied .* *[...]* *The same test method must be applied at type approval and during in-service testing***.**	*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. If a bidirectional charging system is available on board of the HD-PEVs or HD-OVC-HEVs Method 2 shall be applied provided discharge from Method 2 can be performed within [C/6 or less;C/2] range prescribed.* *[...]* ~~*The same test method must be applied at type approval and during in-service testing*~~	• Method 2 is mandatory if it is available in the vehicle., but no general description or reference to a standard regarding the capability of bidi (there could be vehicles with limited bi-di, V2X capabilities but still not suitable for the purpose of this GTR). • […] • Already included in 1.3	
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 .*		• It has not yet been checked. whether the methods are equivalent and the same results can be expected. Will there be a review of this? • CD experts shall review	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
Table A3/2	*HDV Dyno testing with similar driving characteristics*		• Driving conditions on road (Method 1b) are difficult to compare due to different uncertainties and route profiles. • Method 2 depends on the charging/discharging profiles and the related c-rate procedures.	
2.1	***Method 1 HD-PEVs or HD-OVC-HEVs without bidirectional charging system available***			
2.1.2	***Test track***			

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
2.1.1.1.	*For the Method 1a* *[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].*	*[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 UBC, and its texture and composition shall be representative of current urban and highway road surfaces, i.e. no airstrip-specific surface].*	**DTAG** • Descriptions of obstacles and wind barriers already exist in other regulations, such as 2017/2400 (2022/1379), Annex VIII. • Requirements for the test procedure are also described: In the case of route simulations, load profiles, various topologies and recuperation values can be taken into account for UBE measurement. • In these measurements, the measurement of UBC would be more consistent and thus seen as a more resilient criterion. • See also general comments on UBE/UBC • The temperature requirement cannot be met due to long test times and temperature changes during the day. Experience has already been gained with AirDrag measurements.	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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.	• Deviations can be made by comparing ECU and GPS. Large deviations in the speedometer can lead to large differences in vehicle speeds.	
2.1.1.1.2.	*Test room*		• The test time is very long, looking of the required period times e.g. initial settings, pre-conditioning, charging, discharging, testing phase discharging, soak times, etc. This could create challenges, especially due to temperatures fluctuate widely throughout the day. It is to be assumed that the temperature ranges could be sufficient – without guarantee. Challenge could be the availability of a hall / test room on test tracks with constant temperatures for large lorries.	
2.1.1.1.4	*Soak area*		**DTAG:** • See challenges mentioned above	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
2.1.1.1.5	*Measurement frequency* *All the items in Table A3/1 of paragraph 2.2.1. 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].] for Method 2 discharging and charging while 20 Hz for Method 1a, and Method 1b and dynamometer Method discharging and 0.033Hz for charging.*	*Measurement frequency* *All the items in Table A3/1 of paragraph 2.2.1. 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].] for Method 2 discharging and charging while **1 Hz** for Method 1a, and Method 1b and dynamometer Method discharging and 0.033Hz for charging.*	• In our opinion: 20 Hz is too high. 1 Hz instead 20 Hz • Are there measurement evidence justifying 20Hz frequency measurement. • What is the reasoning justifying 0.033 Hz for bi-di including discharging vs. 20Hz discharging Method 1a & 1b ?	
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.	• Not required for the test procedure and represent boundary conditions. Boundary conditions should be laid down in the general part. or in the vehicle selection for the passed/failed families	
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).*		• Calibration interval of measurement devices should be added. Text section can be used from UN Regulation No. 154.	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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].*	*As an alternative to the use of external 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].* *Demonstration of accuracy and frequency shall be done during Type Approval Test for SOCC monitor family concerned [and on request of Type Approval Authority to manufacturers for ISV tests]*	**DTAG:** • Checks on the accuracy of measuring instruments (sensor) could be carried out in the same way as for OBD • To avoid unnecessary additional verification once on-board sensors accuracy is demonstrated at Type Approval.	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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 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 or at ambient temperature of [5 to 30°C] if performed on-road*	**DTAG:** • The initial setting of REESS shall not be repeated (no benefit) • Avoid restrictive temperature conditions with no impact on tests.	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
2.1.2.2.5.	Pre-conditioning and soak *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] as specified in Figure A3/1.* *[…]* *The vehicle shall be soaked in the soak area for a [minimum of 9 hours]. The manufacturer may recommend a specific soak time or range of soak times within the range of [9 to 36 hours] if necessary to ensure temperature stabilization of the high voltage battery. The soak area conditions during soak shall be as specified in [paragraph 2.1.1.1.4. of this annex].].*	*The REESS of the vehicle shall be discharged, left stabilised until temperature stabilization (average temperature shall not vary more than +/-1°C) and then fully charged and left stabilized for a minimum of [30] minutes and maximum [1h] as specified in Figure A3/1*	• Temperature stabilization of the high voltage battery may not require 9h. • Removed text repeating soak requirement.	
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.*		• Does this work for methods 1a, 1b and 2? Or only for dyno?	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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.*		• The abort criterion 4s and standstill within 60 s cannot be implemented. The vehicle may be parked in the middle of the test track or road. Is the vehicle allowed to drive to the charging station in turtle mode (limp home)? • The vehicle speeds and the target speed for the criterion for switching to driving are not defined in the unloading test step. • Deactivation of an accelerator pedal control may have severe safety-relevant impact and must be reviewed!	
2.1.1.2.5.	*The vehicle shall be braked to standstill within 60 seconds.]*		• See 2.1.1.2.5 break off criterion • Is there enough energy left to drive to the charging point with modus “limp home”? • Increase time for driving back to charging spot.	
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*		• Probably a test mode will be necessary, for break off criterion which differs from WLTP as well as for fully charging/discharging of the battery	
2.1.1.2.5.	*It is allowed to operate a battery internal or external pre-warming system if available, recording the energy consumption*		• The temperature conditions are regulated within the battery.	
2.1.1.2.5.	*The REESS shall not be charged during the soak period.*		• Soak period also on the vehicle level (battery)?	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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.*		• The vehicle determines the indication that the battery is fully charged and the charging process is interrupted via the vehicle control. • The control strategy might change from OEM to OEM and from technology to technology • End Charge criterion might be based on manufacturer specifications • → Implementation at the REESS level may not be feasible and is not interrupted 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.*	*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. Vehicle tested in ISV should have same load conditions as the corresponding vehicle tested for the SOCC monitor family at Type Approval to fix this boundary condition.* *[...]* *The acceleration and deceleration during vehicle speed change shall be smooth and accomplished within 60 sec. (or agreed with authorities based on vehicle capabilities)* *[...]* *The UBCdischarge is the total discharged capacity calculated as described in [paragraph 4. of this annex].*	• Experience from Euro 6 Regulation regarding PEMS (EU) 582/2011: Vehicle payload shall be approx.. 60 % of the maximum vehicle payload. • Experience from CO2 VECTO regulation VTP (Annex Xa): 90% payload • Only parent vehicle within SOCE/C monitor family should have vehicle test to reduce testing burden	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
		The UBCcharge is the total charged capacity calculated as described in [paragraph 4 of this annex]. *The full cycle efficiency is calculated by dividing the UBCdischarge by the UBCcharge* *[...]* *These two steps (discharge and charge) are performed on [new vehicles tested for the SOCC monitor family] to determine the UBEcertified, defined as [UBEdischarge..]* *These two steps (discharge and charge) are performed on [aged vehicles within a SOCC monitor family] to determine the UBEmeasured, defined as [UBEdischarge].*		
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*		• The requirement can be very difficult to implement even for very experienced test drivers. External influences are also caused by the pedal behavior. However, these cannot be influenced. • Higher tolerance would make sense to avoid unnecessary test interruptions..	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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) ?*		• Internal temperatures and load profiles have more influence than ambient temperatures.	
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.*		• Same as 2.1.1.2.5	
2.1.1.2.7	*The vehicle shall be braked to standstill within 60 seconds.]*		• Same as 2.1.1.2.5 • When the recording of the measurement stops? After standstill? Comparison with method 1b might make sense.	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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.*		• See 2.1.1.2.6. for comparison • The vehicle determines the indication that the battery is fully charged and the charging process is interrupted via the vehicle control. • The control strategy might change from OEM to OEM and from technology to technology • End Charge criterion might be based on manufacturer specifications • Implementation at the REESS level is not feasible and is not interrupted by a single REESS voltage measured by external instruments.. • Balancing between REESS would be necessary.	
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.]*		• The waiting time should be defined as a limit. Lower charging leads to testing mode and re-connection is required.	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
2.1.1.2.8	*Repetition of 1a test* *[The Method 1a test of paragraph 2.1.1.2.7. of this annex shall be repeated for a total of xx repetitions as shown in Figure A3/4].* *The UBE measured shall be equal to the smaller value between the xx repetitions.* *Repetition of RTE test criterion : 1.000±0.050 @Ah* *[The temperature-related operational metrics listed in paragraph 2.1.1.2.1. of this annex shall be monitored during all repetitions and seen to remain within the normal operating range specified by the manufacturer during each repetition. If necessary, the vehicle shall be re-conditioned between repetitions according to paragraph 2.1.1.2.5. of this annex.].*	*Repetition of 1a test* *[The Method 1a test of paragraph 2.1.1.2.7. of this annex shall be repeated for a total of 3 repetitions maximum as shown in Figure A3/4].* *The UBC measured shall be equal to the smaller value between the 3 repetitions.* *[The temperature-related operational metrics listed in paragraph 2.1.1.2.1. of this annex shall be monitored during all repetitions and seen to remain within the normal operating range specified by the manufacturer during each repetition. If necessary, the vehicle shall be re-conditioned between repetitions according to paragraph 2.1.1.2.5. of this annex.].*	• Sufficient for checking identical vehicles for accuracy. • With appropriate values for a factor and parameters of statistical method few vehicles shall be tested. Therefore, monitoring phase shall confirm relevant number of repetitions with the objective of limiting overall test budern. • Repetitions on fig. A3/4 are not based on RTE criteria.	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
2.1.2	***Method 1b Discharge by driving on the road with average speed with higher tolerances***		• All explanations from method 1a should also apply to method 1b if they do not differ in their implementation.	
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].*		• The same requirements for method 1a – test track – are not applicable for on-road testing on public roads. • Bounding conditions should be considered for method 1b due to topology of the roads.	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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.]		• Above a certain SOC percentage, the vehicle may no longer be able to maintain the speed and switches to the target speed. • A “turtle mode” will be required for remaining ranges in “limp home” mode. This SOC level must be specified for the same conditions. • Maintaining the target speed is considered critical because below a predefined SOC, the vehicle must stop at the charging station and the last remaining SOC must be charged by the auxiliary system. • The abort criterion according to method 1a presumably does not match the warning display and is not adapted to the SOC level.	
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. .		• This procedure is very challenging even for experienced test drivers. In addition, the vehicle is moved in road traffic. Here too, it should be noted that external factors such as pedal behavior play a role. • Note: intervention by driving assistance systems possible and deceleration and acceleration may be higher than necessary.	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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.]		• Does not match 2.1.2.1 in relation to the profile.	
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) ?		• preconditioning and soaking in a temperature-controlled environment is important to generate reproducible results • Pre-warming is no longer necessary after preconditioning. • The temperature change within the battery is relevant for the test phase.	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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.		• How should that be realized on-road?	
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.*		• Existing Standard ISO 15118 provides multiple use cases like secure communication, smart charging and the Plug & Charge feature used by some electric vehicle networks. • Implementation based on standard test required. • Charge modus necessary?	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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.]*		• More precise information is required for the voltages during the charging and discharging process. These differ by the use of different vehicle-specific voltage levels • What about other E/E components?	
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.*		**DTAG:** • See 1.2 and 2.1.1.1.7.	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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 cell 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**%]*		• This data could also be included with the vehicle data in Appendix 2 only if V2X is relevant. But we strongly recommend to omit virtual mileage and refer to energy/capacity throughput instead • The test procedure is carried out via the vehicle control system. • The cell temperature can be used to control the battery behavior. • Is the same route used? Deviations of 5% and more expected due to large variances due to topography, payload, recuperation strength. See OICA measurement results • C-rate will be as for 1a/b within C/2 – C/6? (as orientation?)	
2.2.1.5.	*The manufacturer shall specify if a VRTE operation mode shall be set at vehicle level for performing the test.*		• Proof to be provided that the operating window for two-way discharge is identical to that for driving?	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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].*		• Avoiding high measurement verification should be covered by family formation. As needed, to be supported by technical evidence.	
2.2.2	*Measurement frequency* *All the items in Table A3/1 of paragraph 2.2.1. 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].] for Method 2 discharging and charging while 20 Hz for Method 1a, and Method 1b and dynamometer Method discharging and 0.033Hz for charging.*	*Measurement frequency* *All the items in Table A3/1 of paragraph 2.2.1. 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].] for Method 2 discharging and charging while **1 Hz** for Method 1a, and Method 1b and dynamometer Method discharging and 0.033Hz for charging.*	• In our opinion: 20 Hz is too high. 1 Hz instead 20 Hz	
2.2.2.1.	(b) battery SOC		• Battery SOC from BMS and • 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.]*		• Recalibration of REESS (cells) will need more than 300km or one full charge distance • Should be according to OEM specifications	
2.2.2.3.	*The measurement devices shall be installed at suitable position(s) within the vehicle.*		• Placement of measurement equipment based on manufacturer specifications • Also due to security reasons (high voltage)	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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.*		• Is there another option for REESS setting outside a temperature controlled facility? Should the initial setting performed on the battery level?	
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].*		• At high SOC levels, constant charging with a specified charging capacity by the vehicle may be prohibited.	
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 takes place until the vehicle aborts the discharge or until 0% is displayed on the dashboard. • The SOC estimation algorithm always works differently. • Recharging after stabilization is not allowed • UBE measurement is started immediately afterwards	
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.*		• What should the proof of non-impairment of the SOC estimate, based on the deactivated devices, look like for recording the SOCE after the verification test?	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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 .*		• A bidirectional charge operation mode may be required to have the same SOC threshold values for UBE determination as in driving mode. • Heating and cooling should possibly be excluded as the test procedure requires air conditioning of the cabin for the driver (environmental temperatures).	
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.]*		• Check discharge status until a predefined onboard SOC value is reached or calculate SOC with voltage measurement and OCV table. • There will be differences in the different discharge test procedures. Complete emptying will have to be implemented differently. (Charging mode)	
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.]*		• This implementation can only be achieved on the test bench (WLTP) or by chassis Dyno. • What state are we trying to reach? Influence of vehicle speed and fatigue state.	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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.*		• Values have to been defined. • REESS: What is the implementation when using different battery capacities? • For OVC-HEV relevant?	
2.2.2.5.	*It is allowed to operate a battery internal or external pre-warming system if available, recording the energy consumption.*		• We assume that external preheating refers to the vehicle's own preheating system, as the energy consumption of external systems outside the vehicle can be neglected. • With an exposure time of 9 hours, the charge level may be reduced further than expected and may lead to OBD faults. This has to be verified during a pilot phase! • The internal preheating is deactivated according to manufacturers specifications	
2.2.2.6.	***Vehicle Charge***			

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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.*		• It should be noted that a high SOC results in a reduction in power. • Measurements are performed at the vehicle measuring spots and the requirement for charging current and voltage measurement is analogous to point 1.2.	
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.]*		• If there is more than one charging process, in contrast to a charging process, it may be necessary to disconnect the vehicle by switching off the ignition including a new SOC calculation.	
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].*		• There are now two indications: the value "highest normal charging capacity" from paragraph 6.1.1 and the C-rate limit equal to or less than C/5. (We understood it should be C/6?)	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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].*		• The test conditions during the test with regard to the activation of the ignition should be defined, because the charging process might be harm due to deactivation of the ignition.	
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].*		• The vehicle behaviour influences whether disconnection of the connection is permitted or whether it must remain connected to the bidirectional charging supply. • A process description for the initiation and adaptation of the unloading process by the vehicle shall be specified or described..	
2.2.2.7.	*[The battery shall be fully discharged at constant power].*		• Implementation of a constant performance across the entire SOC range is not realistic and not possible.	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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.*		• Related to our discussions during EVE 66th meeting in Ottawa • To determine the result, the profile of the discharge power is more important than the maximum normal power of the soak. Due to the variety of vehicles and the derived C rate, this would lead to a complex test scheme and make it necessary to calculate the average C rate and the profile for charging.	
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].*		• With respect to the C-rate, coverage is only constant by the minimum or maximum speed. • Constant driving does not result in a higher C rate, but only acceleration.	
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.]*		• What is meant by unwanted battery behavior? • The operating strategy should largely represent the driving characteristics. • It must be checked whether this method is suitable for bidirectional procedures.	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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 UBC/$E_{measured}$ and SOCC/E. • It might not be possible to have the same charging profile, but tolerances that come with different C-rates must be discussed and evaluated.	

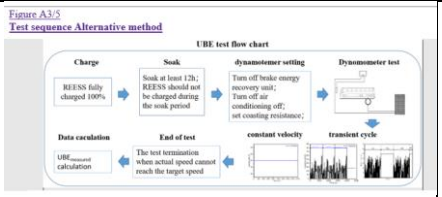
Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
2.2.2.7.	*The end of discharge criterion is reached when the break-off criterion is met.* *[The break-off criterion is reached when [an indication to stop the vehicle appears on the instrument panel], 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]*		• Break-off criterio based on manufacturer specifications • Those my be subject to a verification with approval authority	
			•	
			•	
			•	
			•	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
2.3.	***Alternative method***			
2.3.1	***Constant and transient cycles test method by using HD chassis dynamometer***			
2.3.1.1.	***General test requirements***		• Almost no experience with HDV chassis dynos in the US and EU for HDV segment	
2.3.1.1.	*[The equivalence of the method with Method 1a, 1b and 2 shall be demonstrated to the responsible authority.*		• This has to be defined more in detail • Depending on the result, this demonstration may take same time as the tests themselves. • May be done in close exchange with authorities	
2.3.1.1.	*The same battery discharging test must be applied at type approval and during in-service testing.]*		• Support	
2.3.1.1.	*[A section of constant speed driving is allowed to stabilise the SOC of the battery during the depleting test]*		• Support	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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.*		• No coast down experience. But certainly, needs clarification!	
2.3.1.1.1.4.	*Chassis dynamometer settings*		• No chassis Dyno experience. But certainly, needs clarification!	
2.3.1.1.1.5	*a) Having at least two hubs that can be separately coupled to the tires.*		• Difficult for HDV on dynos. • Connection to wheel hubs is more convenient	
2.3.1.1.1.5	*c) With time, speed, driving distance measurement function*		• Accuracy is missing • E.g. 2017/2400 Annex VIII	
2.3.1.1.1.5	*e) The fan can synchronize with the speed of the car*		• Should be re-defined for HDV	
2.3.1.1.1.6.	*b) Deviation of basic inertia in the scope of ±0.5%;*		• See LDV: *0.5 % or 7.5 kg whichever is the greater for each measured base inertia and ±0.2 % relative to any arithmetic average*	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
2.3.1.1.1.6.	*c) Deviation of acceleration and deceleration in the scope of ±1%;*		• See 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/s².*	
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;*		• See also LDV: ±0.080 km/h	
2.3.1.1.1.6.	*[The test shall be carried out in accordance with paragraph 2.3 of this Annex.*		• Better to delete or refer to 2.3.1.2.?	
2.3.1.1.5.	*Measurement frequency*		• Frequency of 20 Hz is too high for discharged values. At least 1 Hz shall be enough. See also UN-ECE R49, R85, R96 …	
2.3.1.1.6.	*Boundary conditions that qualify vehicle for testing*		• Something for vehicle survey input?	
2.3.1.1.6.	*The manufacturer shall specify if a testing operation mode shall be set at vehicle level for performing the test.*		• important for effects like recuperation, amounts of driven axles, etc.	
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.*		• Who should declare exact measurement positions? Batteries differ. Technology-openness should enable: “based on OEMs specifications and as demonstrated to authority”)	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
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.*		**DTAG:** • Best option for in-service tests • See also OICA presentation on shielded cables.	
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.*		• Which indicators in particular? • Shall we develop a list?	
2.3.1.2.3.	*The measurement devices shall be installed at suitable position(s) within the vehicle.*		• Who describes their positions (OEM/authority)?	
2.3.1.2.8.2	*Figure A3/6*		**DTAG:** • Constant driving speed shall be related on: • segment • vehicle category • characteristic regional speed. • Considering feasibility, time consumption, vehicle use-case	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
2.3.1.2.8.3.	*For the constant velocity segments, the speed deviation shall be controlled in the scope of ± 3 km/h.*		**DTAG:** • Should be achievable, at least with series production automation systems on board (velocity control etc.) • Manually control will be challenging, but experienced drives can do it	
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.*		**DTAG:** • Low battery alarm questionable criterion, but ok if optional • 4 second criterion better to detect	
2.3.1.2.12	Figure A3/5 Test sequence Alternative method 		• Final feasible test sequence and contents to be clarified. • A pilot phase might be very helpful!	
3	***Test procedure***		• All test procedures need to allow pre-condition of the battery via external power sources to the recommended working condition/temperature.	
3.1	***Method 1 HD-PEVs or HD-OVC-HEVs without bidirectional charging system available***			

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
3.1.1	***Method 1a Discharge by standard average speed with tolerances on test track***		• 1a shall focus on both charged and discharged capacity (energy) 1b shall focus on charged capacity (energy)	
3.1.1.1.2	*As an alternative to the use of [external] 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]. (GTR21 excerpt)*		• See GTR21	
3.1.1.4	*Initial setting of REESS*		• Ambient temperature could either be based on signal measured on the vehicle or at a specific location to be more precise. • Current ambient temperature requirement too restrictive (23°C+/-5°); possible proposal: 5-30°C+/-5° • Initial SOC definition to be specified	
3.1.1.6.	*Test sequence*			

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
3.1.1.6.3	*Vehicle conditioning, soak and charge* *[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.]*		• Battery manages the allowed current by its own. • Fully charged in terms of display? in terms of BMS?	
3.1.1.6.4	***Method 1a test*** *[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*	~~*[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 phase between pre-conditioning and test start shall be kept small to avoid energy loss]*	▪ Test requirements are hard to comply with (Starting vehicle conditioning: 7am, Vehicle depleted: 10am, Charging: 3pm, Start test: latest xx pm, Vehicle depleted again: xx am, **Three shift test ??)** ▪ Temperature requirements – see above – general issue. ▪ What does **constant speed** mean exactly (+/- x km/h)? ▪ Vehicle will need to slow down also on test track due to different reasons: Curves, etc. ▪ The regional characteristic speed has to be defined. Otherwise the tests in different countries are not comparable.	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
	(GCW) in agreement with the responsible authorities. *[The battery shall be discharged with a constant speed within the range of the characteristic regional speeds up to a battery SOC equal or less to 10 %.* *In the remaining part of the depleting test the battery shall be discharged with a target constant speed per Gross Vehicle Weight (GVW) and Gross Combination Weight (GCW) in agreement with the responsible authorities with a speed tolerance of [± 5km/h],[GTR4 ± 4km/h], [± 7km/h].* *[It is possible to use the cruise control of the vehicle during the test if available].*		▪ In case of UBE: ▪ GVW has to be constant from TA to in-service verification to ensure comparability of results and no load influences on UBE ▪ In case of UBC: ▪ No GVW influence on charged vs. discharged capacity experienced (see OICA EVE 63rd documents) ▪ Instead first paragraph: the phase between pre-conditioning and test start shall be kept small to avoid energy loss ▪ Acceleration & deceleration range: ± [0.5-1] km/h/sec target speed should be reached within 60s (or agreed with authorities based on vehicle capabilities)	
3.1.1.6.4	*The acceleration and deceleration during vehicle speed change shall be smooth and accomplished within the range ± [0.5-1] km/h/sec]*		• According to transient tests, what would be the C-rate requirement all the time? E.g. windows with zero/negative load (deceleration) or higher (acceleration) • Break-off criteria to be defined by each OEM individually as applicated in series vehicles	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
	[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.] *[The same specified C-rate or vehicle speed should be used during type approval and in-service testing].* *[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.]* *[In case of HD-OVC-HEVs the charge depleting vehicle test operation mode shall be selected. The break-off criterion is reached when …].*		from production and in alignment with approval authority • After stand still, how will the vehicle be transferred to the charging point. Or is the mobile charger used (limited power)?	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
	The UBEdischarge is the total discharged energy calculated as described in [paragraph 4.1.1. of this annex]. *The REESS shall be left stabilising for a minimum of [30] minutes and maximum [1h].* *[The vehicle shall be connected to the mains within 120 minutes after coming to a standstill].*			
3.1.2	***Method 1b Discharge by driving on the road with average speed with higher tolerances***		• See similar comments as in Method 1a test	
3.1.2.1	***General***			
3.1.2.1.1	Required information . . . [Boundary conditions that qualify vehicle for testing • Battery cell temperature normally distributed with average temperature at Y C and variance <Z		• The same route can or must be used? Large spreads of approx. 5% can be expected due to topography, payload, amount of recuperation, … • Same question as for method 1b: - more precise definition is needed for required C-rates - mean of C-rate of the complete test?	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
	• 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**%] The manufacturer shall specify if a testing operation mode shall be set at vehicle level for performing the test.		• Moving average window? Every measuring window/every 0.01s?--> impossible	
3.2	***Method 2 HD-PEVs or HD-OVC-HEVs with bidirectional charging system available***			
3.2.1.	***General test requirements*** ***The following test procedure determines the energy fade of the batteries of the HD-PEV or HD-OVC-HEV.*** ***[The manufactures shall guarantee that all the traction batteries installed on the vehicle are engaged during the VRTE test to determine the Usable Battery***	The following test procedure determines the capacity fade of the batteries of the HD-PEV or HD-OVC-HEV. [The manufactures shall guarantee that all the traction batteries installed on the vehicle are engaged during the VRTE test to determine the Usable Battery Capacity (UBC) certified and measured.]	• Change energy to capacity. See OICA general comment above	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
	Energy (UBE) certified and measured.]			
3.2.1.1 -> 3.2.1.5.	Battery cellcell temperature normally distributed with average temperature at Y C and variance <Z	*Battery cell temperature normally distributed with maximum temperature at Y C and variance <Z*	• Average temperature shall be changed to Maximum	
3.2.1.2 ->3.2.1.6.	Required measurements [The test vehicle shall be instrumented with measurement devices for measuring the necessary input values for the UBE calculation (voltage and electrical current). The discharge and charge energy shall be measured at the battery to avoid combined battery-inverter efficiency and energy losses . 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	*Required measurements* *[The test vehicle shall be instrumented with measurement devices for measuring the necessary input values for the UBC calculation (electrical current). The discharge and charge current capacity shall be measured at the battery to avoid combined battery-inverter efficiency and energy losses .* *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*	• Delete voltage related items	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
	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]. [External REESS voltage measurement 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	*accuracy and frequency described in [paragraph 2.2. of this annex].*		

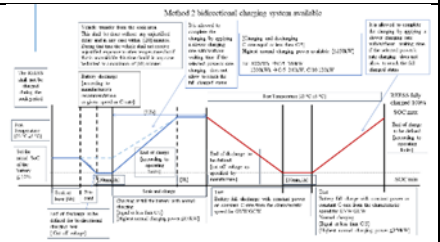
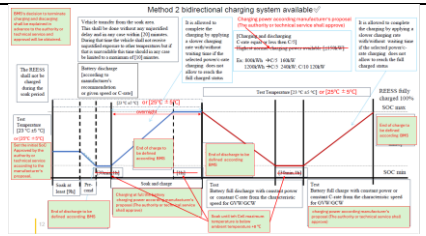
Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
	measurement points and safety instructions. Vehicle on-board REESS voltage data As an alternative to the external REESS voltage measurement specified in paragraph x.x. of this annex, the manufacturer may use the vehicle on-board REESS voltage measurement data. The accuracy of these data shall be demonstrated to the responsible authority .]			
3.2.5	Vehicle soak The vehicle shall be soaked in the soak area for a [minimum of 9 hours]. The manufacturer may recommend a specific soak time or range of soak times within the range of [9 to 36 hours] if necessary to ensure temperature stabilization of the high voltage	*Vehicle soak* *The vehicle shall be soaked in the soak area for a [overnight]. The manufacturer may recommend a specific soak time or range of soak times within the range of [9 to 36 hours] if necessary to ensure temperature stabilization of the high voltage battery. The soak area conditions during soak shall*	• Change hour to overnight as proposal to avoid large discharge over 9h	

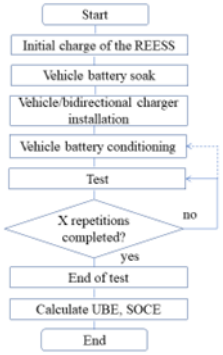
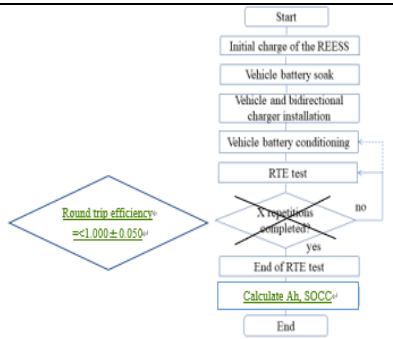
Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
	battery. The soak area conditions during soak shall be as specified in [paragraph 2.1.4. of this annex].]. The REESS shall not be charged during the soak period .	*be as specified in [paragraph 2.1.4. of this annex].].* *The REESS are allowed charging during the soak period .*		
3.2.6	***Test sequence***			
3.2.6.2	*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 .* *Measurement devices installed within the vehicle shall be warmed up as appropriate.*		• General functions as heating or cooling shall be included from our point of view	
3.2.6.2	*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 .* *Measurement devices installed within the vehicle shall be warmed up as appropriate.*	*The vehicle's bidirectional charge operation mode shall not activate, modulate, delay or deactivate the operation of any part that affects the battery capacity throughput under the test conditions .*	• Change energy to capacity. See OICA general comment above	

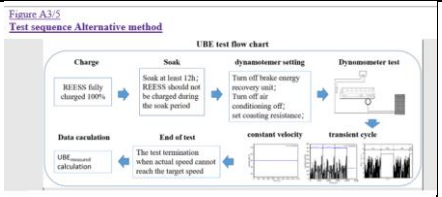
Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
3.2.6.3	*The REESS shall be conditioned by applying a full discharge followed by a full charge at normal charge [as defined in paragraph 6.1.1 of this GTR].* *[The battery shall be charged at full with the highest normal charging power available [≤150kW]* *The end of charge criterion is reached when a fully charged REESS is detected by the on-board or external instruments.*	*The REESS shall be conditioned by applying a full discharge followed by a full charge at charge declared by the manufacturer [as defined in paragraph 6.1.1 of this GTR].* *[The battery shall be charged at full with the highest charging power available [at declared by the manufacturer]* *The end of charge criterion is reached when a fully charged REESS is detected by the on-board BMS .*	• The manufacturers need to explain declared values to TS or certification authority, according to the experimental results from OICA	
3.2.6.4	*[The battery shall be discharged with [a constant power or constant C-rate within the range of the characteristic regional speeds], [duplicate at least minimum and maximum speed].* *[Not to have unwanted battery behaviour the corresponding C-rate shall be in the range of [C/6 or*		• As stated before, we should derivate a certain velocity and keep the procedure open for certain c-rate ranges between C/2 and C/6 as also proposed by CPs.	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
	less, C/2], otherwise the test shall be repeated.] *The end of discharge criterion is reached when [the cut-off voltage as defined by the manufacturer prior to conducting the test is reached] .* *The REESS shall be fully charge d 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.*			
3.2.6.4	*[The battery shall be discharged with [a constant power or constant C-rate within the range of the*		• Replace voltage with threshold	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
	characteristic regional speeds], [duplicate at least minimum and maximum speed]. *[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.]* *The end of discharge criterion is reached when [the cut-off voltage as defined by the manufacturer prior to conducting the test is reached] .* *The REESS shall be fully charge d 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*	The end of discharge criterion is reached when [the cut-off threshold as defined by the manufacturer prior to conducting the test is reached] . The REESS shall be fully charge d with a defined [constant power/C-rate] equal or less than C/5 according to operating limits and the highest normal charging power available at declared by the manufacturer 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	• The manufacturers need to explain declared values to TS or certification authority.	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
	REESS is detected by the on-board or external instruments.			
3.2.6.5	*[The RTE test of paragraph 3.2.6.4. of this annex shall be repeated for a total of xx repetitions as shown in Figure A3/4].* *The UBE measured shall be equal to the smaller value between the xx repetitions.*	*[The RTE test in this Annex 3.2.6.4. shall be repeated until the round trip efficiency shown in Figure A3/4 is 1.000±0.050.*	• It is necessary to judge the suitability of the tests conducted, and use the round trip efficiency value of 1.000±0.050, which is a versatile value that does not incorporate OEM intentions.	
Figure A3/3 Test sequence Method 2			• Describe detailed test conditions based on test results conducted by OICA	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
Figure A3/4 Test sequence repetitions			• Replace, according to the experimental results from OICA • It is necessary to judge the suitability of the tests conducted and use the round trip efficiency value of 1.000±0.050, which is a versatile value that does not incorporate OEM intentions. • Change energy to capacity. See OICA general comment above.	
3.3.1.1	*General* *This method allows both constant speed test and transient condition test on HD chassis dynamometer. The tests is carried out in the laboratory for easy control of environmental conditions. It can replace the scenarios of 1a and 1b.* *. . . .* *[A cycles test method by using HDV chassis dynamometer for measuring the UBE at certification and at given years or mileage [or*		• How could this be done? (demonstration to the responsible authority)	

Article	COM proposal, regulation text	OICA proposal, regulation text (proposals in blue)	OICA comments	
	kWh/equivalent full cycles] should be applied after pre-conditioning as an alternative method]. *[The equivalence of the method with Method 1a, 1b and 2 shall be demonstrated to the responsible authority.*			
3.3.1.6	***Test sequence***			
3.3.1.6.6	***Test method for OVC-HEV***			
3.3.1.6.6.3	Figure A3/5 Test sequence Alternative method  		• Should it be done on test bench level or vehicle level?	