DRAFT OICA Comments to GTR DRAFT version 14.12.2022

Part – 2 of OICA comments **Version 09.01.2022**

From OICA's point-of-view, these comments are valid and need to be addressed

	Excerpt from	Current text	Discussion Item – Proposed changes
PART 2 starting from here			
98	Tab 8.1	Add No. 1 from Table 8.2 as No.2 to Table 8.1 and adjust the following numbers	With this adaption there is no need to distinguish between Chapter 8.1.1 and Chapter 8.1.2. The only difference must be addressed by chosing the correct Wheel load / inertia.
99	8.1.2	Delete section, see comment above	Adapt 8.1.1 as stated before, this section can be deleted.
100	Tab. 8.1 SN: 12	The distance from the ~~center~~ axis of rotation of the brake (~~disc or drum~~) to the theoretical center of the friction material as defined in point (e) in this paragraph	Request for clarification: Geometrically the center of the brake does not necessarily be the axis of rotation, which is relevant.
101	Tab. 8.1 SN: 15	Disc/Drum maximum outer diameter	Request for clarification: Is this a measured value (how?accuracy requirements etc.?) or a disc manufacturer's specification value? Propose to have manufacturer's specification for a.) Disc outer diameter and b.) Drum inner diameter
102	Tab. 8.1 SN: 18	Piston Mean (or hydraulic) Diameter	Request for deletion: Is this a measured value or a disc manufacturer's specification value? What is it needed for? Why is it part of 8.1.1, but not of 8.1.2? d_piston is not used within the document apart from 8.1.1. (h) It should be deleted
103	Tab. 8.1 SN: 21	Threshold pressure	Proposal for deletion: There is no need for or benefit of this value. It is only used in the definitions and Table 8.1 and Table 8.2 without explaining for what it is used or required. If it is needed for calculations, the according equations must be added. Otherwise the value should be deleted.
103	Tab. 8.1 SN: 22	Brake runout limit	Proposal for clarification: A reference to the determination of this value should be added.

			Please see OICA proposal on runout measurement and include this chapter to the GTR.
104	8.1.1. (b)	(b) Brake Force Distribution (FAF or RAF) represents the ratio between the braking force of each axle and the total braking force on the vehicle, respectively. FAF represents the share of the braking force applied to the front axle. RAF represents the braking force share applied to the rear axle. The brake force distribution is expressed as a percentage. The brake force distribution for each vehicle (FAF or RAF) is provided by the vehicle manufacturer. ~~The brake force distribution per the default method on UN Regulation No. 90 for decelerations below 0.65 g shall be applied only whenever the vehicle manufacturer's specific value is not available. This corresponds to:~~ ~~(i) 77 per cent for the front axle and 32 per cent for the rear axle for category 1-1 vehicles;~~ ~~(ii) 66 per cent for the front axle and 39 per cent for the rear axle for category 2 vehicles with a fully laden mass below 3500 kg.~~	Request for clarification: If the foreseen "friction coefficients" shall be used for the calculation of vehicle emission values, the brake forces must add up to 100% otherwise the calculated value will not represent the vehicle emissions. Therefore the bullet points (i) and (ii) must be deleted and the vehicle specific values must be published and used.
105	8.1.1. (h)	Piston Mean (or hydraulic) Diameter (dpiston) for drum brakes is the wheel cylinder piston diameter. The dpiston for the disc brakes represents the equivalent piston diameter of the brake under testing. If the calliper contains several (n) pistons, the testing facility shall determine the piston hydraulic diameter using the equivalent individual piston diameters acting on one side of the calliper with Equation 8.5:	Request for deletion: This part is not used anywhere in the document and seems to be obsolete. If it is required, it should be repeated in 8.1.2 accordingly (if 8.1.1 and 8.1.2 are kept separate). THIS has already been commented in Part 1 – DELETE?
105	8.2.1. (a)	Verify the availability of all the test documentation, brake information, control program, dynamometer capabilities, and test conditions;	Request for clarification: The chapter does not describe the brakes, but the procedure, how to do the test. Question: Is there a description of the parts of "all the test documentation"? Please add reference or explicitly state, which documentation is needed. - Calibration of all devices should be valid - Manuals? - Certificates of sensors? - Which format? Electronically? Where should it be available? At the test bench or on a server? Question: Is this statement needed?

			There should be a requirement to use a certified test-rig, following ISO 17025 or a comparable standard. In this case, these will be fulfilled in any case and the sentence may be deleted. Question: What is meant here? The verification of the test conditions or the verification of the availability of the conditioning unit?
107	8.2.1. (h)	Perform brake static applies at brake pressures in the range of 3-30 bar to verify fluid displacement curve for bleed check and visual inspection of any fluid leak inside the enclosure;	Request for clarification: This sentences does not make sense in the current form. What is the reference for the fluid displacement curve? What are the criteria for “ok” and “not ok”? If this check is required, it must be described in more detail.
108	8.2.1. (j)	Perform acceleration events to reach different linear speeds (5 km/h, 50 km/h, and 135 km/h) and record residual torque during the acceleration to the set speed and after cruising at the target speeds for 10 seconds (at zero brake pressure). Verify that this spinning torque remains less than 20 N·m (excluding the torque absorbed by the dynamometer bearings). If the spinning torque exceeds this value check again the LRO, running clearance (including thermocouples wiring), and brake bleed, in that order of diagnosis;	Request for clarification: What happens, if the spinning torque remains 20Nm or above after the repletion? Does the facility continue with testing? What would be the point of repeating? Must the test be aborted? Then it should be clearly stated here. Request for clarification: This is not fully clear. Does this mean +/- 10Nm or +/-20Nm or below 0 and 20Nm absolute. This measurement is not necessary. On the one hand, there are sport brakes that intentionally have an increased residual braking torque, on the other hand, it can also come with "normal brakes" at higher speeds to a pressing of the pads. This measurement will therefore not provide correct or usable results. What happens, if this cannot be achieved, if all checks are performed and everything is as it should? The measurement of the LRO as described in point e is sufficient. Request for clarification: What if a brake is designed to have a certain residual torque larger than 20Nm. (e.g. to achieve a minimum disc temperature)? Will it be prohibited, as this check cannot be passed?
109	8.2.1. (k)	Repeat the first brake event of the WLTP-Brake cycle ten times to verify data collection, test parameters, brake test inertia, and overall system operation, if the test rig is not controlled by an enhanced automation system with internal verification	Request for addition: This check does not make sense in automated testing systems as they are standard in the automotive industry.

110	8.2.1. (n)	Verify all instruments and devices for brake emissions measurements are within the valid calibration interval and enabled and running without any errors and warning.	Request for addition: It should be clarified that only instruments are used that are properly working and correctly calibrated.
111	8.3 (f)	The installation of embedded or other types of thermocouples for measuring brake pad or shoe temperature during brake particle emissions tests in the context of this UN GTR is strongly discouraged.	Request for clarification: 8.3. (c) states that embedded thermocouples should be used. What does this mean? Is it allowed or is it not allowed? If it is allowed? Why is it discouraged? Request for addition: "If the installation of the thermocouple is not possible as required in this UN GTR for technical reasons, the testing facility may prove equivalency of the alternative method with the requirements of this UN GTR together with the technical authority." This proposal may provide the intended solution.
112	9.1.	192 km of total distance driven with an average speed of 43.7 km/h and a maximum speed of 132.5 km/h representing the 95-percentile of normal driving according to the WLTP database;	Request for addition: It should be stated that the cycle has been developed by intensively studying the WLTP data base and was not made up by collecting "arbitrary braking manoeuvres".
113	9.2.1. (b)	Warm the brake to (40±1) °C following a sequence of brake stops 1 to 7 of Trip #10 with a subsequent cooling phase down to (40±1) °C;	Request for clarification: What happens, if a brake by design will not achieve a temperature of 40°C (e.g. for vehicles with a very low WL/DM ratio)? OEM showed data within PMP TF that indicated the criticality of this requirement. Please specify, what should be done, if the 40°C cannot be achieved by design?
114	9.2.2. (f)	If the brake temperature at the end of the previous WLTP-Brake cycle is below 30 °C, discontinue the bedding section and identify discrepancies in the test execution or repeat the cooling adjustment. After fixing the issue, repeat the bedding section from the beginning;	Request for clarification: This could be critical for some low temperature brake designs. See comment to 9.2.1. (b) What measures should be taken if the 30°C cannot be achieved repeatedly? Please add information concerning this topic.
115	9.2.2. (g)	Run the five individual WLTP-Brake cycles consecutively without any interruption. Paragraph 9.3.2 describes the necessary actions in case of interruptions.	Request for clarification: What is the difference to (c)? Is this paragraph needed?
116	9.2.2.	The minimum threshold temperature of 30 °C specified in this paragraph applies to all tested brake assemblies. Failure to comply with the described brake temperature provisions shall result in an invalid bedding	Request for clarification:

		test and the testing facility shall repeat the bedding section. A new set of brake parts shall be used in case of repeating the bedding procedure. In case the temperature cannot be reached and there is no possibility to reduce cooling air speed. Document the conditions and temperature and continue to run the test at max achievable threshold temperature.	What happens if the brake does not achieve 30°C by design? E.g., large brake disc and lightweight vehicle or brakes designed for low temperatures to minimize particle emissions? Proposal for addition included.
117	9.2.3.	The minimum threshold temperature of 30 °C specified in this paragraph applies to all brakes. Failure to comply with the described brake temperature provisions shall result in an invalid emissions test. In case the temperature cannot be reached and there is no possibility to reduce cooling air speed. Document the conditions and temperature and continue to run the test at max achievable threshold temperature.	Request for clarification: What happens, if a brake will not achieve these temperatures for all trips due to their material or design? Proposal for addition included.
118	9.3.	WLTP-Brake Cycle Interruptions	Request for clarification: What is the purpose of this chapter? Why is it needed? It seems to be more appropriate to integrate these parts in the previous chapter(s), if required.
119	9.3.2.	If the test is interrupted (or the dynamometer faults) during the bedding section, the testing facility shall continue bedding from the point of interruption considering the last recorded timestamp in the Time-Based file with non-zero values for the braking parameters. The testing facility shall not conduct any warm-up stops or snubs to reach 30 °C if the actual brake temperature is lower. The testing facility shall not disassemble the parts. If the brake parts are disassembled after the beginning of the bedding section, they are no longer suitable for completing bedding and the subsequent emissions measurement. In such a case, the testing facility shall replace them with new brake parts and repeat the bedding procedure from the beginning.	Request for clarification: This statement does not make sense at all. Why should the test rig give zero-values (e.g., temp could get too high or low without being zero)? There is no conclusive description of possible failures available. Which are relevant, which are not relevant? This provision seems odd, as it is not clear how to guarantee the data integrity in case of stop and restart. For type approval an interrupted test should always be considered invalid. The test system must be robust enough to provide stable operation. How should the data-files be combined, and “manipulation” be excluded, if interruption is allowed? If bedding is interrupted the test must most probably be restarted to achieve 100% accurate and continuous and traceable data anyway. Input from technical authorities is required, if the provision will be acceptable. Proposal for deletion: This statement does not make sense. To disassemble the parts, the test rig must be stopped.

			If the test rig is stopped, the test-run is interrupted and cannot and the first part of the paragraph applies. Proposal for clarification: We assume that is statement better reflects the situation in the lab facility and clarifies the required steps to achieve a valid brake emission test. “Disassembling of the brake or replacing parts of the brake assembly is not permitted. If this is required for technical reasons the bedding procedure must be repeated from the beginning, If the replacing or reassembling of the brake may have effect on the temperature behaviour of the brake the cooling adjustment section shall be repeated as well.”
120	9.3.3.	If the test is interrupted (or the dynamometer faults) during one or more soaking sections between two consecutive trips, the testing facility shall continue the test without disassembling the parts or conducting any warm-up stops or snubs provided that the interruption does not exceed 1h. In such a case, the testing facility shall deactivate the particle sampling pumps and the cooling air supply at the time of the interruption (auto-controls are strongly recommended for that purpose). The testing facility shall resume the function of the sampling pumps and the cooling air supply once the test is commenced again and after the cooling flow is stabilised in accordance with the specifications described in paragraph 7.2.3. If the test is interrupted during Trips #1 through #10, the testing facility shall discontinue the emissions measurement section. The testing facility shall replace the used $PM_{2.5}$ and PM_{10} filters with new ones and restart the emissions measurement from Trip #1 at an initial brake temperature of (23 ± 5) °C without disassembling the parts.	Proposal for clarification: The test method is used to measure legally relevant emission factors. Therefore, the data integrity must be ensured. If tests are interrupted and restarted, this cannot be achieved. It is not clear how to compare the results of wear, also the „total driven distance“ of the brake assembly is different. For type approval an interrupted test should always be considered invalid. The test system must be robust enough to provide stable operation. Input from technical authorities is required Please add: If the emission measurement test is interrupted due to malfunction of the dynamometer or the measurement equipment, the test is invalid, and the section shall be repeated as a new test.
121	9.4.3.	Kinetic Energy Dissipation The kinetic energy dissipation quality check is necessary to ensure the application of the correct amount of specific friction work (Wf) during the execution of the WLTP-Brake cycle. It is also an additional quality check that other input parameters (e.g. brake test inertia) have been calculated and applied correctly. This quality check applies to all brakes equipped on vehicles within the scope of this UN GTR. The parameters of the brake	Request for clarification: This change has not been discussed with brake experts. Is it feasible to request the fulfilment of this topic?

		emissions family parent vehicle shall be used for the calculations when testing non-friction braking.	
122	9.4.3. (g)	During the emissions measurement section, the calculated friction work over the WLTP-Brake cycle shall be between 15184 J/kg and 16782 J/kg if no non-friction braking method is applied . This corresponds to ±5 per cent of the nominal value. Soaking sections shall not be included in the calculation;	Request for clarification: There is a need to define how to calculate the mean value and define the trigger to calculate the mean value (start time and end time for reference values): trigger on speed, or time, or pressure?
123	10.	Cooling Airflow Adjustment	Request for discussion: Depending on the brake system and the capability of the lab, the cooling airflow adjustment may be performed with a different number of cycles to achieve the target. This leads to differences in brake wear or friction material thickness. Therefore, all adjustment runs should be reported with sequential numbering. In this case, the same brake assembly can be used for all tests. Alternatively, the cooling airflow adjustment could be declared as optional if labs are confident to meet the requirements on the first try. If the requirements are not met in this case anyway, bedding and emission measurement should be completed with new parts and corrected airflow. This should be discussed with all involved testing parties to minimize testing effort and time, number of parts to be used and fulfil documentation requirements at the same time. (see addition at end of paragraph)
124	12.1.1.1. (b)		Proposal for deletion: We propose to only allow a four sampling-probe layout. See comments in appropriate chapters above.
125	12.1.1.3. (h)	Place the nozzles with their axis parallel to that of the dilution tunnel making sure that the aspiration angle remains lower or equal to 15°;	Request for clarification: An angular deviation of less than 5° can easily be noticed without any additional means just by eyeballing. Therefore 15°C seem to be a quite large tolerance. Please consider lowering the tolerance.
126	12.1.1.3. last sentence	Clean the nozzles before every brake emissions test following the specifications defined by their manufacturer regarding the cleaning means.	Request for clarification: Why do the nozzles need to be cleaned before each test, but the probes only every 6 months? Please explain and consider different intervals.

127	Tab. 12.1 & 12.2		Request for clarification: Where do these numbers come from? Is there a standard or any document that defines the procedure to derive this number? How can a lab facility show compliance to this request? There should be a statement like: "The efficiency shall fulfil the requirements according to ISO …." Is there a material / density / morphology dependency on this specification? What is the reference material? If there is no such document, it is required to describe a method to deliver that in this UN GTR.
128	12.1.2.2. (e)	Design the sampling train outside the tunnel (the part of the sampling train that includes the cyclonic separator and the PM sampling line) in a way that no condensation of water can occur. The temperature inside the sample train shall always remain above 15 °C;	Question: What is the intention of this requirement? Justification: From our understanding the test rig should complete be in an aera that has a minimum of air-conditioning. Condensation on any device (PN-counter, enclosure, etc) must be avoided. We would strongly recommend to delete this requirement here and require a test-rig setup within a conditioned and dry location.
129	12.1.2.3. (b)	The temperature sensor shall have an accuracy of ±1.0 °C. The pressure measurements shall have precision and accuracy of ±1.0 kPa;	Request for clarification: Are there requirements on the rise time / fall time of this sensor? We assume that certain time restrictions should apply to achieve accurate results. Due to the length of the test (>>5h), drift restrictions must be added to ensure that the measurement will be correct.
130	12.1.2.4.	U is the average airspeed in the tunnel in km/h per Table 13.2;	Proposal: We would prefer to use the air speed in m/s and adapt the equation accordingly. It is very unlikely to use km/h. Sensors generally provide m/s.
131	12.1.3.1.	Select a filter holder made of inert and non-corroding material such as stainless steel or anodized aluminium;	Request for clarification: What about electrical conductivity? Please add an according statement.
132	12.1.3.1.	The usage of multifilter-holders should be allowed to improve the measurement quality and time-of-use of the brake emission test-rig. For these holders the following requirements apply:	Proposal for addition: Justification: - The current description of the procedure does not allow an adequate use-time of the equipment. It is not possible to start a

		(a) The device manufacturer has to provide information that no negative effect on PM emission factors exist. This may be done by correcting losses or provide according and appropriate measurement data. (b) All holders shall be mounted in the same housing under the same conditions (c) The same flow shall be used for the sampling of different filters (d) The limit of consecutively used filters shall be three to allow measuring for approx. 12h to 16h (e) Only one filter shall be used at a time (f)++ …additional provisions to be discussed	test later than Wednesday afternoon to finish it before the weekend - Multifilter holders allow the sampling either during bedding or for additional emission measurement tests. - It helps to check if bedding is completed - It allows to run tests in a sequence and identify the differences without any change to the brake assembly - There is a possibility of particle loss, which can be overcome by design and even loss correction. - This provision is important to adress to topic of new applied braking technology and materials, where we do not have knowlegde, if the proposed bedding procedure will be appropriate.
133	12.1.5. (b)	Calculate the average normalised tunnel flow (NQ), the average normalised sampling flows (NQPM2.5 and NQPM10), and the total distance of the WLTP-Brake cycle (d) over the emissions measurement section from the given parameters in the Time-Based file;	Proposal for deletion: These statements may be contradiction or at least misleading in combination with the reference to Table 13.2 in the description of the terms below equation 12.8
134	12.2. (c)	A suitable tube (Particle Transfer Tube – PTT) that transfers aerosol from the outlet of the sampling probe to the inlet of the pre-classifier. When the pre-classifier is directly mounted to the outlet of the sampling probe, the PTT may be used to transfer the particles from the outlet of the pre-classifier to the inlet of the dilution system. The specifications for the design of the PTT are described in paragraph 12.2.1.4;	Request for clarification: Please specify the mounting position of the pre-classifier directly at the end of the probe to minimize systematic differences between setups. In that case the PPT will connect the end of the pre-classifier with the inlet of the dilution system
135	12.2.1.1. (e)	When applying a flow splitting device, demonstrate that the penetration with and without the splitter remains within ±5 per cent at all operating conditions. Perform the comparison by measuring the particle penetration at 15 nm and 1.5 µm with and without the flow splitter.	Request for clarification: For our point-of-view this cannot be checked with the systems installed at the brake dyno. This must be checked in an aerosol lab by the manufacturer of the devices and stated as a instrument characteristic. Which material should be used? We are not aware of a PN-generator providing 15nm and 1,5µm particles at the same time or with the same setup. How long should this be tested? 1 min, 5 min, 5h? How should the setup for this test look like?

			Will it be a closed loop system? Is there a similar test for the flow splitters that can be used for the calibration of CPC in PN-labs? Could the description of this test be used or cited? In any case, this topic cannot be handled by a simple paragraph in this chapter. It should be shifted to a different position and described in detail.
136	12.2.1.2. (c)	Select probe(s) with a constant inner diameter (dp) of at least 10 mm and a maximum of 18 mm ensuring a laminar flow (10 mm ≤ dp ≤ 18 mm) under all operating conditions;	Request for clarification: To minimize systematic influences, we propose the usage of a single defined diameter. Input of system manufacturers required
137	12.2.1.2. (d)	The overall length of the probe(s) from the sampling nozzle tip to the inlet of the particle transfer tube or the pre-classifier shall not exceed 1 m;	Request for clarification: Although the intension of this statement is clear, it is ambiguous. According to Fig 12.2 the pre-classifier is part of the "PN-unit". Therefore, the probe end always at the inlet of the PTT.
138	12.2.1.3. (g)	Place the nozzles with their axis parallel to that of the sampling tunnel making sure that the aspiration angle remains lower or equal to 15°	Request for clarification: An angular deviation of less than 5° can easily be noticed without any additional means just by eyeballing. Therefore 15°C seem to be a quite large tolerance. Please consider lowering the tolerance to 5° or 10°. In fact, the nozzles are actually mounted to the probes. If the probes have to be straight, we do not see an option to mount the nozzle in a different angle. Perhaps the positioning of the probes should be defined accordingly.
139	12.2.1.4.	When the PN pre-classifier is not directly connected to the probe's outlet, a suitable particle transfer tube (PTT) shall be used to transfer aerosol from the probe's outlet to the PN pre-classifier's inlet. When the PN pre-classifier is directly connected to the probe's outlet, the PTT shall be used to transfer aerosol from the PN pre-classifier's outlet to the sample conditioning system's inlet.	Request for harmonization: Justification: To minimize systematic deviations between setups, please only use one of the alternative mounting. Preferable: pre-classifier directly at sampling probe
140	12.2.1.4. (c)	Select transfer tubes with an inner diameter (dtt) of at least 4 mm ensuring a laminar flow under all operating conditions;	Request for clarification. This statement contradicts paragraph (b). We propose to delete (b) and replace it, if necessary, by an appropriate statement.
141	12.2.2.1.	(a) Use two cyclonic separators when applying different sampling probes for the TPN10 and SPN10 emissions measurements; (b) When a single sampling probe is used for both TPN10 and SPN10, use one cyclonic separator when placed upstream of the flow splitting	Request for harmonisation: 1. Only one alternative should be allowed to minimize systematic deviations between test-setups.

		device. Alternatively, two cyclonic separators shall be used when placed downstream of the flow splitting device; (c) Place the cyclonic separator anywhere between the outlet of the sampling probe and the inlet of the sample conditioning system;	2. Preferably the 2-cyclone setup should be used, as it allows the usage of the identical cyclones independent of the use of a flow splitter. 3. The cyclones should be mounted directly after the flow-splitter.
142	12.2.2.1.	(d) Use commercially available cyclonic separators with a 50 per cent cut point particle diameter between 2.5 µm and 10 µm at the volumetric sample flow rate that passes through the cyclonic separator; (e) The cyclone shall achieve a minimum penetration efficiency of 80 per cent for a particle diameter of 1.5 µm;	Request for clarification: What is the definition of penetration efficiency? We assume that at least 80% should be separated at 1,5µm as the relevant particles are accounted in PM10 / PM2.5 measurments. To our understanding the CPC optimum operational range is below 1µm. Is this a cut-and-paste error only? Please clarify the requirements and numbers.
143	12.2.2.2. (d)	It shall be capable of maintaining the diluted gas temperature at the inlet to the PNC below 38 °C	Request for harmonization: Here the temperature limit is 38°C, but for SPN it is depending on the specification of the CPC manufacturer. Please harmonize
144	12.2.2.2. (h)	It shall report PCRF-corrected TPN10 concentrations at standard conditions at a reporting frequency equal to or greater than 0.5 Hz	Request for clarification: For the mathematical operations the frequency should be the same as that of other signals. Therefore, we propose to use 1 Hz here as well. To our knowledge, this should not be a problem for commercially available systems.
145	12.2.2.2. (i)	It shall achieve a total particle penetration efficiency of at least 70 per cent for particles of 100 nm electrical mobility diameter;	Request for clarification: What is the method to achieve this? What material should be used? Does this 70% include the PCRF correction or not? How often is this check performed?
146	12.2.2.2. (j)	It shall be capable of operating at sample pressures in the (850 to 1050) mbar range and relative pressure differences from ambient in the ±50 mbar range.	Request for harmonization: We recommend to add this requirement to the PM section as well.
147	12.2.2.2.		Please note that not all relevant comments of the TPN section have been repeated in the SPN section. Therefore, care should be taken to cross-check, if comments are relevant for both use-cases.
148	12.2.2.2. (l)	It shall be capable of diluting the sample in one or more stages to achieve a PN concentration below the upper threshold of the single-particle count	Request for clarification: This dilution ratio will only work this an active catalytic stripper.

		mode of the PNC. The overall system shall be capable of providing a dilution factor of at least 10:1;	Otherwise, the secondary diluter must be mandatory and an additional dilution 1:10 must be added. Please clarify these details in the requirements.
150	12.2.2.2. (s)	It shall report PCRF-corrected SPN10 concentrations at standard conditions at a reporting frequency equal to or greater than 0.5 Hz;	Request for clarification: Please use 1Hz as a fixed frequency
151	12.2.2.2. (u)	It shall achieve a solid particle penetration efficiency of at least 70 per cent for particles of 100 nm electrical mobility diameter;	Request for clarification: Taking into account the PCRF?
152	12.2.3.1. (d)	Have a linear response to particle concentrations over the full measurement range in single-particle count mode;	Request for clarification: What is the meaning of linear in this context? How is this checked? Is this certified by the instrument manufacturer?
153	12.2.3.1. (g)	The PNC calibration material shall be 4 cSt polyalphaolefin (Emery oil), soot-like particles (e.g. flame generated soot or graphite particles), or silver particles;	Request for clarification: Why are there three different materials allowed? If they provide the same result, only one should be used. If they provide different results, which one is the correct one to be used? It would be preferable and beneficial to only use one material.
154	12.2.3.1. (h)	Have counting efficiencies at nominal particle sizes of 10 nm and 15 nm electrical mobility diameter of (65 ± 15) per cent and above 90 per cent, respectively. These counting efficiencies may be achieved by internal (e.g. control of instrument design) or external (e.g. size pre-classification) means;	Request for information: Please explain, if and why this is required? What is the difference? What is the benefit? How is this property checked? Is a regular check required?
155	12.2.3.2. (b)	Use a flow measurement device calibrated to report flow at both operating and standard conditions. To ensure an appropriate conversion to operating conditions, the temperature sensor shall have an accuracy of ±1.0 °C and the pressure measurements shall have a precision and accuracy of ±1.0 kPa;	Request for clarification: Why are there requirements on accuracy for temp and on accuracy and precision for pres. Please add provisions for precision for temp as well. What about requirements concerning drift stability, rise time / fall time etc of the sensor?
156	12.2.3.2. (h)	The PN sampling devices shall operate continuously during the brake emissions measurement section. This includes also the cooling sections between the individual trips of the WLTP-Brake cycle where the PN sampling flow shall not be paused or bypass the main sampling line. The PN sampling devices shall operate until the post-test background verification is completed	Request for clarification: At which time the recording of the measurement values shall be stopped? Due to the allowed time shift between the PN signals and the "actual test time", the averaging cannot be done simply within the same time boundaries. How the time shift shall be addressed in the calculations?
157	12.2.4.	SPN10 EF=〖10〗^6×((SPN_(10 #)×NQ))/V	Request for clarification:

			It appears that this calculation method is not correct. The PN-concentration strongly depends on the total volume flow. Therefore, the average concentration should be calculated by creating the sum of NQ(t) * SPN#(t) and dividing it by the total driven distance. In other words, the particle number per second must be calculated and summed up for the overall test and then devided by the total volume during the test to achieve the average particle concentration.
158	12.2.4. (a) – (c)		Request for correction: Presumably, the calculation method is wrong. Therefore, these paragraphs need to be corrected as well.
159	12.5.1.c	Calculate the PM2.5 and PM10 EF0 of the tested brake following Equations 12.7 and 12.8, respectively. Then, use the friction braking share coefficient in Table 5.1. that corresponds to the vehicle type of which the parameters were used for testing the brake to calculate the final PM2.5 and PM10 EF of the tested brake. Use Equations 12.9 and 12.10 for the calculation of the final PM2.5 and PM10, respectively; $PM_{2.5}\ EF = PM_{2.5}\ EF_0 * c$ (Eq. 12.9) $PM_{10}\ EF = PM_{10}\ EF_0 * c$ (Eq. 12.10)	Need to discuss See also comment Version 1 (No 97)
160	13.1. (a)	Tab 1 titled “Test ID – EBF – Raw Data” shall include all raw data registered by the brake dynamometer throughout the entire test	Request for clarification: What is meant by “all raw data”? This is a not acceptable statement. Who defines what all data is? E.g. the dyno might register the name of the operator for internal documentation reasons. This is irrelevant information and cannot be reported to external bodies. But it would be part of “all data”. Even the term “all relevant data” is critical. Who is defining which data is relevant? What is the purpose of this request? If such data is required for the evaluation of a brake test, then it must be specified in detail, which data needs to be provided in which quality and format.
161	13.1.	The testing facility shall continuously and automatically register and/or calculate the parameters listed in Table 13.1. Details regarding the applied units, number of decimals, and the registration frequency of each parameter	Request for clarification: The calculation / control of data is done in different frequencies for different parameters. Furthermore, the recording of the data is done

		are given in Table 13.1. Registration frequency in the context of this GTR is the frequency in which the automation system measures and registers the various parameters. In the Event-Based File, the parameters are always reported for each braking event; therefore, the registered values are averaged to calculate a unique value for the given brake event. Table 13.1. also provides a short description of each parameter and the symbol used throughout the text (where applicable).	at a different frequency as well, e.g. as an integral or a moving average is used to smoothen fast signals. We strongly recommend to separate the terms sampling rate, measurement rate, control rate etc and recording rate (most probably the registration rate").
162	Tab 13.1	Registration Frequency	Request for clarification: Using different recording frequencies in one ASCII-based file may cause severe data volume increase. Please delete this column and request a constant recording frequency of 1Hz
163	Tab 13.1 R		Request for clarification: The thermocouple ist not defined with a rise/fall tine. We assume it would be something like 0.5s. Therefore, if does not make sense to sample with a frequency significant difference from that value. Furthermore, the heat capacity of the brake assembly does not allow for temperature changes of several K in a few milliseconds. The frequency should be 1Hz. Same for all other temperature values.
164	13.2.	Time-Based File	Shifted/Repeated comment from "definition" section: Request for clarification: e.g. deceleration should be given with unit and recording frequency. The term "registered" is not defined (to be checked) Valid for other terms as well. What about the rise time / fall time etc.
165	Tab. 13.2. F	Brake Torque	Request for clarification: Due to the long duration of the test and the changes in temperature, the torque sensor may show drift behaviour. Is this value corrected accordingly?
166	Tab 13.2 X & AA	Arithmetic average particle concentration reduction factor for the TPN10 measurement	Request for clarification: The PCRF is defined in a laboratory as a fixed system specific value. It does not change. As the dilution is varying in the lab in the same manner as during operation, the dilution variation is (more or less) addressed by its determination. It cannot change during a test. This does not make sense.

			This value can be reported as a header value but not as a 1Hz data value.
167	13.3	The file shall include information about weighing the filters as specified in paragraph 12.1.5. as well as for weighing the brake parts as specified in paragraph 12.3	Request for clarification: The current observation is that there will be a limit value for PM and PN but not on brake "wear mass". For this reason, we request a separation of these to parameters in file-handling, data processing and so on. Otherwise, there could be a situation that irrelevant parameters are "influencing" results of relevant parameters in a "negative" way due to inaccuracies in procedure etc. Concrete distinguishing is required. Request for clarification: As already stated above, it seems very difficult to guarantee data integrity if the file is changed at least 3 time. Pre-weighing procedure --- storing brake assembly data Pre-weighing filters --- storing PM data Post-weighing filters --- storing PM data and calculated result Post-weighing procedure --- storing brake assembly data and calculated results. If the date is collected only at the Post-state, the file must be changed at least once anyway.
168	Tab. 13.3.	Necessary parameters related to the PM mass measurement procedure for reporting at the Mass Measurement file of a brake emissions test	Request for clarification: During the complete chapter the usage of the term PM and mass is somewhat confusing. We strongly recommend using the terms strictly as defined and add definition if required. It should be a clearly distinguishable difference between PM and brake wear or brake mass loss.
169	Tab. 13.4. A	A unique code that allows the testing facility to identify the tested brake – Shall be the same as in "Test ID" in Table 13.6	Request for clarification: The reference measurement is performed with a different filter at a different time. Therefore, it will have a different test ID. From our point-of-view, the link to the reference test is the important information. The reference test can be provided in this format, but it might be valid for several PM-tests.
170	Tab. 13.5. N	Total distance covered during the entire brake emissions test including all sections (and all Trip #10 iterations during the cooling adjustment section, if applicable)	Request for change: Only the distance of the bedding and the emission measurement section should be considered as the cooling air adjustment adds

			additional distance to the brake and the emissions are not accounted for.
171	13.4	The testing facility shall create a unique, complete, and traceable dataset as an input file for the generation of the test report for the specific brake under testing. Table 13.6. contains all the necessary information to include in the report. All information in the report shall be correlated to the specific brake. The test facility shall submit the report in a *.pdf or equivalent format.	Request for clarification: What is the meaning of “unique”? In principle, if a copy of the report is taken to an archive, it is not unique anymore. We assume: The report should have a checksum or any other means to ensure that it cannot be altered after it has been generated. If this assumption is correct, please add an according description and definition. Request for clarification: What is the meaning of “correlated” her? E.g., testing of a different brake of the same batch achieves a “correlating” result as the batch is the same. We assume that the relevant information of the report shall be generated with only one brake assembly. However, if a cooling air adjustment is performed with a different brake, than there is no correlation anymore. Please refine definition and description. Input of authorities required, which information is needed. Only important and relevant information must be included.
172	Tab. 13.6. SN: 9	Part number for the friction material	Please check, if part number or serial number is of relevance
173	Tab. 13.6. SN: 25	Average cooling air temperature – Cooling adjustment section	Request for deletion: Although, this information might be of interest it can/should be determined with a different brake. Therefore, if is not correct to put these temperatures in the report without further comment. In principle the temperature is not required. The only information needed is, if there have been any violations of the boundary conditions during the emission measurement. Simple statement: Temp above recommended value … sec Temp below recommendation… sec Etc. Finally: Temp boundaries fulfilled: yes/no

174	Tab. 13.6.	All Rows with Average Values	Request for deletion: Although, this information might be of interest it is provided in the time based files etc. For the report it is not relevant: The simple question is: Temp boundaries fulfilled: yes/no Please delete this term
175	Tab. 13.6. SN: 159&160	PM sampling nozzles – aspiration angle	Request for deletion: In this GTR a quite large tolerance is given. This indicates that the value is of low relevance. However, if a angle must be measured (otherwise it cannot be reported) than there is no need for such a large tolerance. We recommend to delete #200 and #201 and accept the proposal at the according chapter.
176	Tab. 13.6. SN: 162&163	PM separation device – cut-off size	Request for change: The separation devices are most probably defined by design; therefore, it would be beneficial to put the serial number and type in the document. This would allow to check, if the device is properly calibrated and fulfilling the requirements. The cut-off size does not tell anything of the concept or operation mode. The devices must have a certificate of compliance to be used.
177	Tab. 13.6. SN: 187	Verify that the weighing balance has been stored in an appropriate room fulfilling all the requirements described in paragraph 12.1.4 of this GTR	The weighing room and the balance is an integrate part of the lab. Therefore, it must be certified in the same way as the test rig. The climate shall be monitored all the time and recorded to ensure that no severe changes occur. Reporting the conditions at the moment of measuring should be sufficient in this case.
178	Tab. 13.6. SN: 188	Report the resolution of the weighing balance used for weighing the PM10 and PM2.5 filters	Setup topic, covered by lab certification. Compliance required. No additional entry to the report needed
179	14.	Calibration Requirements and Ongoing Quality Controls	Request for additional discussion: Justification: This chapter has not been commented in detail due to the lack of experience in all relevant fields. However there is a need for discussion on some of the requirements and some missing requirements. Bullet points:

			- Drift stability of sensors - Calibration intervals - Accuracies - Rise times / fall times / response times - Responsibilities for calibration (who has to do what) - Particle size and material - Concentrations of relevance - “Lab certification” Etc.