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DISCLAIMER

This document is intended to facilitate the implementation of Commission Regulations (EU) 2016/427, 2016/646, and 2017/1154 related to the procedure to verify the Real Driving Emissions (RDE) performance of light passenger and commercial vehicles. It is itself not legally binding.

Any authoritative reading of the law should only be derived from the Commission Regulations mentioned above. While this note seeks to assist authorities and operators by explaining the applicable law, only the Court of Justice of the European Union is competent to authoritatively interpret Union legislation.

Questions

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1. ON THE PREPARATION OF THE VEHICLE

1.1. Is it allowed to use a trailer to carry the PEMS?

Yes, the main PEMS unit containing the analysers to measure gaseous emissions and/or PN, as well as the control unit, can be installed either inside or outside the vehicle according to the specifications of the instruments supplier. The PEMS in the exterior of the vehicle can be placed on a tow bar or a trailer hook using a platform.

1.2. Can I install a PEMS on top of the vehicle?

No, it is not allowed to install a PEMS unit on the roof of the vehicle because it impacts the vehicle frontal area and may have a significant impact on its aerodynamic characteristics.

1.3. Windows should in principle be closed, but can the exhaust line be routed to the PEMS installed inside the vehicle through a window?

Yes, when the PEMS is installed inside the vehicle the sampling line can be routed towards the analysers through a window or an access door, always trying to minimize aerodynamic modifications of the vehicle.

1.4. In case the basic payload (as described in point 5.1.1. of Annex IIIA) exceeds 90 % of the sum of the "mass of the passengers" and the "pay-mass" defined in points 19 and 21 of Article 2 of Regulation 1230/2012, but the RDE test vehicle mass is still below the technically permissible maximum laden, is the vehicle fit to perform a valid RDE test?

No, if the payload exceeds 90% it is not permitted to perform an RDE test.

1.5. According to the description of the PEMS test procedure (Appendix 1) "Test start", the sampling, measurement and recording of parameters shall begin prior to the "ignition on" of the engine. What does "ignition on" mean exactly? At "Test end", the vehicle has completed the trip and the ignition is "turned off". What does "ignition off" mean exactly?

"Ignition On" means when the driver presses the vehicle start button/turns the key - which may or not involve starting the internal combustion engine. "Ignition Off" means when the driver presses the button that stops the vehicle movement/turns off the key - which stops the engine(s).

2. ON THE VEHICLE PRECONDITIONING

2.1. **Is there any specific preconditioning to apply before the RDE test?**

Yes, according to the RDE regulation, the vehicle must be "*Driven for at least 30 min, parked with doors and bonnet closed and kept in engine-off status within moderate or extended altitude and temperatures in accordance with points 5.2.2 to 5.2.6 between 6 and 56 hours. Exposure to extreme atmospheric conditions (heavy snowfall, storm, hail) and excessive amounts of dust should be avoided. Before the test start, the vehicle and equipment shall be checked for damages and the absence of warning signals, suggesting malfunctioning.*"

The recommendations regarding the use of vehicle air-conditioning, auxiliary devices, payload, road condition, gear shifting, tires conditions and the driver behaviour also apply to the pre-conditioning drive.

2.2. **Can the vehicle and the PEMS, be soaked outside or inside?**

The vehicle and PEMS may be soaked inside or outside at any ambient temperature within the RDE regulation i.e. from -7 to +35 C, since the RDE regulation does not specify particular soaking conditions. The emissions must comply with the NTE limits even when it has been soaked outside all night in extended temperature conditions (≥ -7 C). If the vehicle was conditioned for the last three hours prior to the test at an average temperature that falls within the extended range in accordance with point 5.2, then the provisions of point 9.5 of Annex IIIA apply to the cold start period, even if the running conditions are not within the extended temperature range.

2.3. **Can the vehicle be preconditioned in the dyno?**

The RDE regulation does not specify if the drive for the vehicle preconditioning can be done on the dyno, it is however recommended to drive at least 20 to 25 minutes on the motorway to limit the risk of regeneration of the DPF during the actual test.

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3. ON THE CHARACTERISTICS OF THE TRIP

3.1. On which days can an RDE test be performed?

PEMS testing performed in the context of RDE must be done on working days, meaning all days other than Saturday, Sunday, and public holidays.

3.2. At what time can an RDE test be performed?

The intention of Point 7.4 of Regulation 2016/427 is to ensure vehicle testing is done under normal traffic conditions, as frequently experienced by vehicle users, around normal office hours, between 7 am and 8 pm.

3.3. What happens, if the vehicle is driven at 61 km/h during the urban part of the trip? Is this time accounted as rural driving, urban driving, or does it invalidate the test?

According to the RDE regulation, "*the urban part of the trip should be driven on urban roads with a speed limit of 60 km/h or less. In case the urban part of the trip needs to be driven for a limited period of time on roads with speed limit higher than 60 km/h, the vehicle shall be driven with speeds up to 60 km/h*". If speeds are occasionally above 60 km/h, these driving events will be classified as rural or motorway driving (depending on the speed). Upon the completion of an RDE trip, between 29% and 44% of the total trip distance has to be driven at speeds ≤60 km/h; else the trip is invalid (see Point 6.6 of Regulation 2016/427).

3.4. The rural and motorway parts of the trip may be interrupted by short periods of urban operation, but how long are these "*short periods*"?

The intention of the trip composition is to ensure that RDE trips are composed of clearly distinguishable urban, rural, and motorway parts. As RDE applies a speed-based classification of urban, rural, and motorway driving (as opposed to classification based on street maps), rural driving may be interrupted by speeds of ≤60 km/h, e.g., when crossing villages or passing traffic lights, and motorway can be interrupted by speeds of <90 km/h (tolls in the highway, dense traffic). As a pass-fail criterion, 33 ± 10% of the trip distance has to be driven at speeds between >60 and 90 km/h and 33 ± 10% of the trip distance has to be driven at speeds > 90 km/h (see Point 6.6 of Regulation 2016/427). The time driven at ≤ 60 km/h is included in the urban part of the trip.

3.5. What happens if the vehicle speed during the motorway part of the trip exceeds 145 km/h? Is this data to be included in the motorway share, is it excluded, or does it void the test?

The RDE regulation states that the maximum speed shall not exceed 145 km/h but it "*may be exceeded by a tolerance of 15 km/h for not more than 3 % of the time duration of the motorway driving*". Therefore, driving events with speeds >145 km/h and ≤ 160 km/h are considered as motorway driving as long as the time driven at these speeds is ≤ 3% of the total motorway time. Driving events > 160 km/h invalidate the trip.

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3.6. **Regarding The speed range of the motorway driving, what does "*properly cover a range between 90 and at least 110 km/h*" mean?**

This means that the speed distribution should include driving events between 90 and 110 km/h.

3.7. **For M2 category vehicles, if vehicle speed is over than 100km/h, is this test valid or invalid? For N2 category vehicles, if vehicle speed is over than 90km/h, is this test valid or invalid?**

In the context of the RDE regulation, speed limits remain in force. However, violations of local speed limits per se do not invalidate the results of a PEMS test. For M2 category vehicles the speed range of the motorway driving shall properly cover a range between 90 and 100 km/h (with velocity above 90 km/h for at least 5 minutes). If the vehicle is driven above 100 km/h the test is still valid. For N2 category vehicles the speed range of the motorway driving of shall properly cover a range between 80 and 90 km/h (with velocity above 80 km/h for at least 5 minutes). If the vehicle is driven above 90 km/h the test is still valid.

3.8. **Is a combination of trips other than urban-rural-motorway compliant with RDE (e.g., U-R-M-R-M)?**

The trip sequence shall consist of urban driving followed by rural and motorway driving. The urban, rural and motorway operation shall be run continuously. Therefore, routes cannot be designed in a way that does not comply with the U-R-M order. However, since the rural operation can be interrupted by short periods of urban, and the motorway can be interrupted by short periods of either urban or rural, it is possible to drive a route, which is RDE compliant, with an U-R-M-R-M design, as long as the shares of each part comply with the RDE requirements and the trip starts with an adequate part driven in urban.

3.9. **Which are the permissible ambient temperature conditions to perform an RDE test?**

It is possible to precondition and perform an actual RDE test under moderate (≥ 0°C and ≤ 30°C) and extended (≥ -7°C and < 0°C or > 30°C and ≤ 35°C) temperature conditions. The emissions during the part of the trip performed under extended temperature conditions should be divided by 1.6 before being evaluated. Outside the moderate and extended temperature conditions the trip is not valid. If the vehicle was conditioned for the last three hours prior to the test at an average temperature that falls within the extended range in accordance with point 5.2, then the provisions of point 9.5 of Annex IIIA apply to the cold start period, even if the running conditions are not within the extended temperature range.

By way of derogation, until the dates indicated in the table below, the ambient temperature are characterised as: moderate (≥ 3°C and ≤ 30°C), and extended (-2°C to <3°C and >30°C to 35°C). The correction factor applies also during the derogation period.

Derogation limits apply until	Vehicles of categories M1 and M2	Vehicles of category N1 (class II and III) and category N2
New types of vehicle	01 January 2020	01 January 2021
New vehicles	01 January 2021	01 January 2022

Vehicle categories defined in Annex II to Directive 70/156/EEC

3.10. Is a trip valid if it starts in extended conditions and it finishes in normal conditions?

If during a particular time interval the ambient conditions are extended then the emissions during this particular time interval shall be divided by 1.6 before being evaluated. If the test conditions are beyond the ones defined as extended, then the test is invalid.

3.11. Which are the recommended settings of the auxiliary systems (AC, radio, cruise control, etc.) during an RDE trip?

The air conditioning system and other auxiliary devices can be operated in a way which corresponds to their possible use by a consumer at real driving on the road. Any misuse of the air-conditioning system should be avoided. Electrical auxiliaries that are automatically shut-down when their goal is achieved (i.e. rear window heating, mirror heating, etc.) should only be re-started again if actually needed for a safe driving. It is not permitted to power any external device (telephone charger, electric fan, mini-fridge, etc.) with the vehicle's battery. It is permitted to use the cruise control during an actual test.

3.12. Can a hot test be driven right after a cold RDE test? Do we need to turn off the engine before running a hot RDE test?

For RDE tests in warm engine conditions, there is no need to precondition the vehicle as described in Point 5.3 of Annex IIIA. An engine can be considered as warm when the vehicle has been driven with the internal combustion engine before the hot RDE test at least for 5 minutes (preferably 10 minutes). Therefore, it is possible to drive a hot test just after a cold one. However, since the test end is defined as "*when the vehicle has completed the trip and the combustion engine is switched off*" (Point 5.3 of Appendix 1), it is not possible to keep the engine on in between PEMS tests.

3.13. Does the 90s allowance of vehicle stop for the cold start refer to aggregated 90s of stop time during the whole period of cold start or to individual stops of 90s?

During the cold start, the vehicle stop time shall be kept to the minimum possible and it cannot exceed 90 seconds (aggregating the stop time of all stops). Otherwise the trip would be invalid. For example, a trip with 5 stops of 18 seconds each during the cold start period is valid (stop time ≤ 90 s). However a trip with 2 stops (1st stop: 85 s; 2nd stop 10s) is not valid (stop time > 90 s).

4. ON THE CHARACTERISTICS OF THE VEHICLE INSTRUMENTATION

4.1. **Which frequency should be used when measuring parameters with sensors with different frequencies?**

Sensors should sample and record trip parameters at constant frequency of at least 1 Hz. If any of the sensors records at a higher frequency than the others, then the recorded signal has to be down sampled to match the common frequency of the other sensors (at least 1 Hz) with an appropriate interpolation method (integral interpolation, pchip, etc.)

4.2. **Is it possible to use ECU signals during a PEMS test?**

In the context of RDE, the PEMS test procedure for vehicle emissions, as described in Appendix 1, states in its section 3.4.5. Connection with the Engine Control Unit that if desired, relevant vehicle and engine parameters (vehicle speed, engine torque, engine speed, engine coolant temperature, and other in Table 1) can be recorded by using a data logger connected with the ECU or the vehicle network following standards, e.g. ISO 15031-5 or SAE J1979, OBD-II, EOBD or WWH-OBD. Therefore it is possible – under certain conditions - to connect to the ECU during a PEMS test although it is not necessary. **In particular, in the context of type approval it is not possible to use the ECU to gather data to calculate the exhaust flow. The exhaust flow has to be measured always using an exhaust flow meter**.

5. ON TRIP VERIFICATION

5.1. How to calculate the altitude gain for the urban part?

The procedure to determine the cumulative positive elevation gain of a trip is described in Appendix 7b of RDE regulation. For the complete trip, it is a 3-step procedure: i) the screening and principle verification of data quality; (ii) the correction of instantaneous vehicle altitude data; and (iii) the calculation of the cumulative positive elevation gain. For the calculation of the urban part a 0 step is required: deleting from the original time series the data corresponding to rural and motorway parts of the trip. Then the calculation of elevation gain will follow the normal procedure described in Appendix 7b.

5.2. Should the corrected altitude data from Appendix7b Section 5.2 or the smoothed altitude data from Appendix 7b Section 5.3.2 be used elsewhere in results evaluation - i.e. for determination of "extended" altitude conditions in Annex IIIa 5.2?

The altitude correction and smoothing applied in Appendix 7b is to be applied only for the calculation of altitude gain of the trip. For other calculations dealing with altitude, such as the calculation of extended conditions, or the difference in altitude between the start and end points of the trip, the original altitude data from the Exchange File that has only be subjected to the consistency check in Appendix 4 Section 6 shall be used.

5.3. Shall smoothed vehicle speed from Appendix 7a Section 3.1.1 be used for all other calculations throughout AnnexIIIa & Appendices?

No, the smoothed vehicle speed from Appendix 7a is intended to be used only for the verification of trip dynamics.

5.4. Regarding the verification of trip dynamics, Regulation 2016/646 Point 3.1.3 states "The number of datasets with acceleration values $a_i > 0{,}1$ m/s^2 shall be bigger or equal to 150 in each speed bin." How is the dataset defined?

Datasets with $v_i \leq 60$ km/h belong to the *urban* speed bin, all datasets with 60 km/h $< v_i \leq 90$ km/h belong to the *rural* speed bin and all datasets with $v_i > 90$ km/h belong to the *motorway* speed bin.

6. ON VERIFICATION OF EMISSIONS

6.1. In Regulation 2016/427, Appendix 4, point 8.1 (Dry-wet correction of emissions), there is the calculation of k_w, under which is shown equation for k_{w1}, but it is not contained in equation for k_w – what is the purpose of k_{w1} calculated?

In Regulation 2016/427 the formula is incorrect. The correct formula is included in Regulation 2017/1151 as shown in the image below.

8. CORRECTION OF EMISSIONS

8.1. **Dry-wet correction**

If the emissions are measured on a dry basis, the measured concentrations shall be converted to a wet basis as:

where:

$$c_{wet} = k_w \times c_{dry}$$

c_{wet} is the wet concentration of a pollutant in ppm or per cent volume

c_{dry} is the dry concentration of a pollutant in ppm or per cent volume

k_w is the dry-wet correction factor

The following equation shall be used to calculate k_w:

$$k_w = \left(\frac{1}{1 + \alpha \times 0{,}005 \times (c_{co_2} + c_{co})} - k_{w1} \right) \times 1{,}008$$

where:

$$k_{w1} = \frac{1{,}608 \times H_a}{1\,000 + (1{,}608 \times H_a)}$$

7. ON THE EX-POST EVALUATION METHODS

7.1. Under which conditions is the extended factor of 1.6 used and to which data you apply it to (i.e., you apply to raw data, or after the evaluation)

The emissions during the part of the trip performed under extended temperature or altitude conditions should be divided by 1.6 before being evaluated (i.e., to the raw emissions).

7.2. Must the emissions comply with the NTE limits with the two evaluation methods (Moving Averaging Window and Power Binning)?

The emissions of a vehicle can be calculated with the methods and requirements set out in Appendices 5 and 6 of Annex IIIA of Regulation 2016/427. Upon the choice of the manufacturer the conditions of at least one of the two points 3.1.0.1 (i.e. Moving Averaging Window) or 3.1.0.2 (i.e. Power Binning) shall be fulfilled. This means that the manufacturer can choose the method that complies with the NTE for both the urban part and the complete trip and that the trip must not necessarily comply with both methods.

7.3. Can only one of the methods be selected by the manufacturer and only assess the data with one?

Yes, in accordance with Regulation 2016/646, Annex II (3), the vehicle shall comply with the applicable emissions limit during urban driving and the entire RDE trip after the application of at least one of the two data evaluation methods. OVC-HEVs shall fulfil the conditions of point 3.1.0.3 of Regulation 2017/1154.

7.4. Even if only one is used, should the validation of data of both methods be used, or only of the method selected?

Evaluating the validity of a trip contains several steps, i.e., the verification of temperature and altitude conditions, urban, rural, motorway shares, the driving dynamics and elevation gain (see also Appendices 7a and 7b of Regulation 2016/646). After the completion of these verification steps, the data evaluation for the overall dynamics (Appendices 5 and 6 of Regulation 2016/427) can be applied. If only one data evaluation method is used, the boundary conditions specific to this respective method apply.

7.5. Why for the Moving Averaging Window method the limits for Urban/Rural/Motorway are different: 45 and 80km/h?

The classification of urban, rural, and motorway driving in Appendix 5 (Regulation 2016/427) is based on the average vehicle speed over entire windows. By contrast, the classification of urban, rural, and motorway driving in Points 6.3-6.5 of Regulation 2016/427 is based on the instantaneous vehicle speed. Our experience suggests that if the requirements of Point 6.6 regarding the urban, rural, motorway shares are met, the averaging window speeds typically fall within the value ranges specified in Appendix 5.

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7.6. **Which values of molecular mass shall be used for the exhaust gases to calculate emissions? Can the *u value* for HC (Table 1) be used for the THC mass emission calculation?**

The calculation procedure to determine instantaneous mass emissions is outlined in Appendix 4 of Regulation 2016/427. Default values depicting the ratio between the densities of exhaust component or pollutant [kg/m^3] and the density of the exhaust gas [kg/m^3] are provided in Table 1 of Appendix 4 for the different components of interest (NO_x, CO, HC, CO_2, O_2, CH_4). The Total hydrocarbons (THC) mass emission can be calculated using the HC *u value* of Table 1.

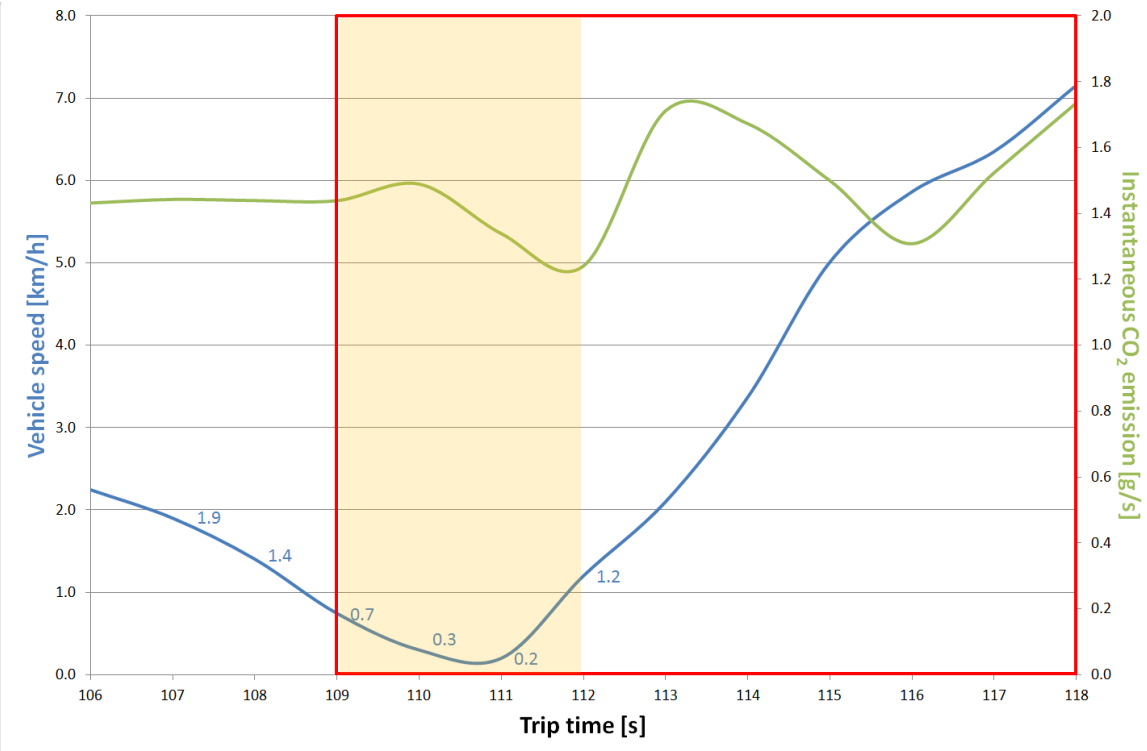
7.7. **For Moving Averaging Windowing should a window be opened for every 1s data point, regardless of vehicle speed? Or should a window only be opened if vehicle speed > 1 km/h?**

Appendix 5, section 3.1 Definition of MAWs, states that: "*The moving average calculations are conducted with a time increment corresponding to the data sampling frequency. The following data shall not be considered for the calculation of the CO2 mass, the emissions and the distance of the averaging windows: — vehicle ground speed < 1 km/h*". Therefore, windows should be opened only if the vehicle speed is >= 1 kmh.

The following example illustrates the reasoning. In case a new window was to be opened every second, the red window, starting from second 109, would start summing CO_2 mass only when the vehicle speed is >= 1 km/h (outside the orange zone, i.e. from second 112). Windows starting in second 110, 111, and 112 would also start summing CO_2 mass from the same second (112).

The duration of the windows starting in seconds 109, 110 , 111, and 112 would be the same since the duration of the window depends on the cumulated CO_2 mass until the half of the CO_2 mass [g] emitted by the vehicle over the WLTP cycle is reached.

Having the same window repeated makes less robust the analysis since they are being counted several times for the share of windows, and share of normal windows.



7.8. **In EMROAD, where is the frequency of the beginning of windows specified? Is that frequency connected to the frequency of measurement? Can it be changed when the sampling frequency is higher?**

With the current version of EMROAD (5.96) it is not possible to use PEMS files with a frequency higher than 1 Hz. In case files with higher frequency are provided to EMROAD, the software will interpret that the frequency is 1 Hz and it will therefore produce erroneous outputs (e.g., a PEMS file recorded at a 10 Hz frequency will produce a trip 10 times longer than the same trip recorded with a PEMS at 1 Hz frequency).

7.9. **Which are the criteria to determine the P1, P2, P3 parameters for EMROAD (Moving Averaging Window)? (with PEMS?, without PEMS?, with 90% of max load of the car?)**

In EMROAD, P1, P2, and P3 correspond to the $WLTC_{low}$, $WLTC_{high}$, $WLTC_{extra\_high}$ CO_2 values obtained in a standard WLTC test for the given vehicle performed following the Commission Regulation (EU) 2017/1151 (i.e., without PEMS).

7.10. **Regarding the inclusion of the cold start in the MAWs, Appendix 5 point 6.1. states "For all averaging windows including cold start data points, as defined in point 4 of Appendix 4, the weighting function is set to 1." Does it mean, if averaging window including cold start data point, the weighting function is set to 1, even thought that window is outside of Tol1? Or the weighting function is set to 1, even if the averaging window includes the cold start data point?**

The weighting function is set to 1, even if the averaging window includes the cold start data point.

7.11. **Regarding the verification of test normality (Appendix 5, point 5.3), if the specified minimum requirement of 50 % is not met, then the primary tolerance (tol_1) can be increased by steps of 1% until the 50 % of normal windows target is reached. Does that refer to $+tol_1$ and to $-tol_1$ (i.e., can $-tol_1$ be -30%)?**

No, the regulation states that only the upper positive tolerance ($+tol_1$) may be increased in steps of 1% up to 30%. Therefore –tol1 should always be -25%.

7.12. **Regarding the Calculation of weighted distance-specific emissions (Appendix 5, point 6), if +tol1 has been increased to meet the 50% requirement (point 5.3), is the weighing of emissions done using the modified value of +tol1? Or is it fixed at +25%?**

The calculation of weighted distance-specific emissions uses the modified value of +tol1.

7.13. **How does the "weighing function" of EMROAD work?**

EMROAD has implemented the calculation of weighted distance-specific emissions as described in Appendix 5, point 6. In brief words, the distance-specific emission of each window is multiplied by a factor:

- If the CO_2 distance-specific emission of a window lies within the CO_2 band defined by the upper and lower primary tolerances (+tol1, -tol1), then the weighing factor of the window is 1.
- If the CO_2 distance-specific emission of a window lies beyond the CO_2 band defined by the upper and lower secondary tolerances (+tol2, -tol2), then the weighing factor of the window is 0. The emissions of this window are not considered in the final calculations of emissions of the trip.
- If the CO_2 distance-specific emission of a window lies within the CO_2 band defined by the primary tolerances (+tol1, -tol1) and the secondary tolerances (+tol2, -tol2), then the weighing factor of the window is a value between 0 and 1, interpolated from the position of the CO_2 distance-specific emission of the window in the tol1; tol2 band.

7.14. **Which are the criteria to determine the f0, f1, f2 coefficients to be provided to CLEAR (Power Binning)? (with PEMS?, without PEMS?, with 90% of max load of the car?)**

From Version 2.0 of the CLEAR software, the road load parameters (f0, f1, f2) and the mass to be provided in the input file are the ones from the WLTP type approval test (previous versions of the software used NEDC based test mass and road loads). Therefore the road load values that have to be provided to CLEAR are those corresponding to the Regulated WLTP test (i.e., without PEMS).

7.15. **In CLEAR, for the Veline slope and intercept calculation, should the acceleration calculation from Appendix7a section 3.1.2 be used to calculate the acceleration values requested in Appendix 6 section 4?**

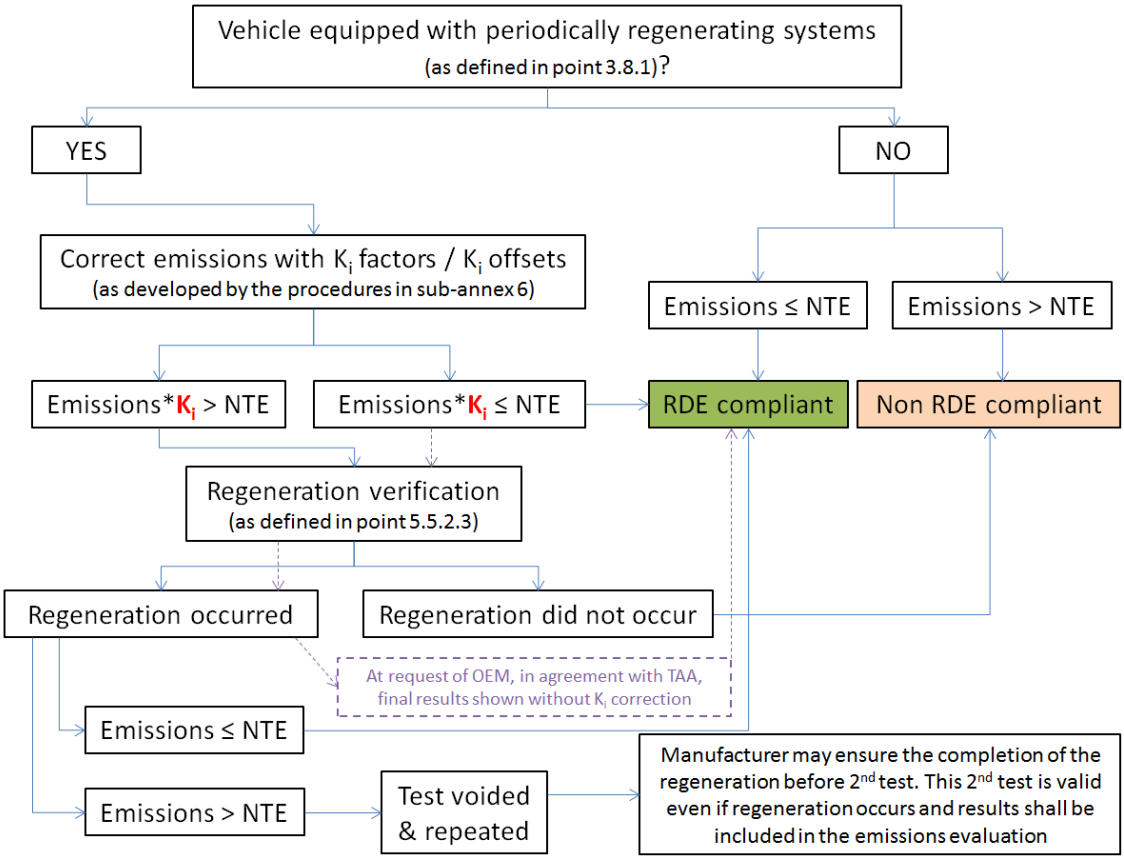
It is recommended to use the 2s acceleration calculation method, from Appendix 7a section 3.1.2, for the Veline acceleration calculation in Appendix 6 section 4.

7.16. **In CLEAR, for the Power demand at the wheel hub for a vehicle at reference speed and acceleration (P_{drive}) calculations which are the correct values for the reference velocity (V_{ref}) & the reference acceleration (A_{ref})?**

The revised values from the WLTP Correcting Act shall be applied (V_{ref} = 66 km/h & a_{ref} = 0.44 m/s^2)

7.17. **Can you explain when to use the ki-factor? What happens with the urban part?**

Regulation 2017/1154 establishes the conditions for tests with vehicles equipped with periodically regenerating systems [defined as exhaust emissions control devices (e.g. catalytic converter, particulate trap) that require a periodical regeneration process in less than 4 000 km of normal vehicle operation]. The diagram below represents the flow of decisions for RDE tests with vehicles equipped with such systems. The application of K_i factor/K_i offset to the raw emissions of a trip shall be done in the same way for the total trip and for the urban part of it. The use of ex-post evaluation methods should be done with the corrected raw emissions.



The procedure to calculate the *K_i factor* and the *K_i offset* are defined in Sub-Annex 6, Appendix 1 of Annex XI of Regulation 2017/1151. The following figure presents an overview of the formulas to calculate them.

$$M_{si} = \frac{\sum_{j=1}^{n} M'_{sij}}{n} \text{ for } n \geq 1$$

$$M_{ri} = \frac{\sum_{j=1}^{d} M'_{rij}}{d} \text{ for } d \geq 1$$

$$M_{pi} = \frac{M_{si} \times D + M_{ri} \times d}{D + d}$$

where for each compound i considered:

M'_{sij} are the mass emissions of compound i over test cycle j without regeneration, g/km;

M'_{rij} are the mass emissions of compound i over test cycle j during regeneration, g/km (if , the first WLTC test shall be run cold and subsequent cycles hot);

M_{si} are the mean mass emissions of compound i without regeneration, g/km;

M_{ri} are the mean mass emissions of compound i during regeneration, g/km;

M_{pi} are the mean mass emissions of compound i, g/km;

n is the number of test cycles, between cycles where regenerative events occur, during which emissions measurements on Type 1 WLTCs are made, ≥ 1;

d is the number of complete applicable test cycles required for regeneration;

D is the number of complete applicable test cycles between two cycles where regeneration events occur.

3.1.1. Calculation of the regeneration factor K_i for each compound i considered.

The manufacturer may elect to determine for each compound independently either additive offsets or multiplicative factors.

K_i factor: $K_i = \frac{M_{pi}}{M_{si}}$

K_i offset: $K_i = M_{pi} - M_{si}$

M_{si}, M_{pi} and K_i results, and the manufacturer's choice of type of factor shall be recorded. The K_i result shall be included in all relevant test reports. M_{si}, M_{pi} and K_i results shall be included in all relevant test sheets.

7.18. What happens with periodically regenerating systems that regenerate with a frequency of more than 4 000 km? How to treat such systems?

Such periodically regenerating systems do not comply with the definition provided in Point 3.8.1 of Annex XXI and therefore are not treated as such.

8. ON THE WLTP

The WLTP regulation mentioned in the questions of this section corresponds to *Commission Regulation (EU) 2017/1151 of 1 June 2017 supplementing Regulation (EC) No 715/2007 of the European Parliament and of the Council on type-approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6) and on access to vehicle repair and maintenance information, amending Directive 2007/46/EC of the European Parliament and of the Council, Commission Regulation (EC) No 692/2008 and Commission Regulation (EU) No 1230/2012 and repealing Commission Regulation (EC) No 692/2008*

8.1. **Does the WLTC have to be run just before the RDE test in a test cell?**

The WLTC test can be run before or after the RDE on-road test. WLTC testing is recommended to validate the installation of the PEMS equipment and it is required for constructing the CO_2 reference curve according to Appendix 5, and approximating the actual wheel power according to Appendix 6 (if direct torque measurements are unavailable). The WLTC test must be done with a cold engine and follow the test requirements set in Regulation 2017/1151 and its amendments.

8.2. **How are the parameters for the evaluation methods obtained if more than 1 WLTC tests are performed?**

The provisions for the type approval of vehicles as specified in the WLTP regulation apply. In particular, when 2 WLTC tests are performed, the parameters for the RDE evaluation methods are obtained from the test with highest distance-specific CO_2 emissions. If 3 WLTC tests are performed, then the values are obtained from the test with median distance-specific CO_2 emissions.

8.3. **Are there any specific conditions for the WLTP: preconditioning cycle, ambient temperature, etc.?**

The provisions for the type approval of vehicles as specified in the WLTP regulation apply.

8.4. **What coast down values and test mass should be used for the WLTC test?**

The provisions for the type approval of vehicles as specified in the WLTP regulation apply.

8.5. **What gear should be used for the WLTC for manual transmission vehicles?**

The provisions for the type approval of vehicles as specified in the WLTP regulation apply.

8.6. **As the Type 1 test applies to vehicles with minimum "mileage" of 3 000 km, does this also apply to the RDE test?**

Yes, RDE tests in the context of Type Approval are done with vehicles with a minimum mileage of 3 000 km.

8.7. **What is the test mass to be used in the WLTC? Weight of the car with PEMS or without PEMS?**

The test mass to be applied in the WLTC test is the one specified in regulation 2017/1151 (i.e., without PEMS).

9. ON THE REQUIREMENTS FOR TYPE APPROVAL

9.1. **Which conditions have to be applied to type approve a diesel or GDI vehicle complying with step AD?**

In order to type approve a vehicle according to step AD, the EURO 6-c emission standard is applied, RDE NO_x testing is applied for monitoring only (no NTE emission limits applied). After the entry into force of RDE3, full Euro 6 tailpipe emissions are required (including PN RDE). This means, that the RDE testing should be done according to RDE3 procedure (i.e. including cold start and PN measurement) but there is no NTE limit. Such vehicles will only be allowed to be registered till 31.08.2019.

9.2. **50% of tests need to be driven by technical service. Is this per vehicle or test base?**

The regulation indicates that 50 % of the PEMS tests required by Appendix 7 for validating the PEMS test family have to be driven by a Technical Service. The 50% requirement is not a per vehicle condition but per PEMS test family.

10. ON THE MONITORING PHASE

10.1. How can the emissions from the monitoring phase be accessed?

According to the RDE regulation, test data may be shared with any interested party. Request should be made either to the appropriate technical authority, or the manufacturer. Currently the Commission is collecting all such data from the monitoring phase and will analyse them appropriately.

10.2. For monitoring period, one valid test out of two with one tool is enough?

During the monitoring phase, when the requirements set out in Appendices 5 and 6 of Annex IIIA are satisfied for only one of the two data evaluation methods, the trip has to be repeated. A second trip is only envisaged if in the 1st trip only one method was valid. If both methods are invalid, the trip has to be invalidated, and the process has to start again from zero.

10.3. Is the additional test if one of the ex-post evaluation tools is not OK, to be performed only during the monitoring period or also afterwards?

Where the requirements set out in Appendices 5 and 6 of Annex IIIA are satisfied for only one of the two data evaluation methods described in those Appendices, an additional RDE test has to be performed. The regulation foresees to repeat an additional test when one of the 2 methods is invalid until 01/09/2017 for new types and until 01/09/2019 for new vehicles (for N1 class II and III and N2 until 01/09/2018 and 01/09/2020 for new types and new vehicles, respectively). After these dates the manufacturer may choose to evaluate their emissions with one or both methods.

10.4. In the monitoring phase, no NTE are applicable, therefore is it needed to declare the maximum RDE values in item 48.2 of the Certificate of Conformity?

No it is not needed.

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11. VALIDATION OF THE PEMS EQUIPMENT IN THE LAB

11.1. Is the validation in the chassis dyno supposed to be done each time you install a new PEMS, or for each installation to a new vehicle?

It is recommended to perform a validation of the PEMS on every installation on a new vehicle, before or after a set of tests with the same car.

12. ON REPORTED EMISSIONS

12.1. What values should be reported in the CoC? CF (with or without margin?), or absolute values? What are the units? Will they still appear after the 2nd step of RDE?

The RDE max value to be declared by the manufacturer in the CoC, is in the same units as all the other values reported therein, i.e. in mg/km or #/km. The units were not expressed in order to keep the same format as all other entries in the CoC.

They are not to be declared as conformity factors, but they should be at the NTE limit or below. They represent the highest possible value the manufacturer believes that this particular vehicles will be able to achieve under any of the boundary conditions in RDE and will be used to check its in-service conformity.

The RDE max value will be kept as an incentive for manufacturers to produce vehicles that are as clean as possible.