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COMMISSION IMPLEMENTING REGULATION (EU) 2025/2161

of 27 October 2025

implementing Regulation (EC) No 595/2009 of the European Parliament and of the Council as regards the technical requirements of on-board devices for the monitoring and recording of fuel and energy consumption and mileage of certain heavy-duty vehicles, and for determining and recording the payload or total weight thereof

(Text with EEA relevance)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Regulation (EC) No 595/2009 of the European Parliament and of the Council of 18 June 2009 on type-approval of motor vehicles and engines with respect to emissions from heavy duty vehicles (Euro VI) and amending Regulation (EC) No 715/2007 and Directive 2007/46/EC and repealing Directives 80/1269/EEC, 2005/55/EC and 2005/78/EC ([1]), and in particular Article 5c, point (b), thereof,

Whereas:

(1) In accordance with Commission Regulation (EU) 2017/2400 ([2]), the CO_2 emissions and fuel consumption of whole heavy-duty vehicles are to be simulated using a methodology based on the VECTO tool ('regulatory VECTO procedure'). The CO_2 emissions so determined form the basis for assessing manufacturers' compliance with their annual specific CO_2 emissions targets as set out in Regulation (EU) 2019/1242 of the European Parliament and of the Council ([3]). The effectiveness of those CO_2 emissions targets is strongly dependent on the real-world representativeness of the CO_2 emissions and electric energy consumption values determined by the VECTO tool, which is to be monitored and assessed by using data from on-board fuel and electric energy consumption monitoring (OBFCM) devices in accordance with Regulation (EU) 2019/1242.

(2) For that purpose, the information recorded by OBFCM devices should cover the parameters required to accurately determine the representativeness of the regulatory VECTO procedure. That procedure takes into consideration the mission profile, loads, fuel type, and total vehicle mass, and expresses the emissions in grams of CO_2 per tonne kilometre to reflect the utility of the heavy-duty vehicles and grams of CO_2 per passenger kilometre for interurban buses and coaches. In order to enable this approach, the OBFCM device should record both the overall lifetime fuel and electric energy consumption and lifetime distance driven. It should also record the fuel and electric energy consumption and distance in relation to the vehicle speed and total mass by accumulating these over periodic intervals of vehicle operation. For interurban buses and coaches, to assess the representativeness of the procedure, the comparison should take into consideration the underlying loads and total vehicle mass used in the procedure.

(3) The quantity of fuel and electric energy used already being determined, and the relevant data already being stored on board of most new vehicles, but the devices presently used to monitor this information not being subject to standardised requirements, basic type-approval requirements with regard to those devices should be laid down to ensure that the data provided by them are accessible and may serve as a harmonised basis for a comparison between the VECTO simulated fuel consumption and emissions and the real-world values determined by the OBFCM device.

([1]) OJ L 188, 18.7.2009, p. 1, ELI: http://data.europa.eu/eli/reg/2009/595/oj.

([2]) Commission Regulation (EU) 2017/2400 of 12 December 2017 implementing Regulation (EC) No 595/2009 of the European Parliament and of the Council as regards the determination of the CO_2 emissions and fuel consumption of heavy-duty vehicles and amending Directive 2007/46/EC of the European Parliament and of the Council and Commission Regulation (EU) No 582/2011 (OJ L 349, 29.12.2017, p. 1, ELI: http://data.europa.eu/eli/reg/2017/2400/oj).

([3]) Regulation (EU) 2019/1242 of the European Parliament and of the Council of 20 June 2019 setting CO_2 emission performance standards for new heavy-duty vehicles and amending Regulations (EC) No 595/2009 and (EU) 2018/956 of the European Parliament and of the Council and Council Directive 96/53/EC (OJ L 198, 25.7.2019, p. 202, ELI: http://data.europa.eu/eli/reg/2019/1242/oj).

(4) The total mass of vehicles and of their combinations should be determined by an on-board mass monitoring system, as part of the OBFCM device. To allow manufacturers to make use of existing systems and sensors where possible, offering lower costs and robustness, while providing for high accuracy, it is appropriate to allow for the total mass to be determined using indirect methods.

(5) To assess the mission profiles and payload conditions during the lifetime of the vehicles, thereby reflecting the utility of the heavy-duty vehicles on the road and allowing for a comparison to the simulated conditions, over the lifetime of the vehicle the fuel and electric energy consumption and distance values accumulated over determined intervals should be stored at the end of each interval on the relevant control unit in a format where the parameters are indexed by the average total vehicle mass and the average speed determined for that interval. While the accumulated fuel and electric energy consumption and distance values should be reset at the end of each interval to ensure that only the accumulated values during a single interval are considered, the speed and total mass may be informed by the previous interval as these values are used for indexing the accumulated parameters.

(6) To support the assessment of the regulatory VECTO procedure by providing a better indication of the real-world driving profiles of vehicles on the road, vehicles which are not required to have an on-board mass monitoring system should also record the fuel consumption and distance driven accumulated over intervals of vehicle operation and store this data based only on the average speed determined during that interval.

(7) As the OBFCM device uses engine parameters to determine the relevant OBFCM parameters, compliance with OBFCM device requirements should be part of the emissions approval under Commission Regulation (EU) No 582/2011 ([4]). To minimise the additional testing burden and thereby simplify the approval procedure, manufacturers should be able to meet compliance requirements by providing a declaration of the compliance to the requirements set out in this Regulation regarding the functionality and accuracy of the OBFCM device.

(8) To ensure that the data provided by the OBFCM devices remain accurate during the use of the vehicles, while minimizing the additional testing burden, the accuracy of those devices should be monitored whenever fuel consumption is being recorded during existing regulatory testing procedures. These testing procedures should include engine testing procedures where the fuel map is being evaluated, as specified in Annex V to Regulation (EU) 2017/2400, and on-road testing procedures where the fuel and electric energy consumption, total distance and mass monitoring accuracies can be monitored, as specified in the emissions approval and in-service conformity procedures under Regulation (EU) No 582/2011, the verification testing procedure under Regulation (EU) 2017/2400 and portable emissions measurement system tests under UN Regulation No 49 ([5]).

(9) The responsible authority for checking the results regarding the fuel consumption, total distance and total mass during monitoring tests should be the authority that granted the emissions approval, which should receive the necessary data to check the results from the authority or manufacturer performing this test. A recorded OBFCM parameter not falling between the lower and upper accuracy limits during a regulatory test procedure should not influence the outcome of the regulatory testing procedure.

(10) In the case that the granting authority determines that the recorded OBFCM parameter does not fall between the lower and upper accuracy limits during a test procedure, a statistical test should be performed to verify the accuracy of the fuel consumption and distance travelled, or mass monitoring and determine compliance. The boundary conditions for this statistical test should be similar to the existing verification testing procedure conditions with simplified recording requirements, and with hilly and dynamic conditions to verify the OBMM system operation based on indirect methods, as the trip requirements for this procedure use representative speed distributions for different driving groups, and allow for existing routes and infrastructure to be used by vehicle manufacturers and independent accredited laboratories.

([4]) Commission Regulation (EU) No 582/2011 of 25 May 2011 implementing and amending Regulation (EC) No 595/2009 of the European Parliament and of the Council with respect to emissions from heavy duty vehicles (Euro VI) and amending Annexes I and III to Directive 2007/46/EC of the European Parliament and of the Council (OJ L 167, 25.6.2011, p. 1, ELI: http://data.europa.eu/eli/reg/2011/582/oj).

([5]) UN Regulation No 49 – Uniform provisions concerning the measures to be taken against the emission of gaseous and particulate pollutants from compression-ignition engines and positive ignition engines for use in vehicles [2023/64] (OJ L 14, 16.1.2023, p. 1, ELI: http://data.europa.eu/eli/reg/2023/64/oj).

(11) To simplify the compliance with accuracy requirements and thereby reduce the development burden for manufacturers, for certain fuel types and testing procedures initially only a surveillance of accuracy applies. Where there is a surveillance of accuracy, the accuracy requirements for the declaration of compliance should not apply, and a statistical verification procedure should not be performed when the recorded parameter does not fall between the lower and upper accuracy limits during a test procedure. Even so, the manufacturer should provide the most accurate values that can be achieved by the measurement and calculation system of the vehicle control units.

(12) The Commission should assess the results of the monitoring tests and evaluate the accuracy requirements for vehicles where a surveillance of accuracy applies. To this extent, the granting approval authorities should provide the results of the monitoring tests in a standardised format upon request of the Commission.

(13) As the declaration of compliance of the OBFCM device requirements is a condition for the extension of the emissions approval under Regulation (EU) No 582/2011, the authority responsible for the emissions approval should be responsible for assessing the results of the monitoring tests and should evaluate the accuracy of the OBFCM based on a statistical testing procedure, where necessary. This requires close cooperation between manufacturers, authorities performing monitoring tests and the authority granting the emissions approval.

(14) As there is no separate initial type-approval testing for the OBFCM device, and the declaration of compliance of the OBFCM device to the requirements in this Regulation being required for the emissions approval, failure of the statistical testing procedure should lead to remedial measures of the emissions approval.

(15) Considering the lead-time necessary to develop OBFCM devices, and to develop standardised signals that are not currently available, OBFCM requirements should be set as of 2027, while the real-world representativeness of the CO_2 emissions and electric energy consumption values should be monitored and assessed through other means until these standardised signals are available. In that first instance, the requirements of the on-board fuel consumption and on-board mass monitoring should be limited to conventional heavy-duty vehicles with an internal combustion engine.

(16) The scope of vehicles required to be equipped with OBFCM devices should expand in 2029 to also include all types of heavy-duty vehicles, in line with the timeline of requirements under Regulation (EU) 2024/1257 of the European Parliament and of the Council ([6]), giving manufacturers enough time to prepare for the application of these new provisions in a harmonised manner.

(17) The measures provided for in this Regulation are in accordance with the opinion of the Technical Committee for Motor Vehicles established by Regulation (EU) 2018/858 of the European Parliament and of the Council ([7]),

HAS ADOPTED THIS REGULATION:

Article 1

Definitions

For the purpose of this Regulation, the definitions of Article 3 of Regulation (EU) 2017/2400, point 2 of Annex III, point 2 of Annex VI, and point 2 of Annex Xa to that Regulation shall apply.

([6]) Regulation (EU) 2024/1257 of the European Parliament and of the Council of 24 April 2024 on type-approval of motor vehicles and engines and of systems, components and separate technical units intended for such vehicles, with respect to their emissions and battery durability (Euro 7), amending Regulation (EU) 2018/858 of the European Parliament and of the Council and repealing Regulations (EC) No 715/2007 and (EC) No 595/2009 of the European Parliament and of the Council, Commission Regulation (EU) No 582/2011, Commission Regulation (EU) 2017/1151, Commission Regulation (EU) 2017/2400 and Commission Implementing Regulation (EU) 2022/1362 (OJ L, 2024/1257, 8.5.2024, ELI: http://data.europa.eu/eli/reg/2024/1257/oj).

([7]) Regulation (EU) 2018/858 of the European Parliament and of the Council of 30 May 2018 on the approval and market surveillance of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles, amending Regulations (EC) No 715/2007 and (EC) No 595/2009 and repealing Directive 2007/46/EC (OJ L 151, 14.6.2018, p. 1, ELI: http://data.europa.eu/eli/reg/2018/858/oj).

In addition, the following definitions shall apply:

(1) ‘on-board fuel and electric energy consumption monitoring device’ or ‘OBFCM device’ means any software or hardware that senses and uses vehicle, engine, fuel or electric energy and payload/mass parameters to determine, store in the vehicle the fuel and electric energy consumption data and other parameters relevant for determining the fuel or electric energy consumption and energy efficiency of the vehicle;

(2) ‘on-board energy monitoring system (OBEM)’ means any software or hardware as part of the OBFCM device that senses and uses vehicle, engine, fuel or electric energy parameters to determine and store in the vehicle the fuel and electric energy consumption data, their accumulating data, and other parameters relevant for determining the vehicle’s fuel or electric energy consumption and energy efficiency;

(3) ‘on-board mass monitoring system (OBMM)’ means any software or hardware as part of the OBFCM device to determine the vehicle total mass;

(4) ‘lifetime value’ of a certain quantity determined and stored at a time *t* means the value of this quantity accumulated since the completion of production of the vehicle until time *t;*

(5) ‘lifetime of a vehicle’ at a time t means the period since the completion of its production until the time *t*;

(6) ‘engine fuel rate’ means the instantaneous amount of all fuel injected into the engine per unit of time, not including fuel injected directly into the pollution control device;

(7) ‘vehicle fuel rate’ means the instantaneous amount of all fuel injected into the engine and directly into the pollution control device per unit of time, not including the fuel used by a fuel operated space heater;

(8) ‘total fuel consumed (lifetime)’ means the accumulation of the vehicle fuel rate during a vehicle’s lifetime;

(9) ‘total distance travelled (lifetime)’ means the accumulation of the distance travelled during a vehicle’s lifetime;

(10) ‘instantaneous brake engine power’ means the instantaneous mechanical output energy per second;

(11) ‘engine output energy’ means the brake engine power output over a vehicle’s lifetime, that is the accumulated mechanical energy provided by the engine;

(12) ‘accumulation period’ means a time period during a single trip, indexed by an average speed and average total mass value, for which the vehicle determines the indexed values;

(13) ‘vehicle fuel consumed during accumulation period’ means the accumulation of the vehicle fuel rate during a vehicle’s lifetime, indexed by average speed and average total mass ranges, and limited to those accumulation periods the indexed values of which fall within the indexed ranges;

(14) ‘distance travelled during accumulation period’ means the accumulation of the distance travelled during a vehicle’s lifetime, indexed by average speed and average total mass ranges, and limited to the accumulation periods the indexed values of which fall within the indexed ranges, using the same data source that the vehicle odometer uses;

(15) ‘vehicle total mass (TM)’ means the total mass of a motor vehicle and, in case of a vehicle combination, of the vehicle combination as determined by the OBMM, in kilograms;

(16) ‘odometer’ means an instrument as defined in Article 2, point (3), of Commission Regulation (EU) 2017/1151 ([8]);

(17) ‘battery’ means a rechargeable electrical energy storage system (REESS) installed in an electrified vehicle and used mainly for traction purposes;

([8]) 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 (OJ L 175, 7.7.2017, p. 1, ELI: http://data.europa.eu/eli/reg/2017/1151/oj).

(18) ‘total electric energy into the vehicle’ means, for Pure Electric Vehicles (PEVs), Off-Vehicle Charging-Hybrid Electric Vehicles (OVC-HEVs) and Off-Vehicle Charging Fuel Cell Hybrid Vehicles (OVC-FCHVs), the accumulation of the electric energy flowing into the vehicle from an external power supply connected via any charging interface the vehicle is equipped with during a vehicle’s lifetime;

(19) ‘total electric energy into the vehicle during alternating current (AC) charging’ means, for PEVs, OVC-HEVs and OVC-FCHVs, the accumulation of the electric energy from AC charging flowing into the vehicle from an external power supply connected via any charging interface the vehicle is equipped with during a vehicle’s lifetime;

(20) ‘total electric energy into the vehicle during direct current (DC) charging’ means, for PEVs, OVC-HEVs and OVC-FCHVs, the accumulation of the electric energy from DC charging flowing into the vehicle from an external power supply connected via any charging interface the vehicle is equipped with during a vehicle’s lifetime;

(21) ‘total electric energy into the battery’ means, for PEVs, OVC-HEVs and OVC-FCHVs, the accumulation of the electric energy flowing into the battery from an external power supply connected via any charging interface the vehicle is equipped with during a vehicle’s lifetime, excluding any electrical losses between the external power source and the battery;

(22) ‘total battery energy supplied to an off-board usage’ means, for PEVs, OVC-HEVs and OVC-FCHVs equipped with V2X capabilities, the accumulation of the electric energy flowing out of the battery and used for V2X applications during a vehicle’s lifetime;

(23) ‘total electric energy into the battery during AC charging’ means, for PEVs, OVC-HEVs and OVC-FCHVs, the accumulation of the electric energy from AC charging flowing into the battery from an external power supply connected via any charging interface the vehicle is equipped with during a vehicle’s lifetime;

(24) ‘total electric energy into the battery during DC charging’ means, for PEVs, OVC-HEVs and OVC-FCHVs, the accumulation of the electric energy from DC charging flowing into the battery from an external power supply connected via any charging interface the vehicle is equipped with during a vehicle’s lifetime;

(25) ‘vehicle electric power consumption’ means the amount of electrical energy being either discharged from (positive consumption) or charged to (negative consumption) any rechargeable electric energy storage system by the vehicle per unit of time (i.e. the change in battery’s state of charge);

(26) ‘vehicle electric energy consumption during accumulation period’ means the accumulation of the vehicle electric power consumption during a vehicle’s lifetime, indexed by average speed and average total mass values ranges, but limited to those accumulation periods the indexed values of which fall within the indexed ranges;

(27) ‘vehicle electric energy consumption during accumulation period with engine on’ means the accumulation of the vehicle electric power consumption during a vehicle’s lifetime with the engine on, indexed by average speed and average total mass values ranges, but limited to those accumulation periods the indexed values of which fall within the indexed ranges;

(28) ‘vehicle electric energy consumption during accumulation period with engine off’ means the accumulation of the vehicle electric power consumption during a vehicle’s lifetime with the engine off, indexed by average speed and average total mass values ranges, but limited to those accumulation periods the indexed values of which fall within the indexed ranges;

(29) ‘distance travelled during accumulation period with engine on’ means the accumulation of the distance travelled during a vehicle’s lifetime with the engine on, indexed by average speed and average total mass ranges, and limited to the accumulation periods the indexed values of which fall within the indexed ranges, using the same data source that the vehicle odometer uses;

(30) ‘distance travelled during accumulation period with engine off’ means the accumulation of the distance travelled during a vehicle’s lifetime with the engine off, indexed by average speed and average total mass ranges, and limited to the accumulation periods the indexed values of which fall within the indexed ranges, using the same data source that the vehicle odometer uses;

(31) ‘charging event’ means to fully charge the battery after break-off criterion is reached until the end-of-charge criterion is reached, as set out in the type-approval procedure;

(32) ‘total energy supplied to on-board special equipment’ means, for PEVs, OVC-HEVs and OVC-FCHVs equipped with ‘ePTO’ capabilities, the accumulation of the electric energy used for ‘ePTO’ applications during a vehicle’s lifetime;

(33) ‘vehicle-to-everything (V2X)’ means the use of the traction batteries to cover external power and energy demand, such as V2G (Vehicle-to-Grid) for grid stabilisation 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 utilising 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;

(34) ‘total fuel cell fuel consumed’ means the accumulation of the calculated amount of fuel injected into the fuel cell in kilograms during a vehicle’s lifetime;

(35) ‘total fuel cell active time’ means the accumulation of the total time in which the fuel cell stack consumes hydrogen and generates electricity in any mode of operation during a vehicle’s lifetime;

(36) ‘total fuel cell system energy generated’ means the total energy generated by the fuel cell in kWh during a vehicle’s lifetime;

(37) ‘fuel cell fuel consumed’ means the accumulation of the calculated amount of fuel injected into the fuel cell during a vehicle’s lifetime, indexed by average speed and average total mass values ranges, and limited to those accumulation periods the indexed values of which fall within the indexed ranges;

(38) ‘emissions approval’ means the approval of an engine system or engine family as a separate technical unit with regard to emissions, or of the vehicle with regard to emissions in accordance with Regulation (EC) No 595/2009 or any approval provided for as an alternative in accordance with Regulation (EU) 2018/858, as the case may be;

(39) ‘granting approval authority (GAA)’ means the authority responsible for granting an emissions approval.

Article 2

Manufacturers’ obligations

1. Manufacturers shall ensure that the OBFCM device’s design and functionality comply with the requirements set out in Article 3 and provide the approval authority with a signed declaration as set out in point 6.1 of Annex I, declaring compliance with the requirements set out in Article 3.

2. By way of derogation to paragraph 1, the manufacturer may declare in its signed declaration as set out in point 6.1 of Annex I, that the engine does not fulfil the on-board mass monitoring requirement to determine the vehicle total mass parameter as set out in Annex I. In this case, for vehicles with the characteristics set out in point 2.1 of Annex I, the manufacturer responsible for the vehicle approvals according to Articles 7 and 9 of Regulation (EU) No 582/2011 or according to point 2.3 of UN Regulation No 49 shall fulfil this on-board mass monitoring requirement and provide a signed declaration of compliance as set out in point 6.2 of Annex I.

Article 3

Requirements for devices for monitoring the consumption of fuel and electric energy and for determining the total mass of vehicles and their combinations

1. Vehicles with the characteristics as set out in Table 1 of Annex I shall be equipped with an OBFCM device for monitoring on-board fuel consumption and electric energy consumption and determining those vehicles’ total mass, as well as storing and making available such data in a standardised format, following the requirements set out in Annex I.

2. With regard to the information specified in Annex I, the manufacturer shall ensure that the OBFCM device provide, from the dates set out in Table 1 of Annex I, the most accurate values that can be achieved by the measurement and calculation system of the vehicle control units.

3. The requirements set out in paragraphs 1 and 2 shall not apply to small volume manufacturers as defined in point 5 of Annex X to Regulation (EU) 2018/858.

4. The requirements set out in paragraphs 1 and 2 shall not apply to vehicles of categories M_2 and N_2 with a technically permissible maximum laden mass not exceeding 7,5 tonnes and with an alternative approval under Point 2.4 of Annex X to Regulation (EU) No 582/2011, or to vehicles that are registered as Euro 7ext vehicles as defined in Article 5(2) of Regulation (EU) 2024/1257.

5. The requirements set out in paragraphs 1 and 2 shall not apply to off-road vehicles, special purpose vehicles and off-road special purpose vehicles as defined, respectively, in Part A, points 2.1, 2.2 and 2.3, of Annex I to Regulation (EU) 2018/858.

Article 4

OBFCM monitoring data

1. The approval authorities and manufacturers responsible for performing the monitoring tests as specified in Table 1 of Annex I shall collect, during those tests, the data specified in point 5.1 of Annex I and the approval authority shall report that data to the GAA within one month.

2. The approval authorities and manufacturers responsible for the tests referred to in paragraph 1 shall cooperate efficiently and effectively with the GAA and shall use tools and platforms of the Commission if those are made available.

Article 5

Verification of compliance by the GAA

1. The GAA shall collect monitoring data from the tests set out in Table 1 of Annex I as described in Article 4.

2. The GAA shall assess the monitoring data to determine whether the OBFCM accuracy requirements set out in point 4 of Annex I are met.

3. If the OBFCM accuracy requirements referred to in paragraph 2 are not met the following shall apply:

(a) if the accuracy requirement for the fuel consumption or distance travelled as set out in Table 8 of Annex I is not met, then the GAA shall perform and evaluate an OBFCM accuracy verification test in accordance with Annex II;

(b) if the accuracy requirement for the vehicle total mass as set out in Table 9 of Annex I is not met, then the GAA shall perform and evaluate an OBMM accuracy verification test in accordance with Annex III.

4. The OBFCM or OBMM accuracy verification test shall also be carried out if the GAA has evidence or suspicion that the requirements as referred to in Article 3 are not fulfilled, or at the Commission's request.inca nis

5. The GAA shall share the findings of the OBFCM and OBMM accuracy verification tests with the manufacturer and with the Commission at the latest 12 months after collecting the monitoring data as referred to in paragraph 1.

6. Upon request by the Commission, the GAA shall provide the results of the assessment of the monitoring data. This may also include a request to provide test results systematically according to a dedicated procedure.

Article 6

Remedial measures

1. If the GAA concludes that the requirements set out in Article 3 are not complied with for an OBFCM family as defined under point 2.2.1 of Annex I to this Regulation, the approval authority shall follow the procedure for remedial measures set out in Article 13 of Regulation (EU) No 582/2011.

2. If the GAA concludes that the requirements set out in Article 3 are not complied with for an OBMM family as defined under point 2.2.2 of Annex I to this Regulation, the approval authority shall follow the procedure for remedial measures set out in Article 13 of Regulation (EU) No 582/2011.

Article 7

Entry into force

This Regulation shall enter into force on the twentieth day following that of its publication in the *Official Journal of the European Union*.

This Regulation shall be binding in its entirety and directly applicable in all Member States.

Done at Brussels, 27 October 2025.

For the Commission
The President
Ursula VON DER LEYEN

ANNEX I

ON-BOARD DEVICES FOR MONITORING THE VEHICLE'S FUEL AND ELECTRIC ENERGY CONSUMPTION AND TOTAL MASS

1. INTRODUCTION

1.1. This Annex sets out the general requirements for on-board fuel and electric energy consumption monitoring (OBFCM) devices and for the monitoring of total mass for vehicles of categories M_2, M_3, N_2 and N_3 as referred to in Article 2 of Regulation (EU) 2019/1242.

2. APPLICATION OF OBFCM DEVICE AND ACCURACY REQUIREMENTS

Table 1

Application dates for OBFCM device and accuracy requirements based on the propulsion technology and regulatory test cycle

Propulsion technology	Mono fuel, pure ICE vehicle, HEV		Dual-fuel vehicle		Compression ignition, pure ICE vehicle, HEV		OVC-HEV		Pure electric vehicle ([1])	Fuel cell hybrid vehicle, OVC-FCHV ([1])	Application date for newly registered vehicles
	Other fuels (e.g. LPG, LNG, NG/Biomethane, E10, Ethanol)	Hydrogen (ICE)	Diesel (B7) and other fuels (LNG, LPG, NG/Biomethane) LPG (Fuel B)	Diesel (B7) and Hydrogen (ICE)	Diesel (B7)	Other fuels (e.g. biofuels, ED95/B100)	Diesel (B7), Biofuels (ED95, B100)	Other fuels (e.g. LPG, NG/Biomethane, E10, E85)			
OBFCM requirement	F ([2])	—	F	—	F	F	T ([3])	T	—	—	1 July 2027 ([g])
	F	F	F	F	F	F	F	F	F	F	29 May 2029 ([h])
WHTC ([a])	SE ([4])	—	SE	—	E ([5])	SE	SE	SE	—	—	1 July 2027 ([g]) ([i])
WHSC ([b])	SE	—	SE	—	E	SE	SE	SE	—	—	
FCMC ([c])	SE	—	SE	—	E	SE	SE	SE	—	—	
PEMS ([d])	SE + SM ([6])	—	SE + SM	—	SE + SM	SE + SM	SE + SM	SE + SM	—	—	
VTP ([e])	SE + SM	—	SE + SM	—	E + M ([7])	SE + SM	SE + SM	SE + SM	—	—	

Propulsion technology	Mono fuel, pure ICE vehicle, HEV		Dual-fuel vehicle		Compression ignition, pure ICE vehicle, HEV		OVC-HEV		Pure electric vehicle ([1])	Fuel cell hybrid vehicle, OVC-FCHV ([1])	Application date for newly registered vehicles
	Other fuels (e.g. LPG, LNG, NG/Biomethane, E10, Ethanol)	Hydrogen (ICE)	Diesel (B7) and other fuels (LNG, LPG, NG/Biomethane) LPG (Fuel B)	Diesel (B7) and Hydrogen (ICE)	Diesel (B7)	Other fuels (e.g. biofuels, ED95/B100)	Diesel (B7), Biofuels (ED95, B100)	Other fuels (e.g. LPG, NG/Biomethane, E10, E85)			
WHTC	E	SE	E	SE	E	E	E	E	—	—	29 May 2029 ([h])
WHSC	E	SE	E	SE	E	E	E	E	—	—	
FCMC	E	SE	E	SE	E	E	E	E	—	—	
PEMS	E + M	SE + SM	E + M	SE + SM	E + M	E + M	E + SM	E + SM	—	—	
VTP	E + M	SE + SM	E + M	SE + SM	E + M	E + M	E + SM	E + SM	E + SM	E + SM	
Battery durability ([f])	—	—	—	—	—	—	E + SM	E + SM	E + SM	—	

([1]) Specific test procedures for hydrogen and pure electric vehicles will be defined at a later stage.
([2]) 'F' indicates full requirements as specified in point 3.3.
([3]) 'T' indicates transitional requirements as specified in point 3.3.2.
([4]) 'SE' indicates surveillance of the accuracy for OBEM as specified in point 5.3.
([5]) 'E' indicates accuracy requirements for OBEM apply as specified in point 4.2.
([6]) 'SM' indicates surveillance of the accuracy for OBMM as specified in point 5.3.
([7]) 'M' indicates accuracy requirements for OBMM apply as specified in point 4.5.

([a]) World harmonised transient driving cycle ('WHTC') test as performed in accordance with point 4.3.3. of Annex V to Regulation (EU) 2017/2400.
([b]) World harmonised steady state cycle ('WHSC') test as performed in accordance with point 4.3.4 of Annex V to Regulation (EU) 2017/2400.
([c]) Fuel consumption mapping cycle ('FCMC') test as performed in accordance with point 4.3.5 of Annex V to Regulation (EU) 2017/2400.
([d]) Portable emissions measurement systems ('PEMS') test procedure as performed in accordance with Annex 8 to UN Regulation No 49 or Appendix 1 to Annex II to Regulation (EU) No 582/2011.
([e]) Verification testing procedure ('VTP') test as performed in accordance with Annex Xa to Regulation (EU) 2017/2400.
([f]) tbd.
([g]) Level 'Euro VI E+' for the purpose of the declaration document in point 6.
([h]) Level 'Euro 7' for the purpose of the declaration document in point 6.
([i]) On-board mass monitoring provisions shall apply only to vehicles with Automated Manual Transmission (AMT) as defined in point 2(19) of Annex VI to Regulation (EU) 2017/2400.

ELI: http://data.europa.eu/eli/reg_impl/2025/2161/oj

2.1. **On-board mass monitoring**

The provisions for the on-board mass monitoring as set out in this Annex shall only apply to the vehicles in the following vehicle groups as defined in Table 1 of Annex I to Regulation (EU) 2017/2400:

Groups 4, 5, 9, and 10 ('vehicle group set #1')

Groups 1s, 1, 2 and 3 ('vehicle group set #2')

Groups 11, 12 and 16 ('vehicle group set #3')

In addition, those provisions shall apply to coaches and interurban buses with high floors in the vehicle groups 32a, 32b, 32c, 32d, 32e and 32f as defined in Table 4, vehicle groups 34a, 34b, 34c, 34d, 34e, 34f, 36a, 36b, 36c, 36d, 36e, and 36f as defined in Table 5, and vehicle groups 38a, 38b, 38c, 38d, 38e, 38f, 40a, 40b, 40c, 40d, 40e, and 40f as defined in Table 6 of Annex I to Regulation (EU) 2017/2400.

2.2. **Family definitions**

2.2.1. The OBFCM family, as determined by the engine manufacturer, shall be the same as the engine family for which the declaration of compliance as set out in point 6.1 was submitted.

2.2.2. The OBMM family shall be the same as the OBFCM family where the manufacturer responsible for the vehicle approvals according to Articles 7 and 9 of Regulation (EU) No 582/2011 or according to point 2.3 of UN Regulation No 49 did not provide a separate declaration of compliance under point 6.2.

However, where the manufacturer responsible for the vehicle approvals according to Articles 7 and 9 of Regulation (EU) No 582/2011 or according to point 2.3 of UN Regulation No 49 provided a separate declaration of compliance under point 6.2, the OBMM family shall be all vehicles of that manufacturer with the same working principle of the on-board mass monitoring system as described in the declaration of compliance as set out in point 6.2.

2.2.3. The parent engine of the family shall be selected in accordance with the requirements set out in paragraph 5.2.4 of Annex 4 to UN Regulation No 49 and, in the case of dual-fuel engines and vehicles, with paragraph 3.1.2 of Annex 15 to UN Regulation No 49.

2.2.4. For Pure Electric Vehicles, the OBFCM family and choice of parent, as determined by the manufacturer, shall comply with Appendix 13 to Annex Xb of Regulation (EU) 2017/2400. In case of multiple electric motors or IEPCs, the parent electric motor shall be the one with the highest rated power.

3. DATA STORAGE REQUIREMENTS

3.1. **Overall requirements**

The general structure of information to be stored comprises lifetime values, active accumulating data and static data.

Lifetime values: This category represents aggregate values accumulated since the first initial engine operation after production.

Active accumulating data: Values stored in this category are accumulating instantaneous values up to 10 minutes of operation. The category shall transfer data to the static data category, prior to a reset to zero, and begin incrementing again when the operation time in this category reaches 10 minutes, or on engine switch off. By way of derogation to the reset, the vehicle average speed and vehicle total mass shall be calculated at the end of the 10-minute period, or on engine switch off, and the value shall be kept and updated with the new calculated value at the end of the subsequent period.

Static data: These are accumulated values (transferred into bins from the active accumulating data category) each 10-minute interval of engine operation, or on engine switch off, added up over the lifetime of the vehicle. These data are matrices, indexed by average speed and average vehicle total mass.

In addition to the three types of information to be stored, instantaneous values at a frequency sampled at 1 Hz shall be made available. This category represents current values derived from the instantaneous condition of the vehicle, such as fuel rates, vehicle velocity, instantaneous brake engine power and vehicle total mass.

3.2. **OBMM system requirements**

3.2.1. *Quantity to be determined*

The OBMM system shall determine vehicle total mass as defined in Article 1(15).

3.2.2. *Requirements for vehicle total mass signal*

The vehicle total mass signal shall be broadcasted via CAN in at least 1 Hz frequency in the unit of kilogram (kg). The mass resolution of the broadcasted signal shall be 100 kg or better.

3.2.3. *Further use of the vehicle total mass signal for OBFCM purposes*

The vehicle total mass signal shall be used for the purposes of calculating and storing of OBFCM data in accordance with points 3.3 and 3.5.

3.3. **Parameters to be recorded**

3.3.1. *For pure ICE vehicles, HEVs*

The OBFCM device shall determine at least the parameters referred to in Table 2 and store the lifetime and instantaneous values, and active accumulating and static data on board the vehicle as indicated in Table 2.

The parameters in Table 2 shall apply to pure ICE vehicles, HEVs with the fuel types outlined in Table 1 of this Annex.

The static accumulated data shall be stored as a two-dimensional matrix according to the average speed and the total vehicle mass as determined during the active accumulating period in accordance with point 3.4 for the average speed and point 3.5 for the total vehicle mass.

Table 2

OBFCM parameters for pure ICE vehicles, HEVs

Ref.	Parameter	Lifetime values	Instantaneous values	Active accumulating data ([1])	Static (accumulated) data
1	Total fuel consumed (lifetime) (kilograms) ([2])	Yes			
1.1	Fuel consumed during accumulation period (kilograms)			Yes	Yes
2	Total distance travelled (lifetime) (kilometres)	Yes			
2.1	Distance travelled during accumulation period (kilometres)			Yes	Yes

Ref.	Parameter	Lifetime values	Instantaneous values	Active accumulating data (1)	Static (accumulated) data
3.0	Engine fuel rate (grams/second)		Yes		
3.1	Vehicle fuel rate (grams/second)		Yes		
3.2	Vehicle speed (kilometres/hour)		Yes (actual speed)	Yes (average speed)	
4	Engine output energy (3) (kilowatt hours)	Yes		Yes	Yes
4.1	Instantaneous brake engine power (3) (kilowatts)		Yes		
5	Vehicle total mass (4) (kilograms)			Yes (average mass)	

(1) The parameters recorded in the active accumulating data shall be updated at least every second, and based on signals that are sampled at a frequency of at least 1 Hertz. The average vehicle speed is based on the distance travelled during the interval.
(2) For dual-fuel vehicles, the total lifetime accumulated fuel consumption shall be the sum of each fuel. The mass matrix shall differentiate between the two fuels and have a separate matrix per fuel.
(3) Instantaneous brake engine power to be calculated from the engine's torque and speed, as determined in accordance with Regulation (EU) No 582/2011, and accumulated (at 1 Hz) to give engine's output energy as a matrix.
(4) Signal as to be provided in accordance with point 3.2.2.

3.3.2. *For OVC-HEVs*

For OVC-HEVs, as defined in point 2(30) of Annex III to Regulation (EU) 2017/2400 and for fuel types as specified in Table 1, the OBFCM device shall determine at least the following parameters and store the lifetime and instantaneous values, and active accumulating and static data values on board the vehicle as indicated in Table 3.

For the transitional implementation, as indicated in Table 1, OVC-HEVs shall require all lifetime and instantaneous values, and active accumulating and static accumulated data as set out in Table 2, in addition to the total electric energy into the battery and total battery energy supplied to an off-board usage.

Table 3

OBFCM parameters for OVC-HEVs

Ref.	Parameter	Lifetime values	Instantaneous values (1)	Active accumulating data	Static (accumulated) data
1	Total fuel consumed (lifetime) (kilograms)	Yes			
1.1	Fuel consumed during accumulation period (kilograms)		Yes	Yes	Yes
2	Total distance travelled (lifetime) (kilometres)	Yes			
2.2	Distance travelled during accumulation period with engine on (kilometres)		Yes	Yes	Yes

Ref.	Parameter	Lifetime values	Instantaneous values (1)	Active accumulating data	Static (accumulated) data
2.3	Distance travelled during accumulation period with engine off (kilometres)		Yes	Yes	Yes
3.0	Engine fuel rate (grams/second)		Yes		
3.1	Vehicle fuel rate (grams/second)		Yes		
3.2	Vehicle speed (kilometres/hour)		Yes	Yes	
4	Engine output energy during accumulation period (kilowatt hours)		Yes	Yes	Yes
5	Vehicle total mass (2) (kilograms)			Yes (average mass)	
6	Total electric energy into the vehicle (lifetime) (kilowatt hours)	Yes			
6.1	Total electric energy into the vehicle during AC charging (lifetime) (kilowatt hours)	Yes			
6.2	Total electric energy into the vehicle during DC charging (lifetime) (kilowatt hours)	Yes			
7	Total electric energy into the battery (lifetime) (kilowatt hours)	Yes			
7.1	Total battery energy supplied to an off-board usage (lifetime) (kilowatt hours)	Yes			
7.2	Total electric energy into the battery during AC charging (lifetime) (kilowatt hours)	Yes			
7.3	Total electric energy into the battery during DC charging (lifetime) kWh	Yes			
7.4	Total battery energy supplied to on-board special equipment	Yes			
8	Vehicle electric power consumption (kilowatts)		Yes		
8.2	Vehicle electric energy consumption during accumulation period with engine on (kilowatt hours)			Yes	Yes

Ref.	Parameter	Lifetime values	Instantaneous values (1)	Active accumulating data	Static (accumulated) data
8.3	Vehicle electric energy consumption during accumulation period with engine off (kilowatt hours)			Yes	Yes
9.1	Battery current (A)		Yes		
9.2	Battery voltage (V)		Yes		
9.3	Battery state of charge (%)		Yes		
9.4	Battery state of health (%)		Yes		

(1) The parameters recorded in the active accumulating data shall be updated at least every second, and based on signals that are sampled at a frequency of at least 1 Hertz. The average vehicle speed is based on the distance travelled during the interval.
(2) Signal as to be provided in accordance with point 3.2.2.

3.3.3. *For pure electric vehicles*

For pure electric vehicles (PEVs), as defined in point 2(34) of Annex III to Regulation (EU) 2017/2400, the OBFCM device shall determine at least the parameters referred to in Table 4 and store the lifetime and instantaneous values, and active accumulating and static data on board the vehicle as indicated in Table 4.

Table 4

OBFCM parameters for PEVs

Ref.	Parameter	Lifetime values	Instantaneous values (1)	Active accumulating data (1)	Static (accumulated) data
2	Total distance travelled (lifetime) (kilometres)	Yes			
2.1	Distance travelled during accumulation period (kilometres)			Yes	Yes
3.2	Vehicle speed (kilometres/hour)		Yes (actual speed)	Yes (average speed)	
5	Vehicle total mass (2) (kilograms)			Yes (average mass)	
6	Total electric energy into the vehicle (lifetime) (kilowatt hours)	Yes			
6.1	Total electric energy into the vehicle during AC charging (lifetime) (kilowatt hours)	Yes			
6.2	Total electric energy into the vehicle during DC charging (lifetime) (kilowatt hours)	Yes			

Ref.	Parameter	Lifetime values	Instantaneous values (1)	Active accumulating data (1)	Static (accumulated) data
7	Total electric energy into the battery (lifetime) (kilowatt hours)	Yes			
7.1	Total battery energy supplied to an off-board usage (lifetime) (kilowatt hours)	Yes			
7.2	Total electric energy into the battery during AC charging (lifetime) (kilowatt hours)	Yes			
7.3	Total electric energy into the battery during DC charging (lifetime) (kilowatt hours)	Yes			
7.4	Total battery energy supplied to on-board special equipment	Yes			
8	Vehicle electric power consumption (kilowatts)		Yes		
8.1	Vehicle electric energy consumption during accumulation period (kilowatt hours)			Yes	Yes
9.1	Battery current (A)		Yes		
9.2	Battery voltage (V)		Yes		
9.3	Battery state of charge (%)		Yes		
9.4	Battery state of health (%)		Yes		

(1) The parameters recorded in the active accumulating data shall be updated at least every second, and based on signals that are sampled at a frequency of at least 1 Hertz. The average vehicle speed is based on the distance travelled during the interval.
(2) Signal as to be provided in accordance with point 3.2.2.

3.3.4. *For fuel cell hybrid vehicles*

For fuel cell hybrid vehicles (FCHVs), as defined in point 2(13) of Annex III to Regulation (EU) 2017/2400, the OBFCM device shall determine at least the parameters referred to in Table 5 and store the lifetime and instantaneous, and active accumulating and static data on board the vehicle as indicated in Table 5.

Table 5

OBFCM parameters for FCHVs

Ref.	Parameter	Lifetime values	Instantaneous values (1)	Active accumulating data (1)	Static (accumulated) data
2	Total distance travelled (lifetime) (kilometres)	Yes			

Ref.	Parameter	Lifetime values	Instantaneous values ([1])	Active accumulating data ([1])	Static (accumulated) data
2.1	Distance travelled during accumulation period (kilometres)			Yes	Yes
3.2	Vehicle speed (kilometres/hour)		Yes (actual speed)	Yes (average speed)	
5	Vehicle total mass ([2]) (kilograms)			Yes (average mass)	
10	Total Fuel Cell Fuel Consumed (Lifetime) (kilograms)	Yes			
10.1	Total Fuel Cell Active Time (Lifetime) (seconds)	Yes			
10.2	Total Fuel Cell System Energy Generated (Lifetime) (kilowatt hours)	Yes			
11	Fuel cell fuel consumed during accumulation period (kilograms)			Yes	Yes

([1]) The parameters recorded in the active accumulating data shall be updated at least every second, and based on signals that are sampled at a frequency of at least 1 Hertz. The average vehicle speed is based on the distance travelled during the interval.

([2]) Signal as to be provided in accordance with point 3.2.2.

3.3.5. *For off-vehicle charging fuel cell hybrid vehicles*

For off-vehicle charging fuel cell hybrid vehicles (OVC-FCHVs), as defined in point 2(48) of Annex III to Regulation (EU) 2017/2400, the OBFCM device shall determine at least the parameters referred to in Table 6 and store the lifetime and instantaneous, and active accumulating and static data on board the vehicle as indicated in Table 6.

Table 6

OBFCM parameters for OVC-FCHVs

Ref.	Parameter	Lifetime values	Instantaneous values	Active accumulating data ([1])	Static (accumulated) data
2	Total distance travelled (lifetime) (kilometres)	Yes			
2.1	Distance travelled during accumulation period (kilometres)			Yes	Yes
3.2	Vehicle speed (kilometres/hour)		Yes (actual speed)	Yes (average speed)	
5	Vehicle total mass ([2]) (kilograms)			Yes (average mass)	

Ref.	Parameter	Lifetime values	Instantaneous values	Active accumulating data [1]	Static (accumulated) data
6	Total electric energy into the vehicle (lifetime) (kilowatt hours)	Yes			
6.1	Total electric energy into the vehicle during AC charging (lifetime) (kilowatt hours)	Yes			
6.2	Total electric energy into the vehicle during DC charging (lifetime) (kilowatt hours)	Yes			
7	Total electric energy into the battery (lifetime) (kilowatt hours)	Yes			
7.1	Total battery energy supplied to an off-board usage (lifetime) (kilowatt hours)	Yes			
7.2	Total electric energy into the battery during AC charging (lifetime) (kilowatt hours)	Yes			
7.3	Total electric energy into the battery during DC charging (lifetime) (kilowatt hours)	Yes			
7.4	Total battery energy supplied to on-board special equipment	Yes			
8	Vehicle electric power consumption (kilowatts)		Yes		
8.1	Vehicle electric energy consumption during accumulation period (kilowatt hours)			Yes	Yes
10	Total Fuel Cell Fuel Consumed (Lifetime) (kilograms)	Yes			
10.1	Total Fuel Cell Active Time (Lifetime) (seconds)	Yes			
10.2	Total Fuel Cell System Energy Generated (Lifetime) (kilowatt hours)	Yes			
11	Fuel cell fuel consumed during accumulation period (kilograms)			Yes	Yes

([1]) The parameters recorded in the active accumulating data shall be updated at least every second, and based on signals that are sampled at a frequency of at least 1 Hertz. The average vehicle speed is based on the distance travelled during the interval.

([2]) Signal as to be provided in accordance with point 3.2.2.

3.4. **Calculation of the average speed over the accumulation period**

At the end of the active accumulation period (10 minutes, or on engine switch off), the distance travelled is converted into an average speed.

In the case that the end of the active accumulation period is defined by the 10 minutes elapsing, the average speed is defined by:

Average speed over the accumulation period = distance travelled × 60/10 minutes (km/h)

In the case the active accumulation period is defined by the engine switch off, the average speed is defined by:

Average speed over the accumulation period = distance travelled × 60/number of minutes since the end of the last accumulation period and engine off (km/h)

3.5. **Static data matrix**

3.5.1. *Average speed binning*

For all vehicles there are four average speed windows, and one window where data shall be stored in the cases specified in point 3.6:

Idle (very low speed) running, I, without PTO operation I < 1,6 km/h

Idle (very low speed) running, I (PTO), with PTO operation I (PTO) < 1,6 km/h

Urban speed running, U 1,6 ≤ U < 60 km/h

Higher speed running, H H ≥ 60 km/h

Speed data not available

The average speed, as determined following the calculation in 3.4 shall be used to determine the index in the average total vehicle mass matrix.

3.5.2. *Average total vehicle mass matrix*

The average total weight of an accumulation period shall be used to determine the index in the average total vehicle mass matrix. The average total vehicle mass shall be calculated and scaled according to the methodology described in point 3.2. Only in the case specified in point 3.6.1 may a 'mass data not available' window be used.

For all vehicles, the same average mass windows apply:

N – N + 1 000 kg for mass from 2 000 kg to 16 000 kg

N – N + 2 000 kg for mass from 16 000 kg to 26 000 kg

N – N + 3 000 kg for mass from 26 000 kg to 41 000 kg

N – N + 4 000 kg for mass from 41 000 kg to 49 000 kg

N – N + 5 000 kg for mass from 49 000 to 59 000 kg

N – N + 6 000 kg for mass from 59 000 to 65 000 kg

65 000 kg and above

Mass data not available

3.5.3. *OBFCM static data matrix*

The OBFCM static data matrix shall be indexed by the average vehicle speed during the accumulation period, as set out in point 3.5.1 following the calculation in point 3.4, and the average total vehicle mass as specified in point 3.5.2 and determined during the mass accumulation period.

The values to be indexed for each fuel type are the static (accumulated) data as specified in point 3.3. A separate data matrix shall be stored for each of the static data parameters. Each parameter is evaluated over the same time interval for the speed and mass.

For HDV configurations that do not have an on-board mass monitoring (OBMM) system requirement, as specified in point 2.1, the average vehicle total mass is not applicable. Those vehicles shall provide the relevant static accumulated values in the OBFCM static data matrix indexed by the active accumulating vehicle speed only and the 'mass data not available' window as specified in point 3.5.2.

If the vehicle mass data cannot be determined, as specified in point 3.6(1), then these vehicles shall also record the static data indexed by the average active accumulating vehicle speed as specified in point 3.5.1 and the 'mass data not available' window.

If the vehicle average speed data cannot be determined, as specified in point 3.6(2), then these vehicles shall record the static data indexed by the 'speed data not available' and the average mass window as set out in point 3.5.2.

3.6. **Data availability**

There may be two cases where data is not available to determine both the mass and speed index:

(1) the communication network to obtain mass readings, or the signals required to provide the mass readings are not functioning, or the vehicle is not required to have an OBMM system;

(2) the communication network to obtain speed readings, or the signals required to provide the speed readings are not functioning.

In the case where the mass data is not available, notwithstanding the freeze or reset conditions specified in point 3.7, data shall still be logged in the OBFCM static data matrix indexed by the average speed and 'mass data not available'.

In the case there the vehicle speed data is not available, and where the freeze or reset conditions specified in point 3.7 are not met, data shall still be logged in the OBFCM static data matrix indexed by the average vehicle total mass determined during the mass accumulation period and 'speed data not available'.

A lifetime counter shall indicate the frequency of these occurrences.

3.7. **Access to the information provided by the OBFCM device**

3.7.1. The OBFCM device shall provide for standardised and unrestricted access of the information specified in point 3.3 and shall conform to the standards referred to in either paragraph 4.7.3 of Annex 9B to UN Regulation No 49, SAE J1979, SAE J1979-2 or SAE J1979-3.

3.7.2. By way of derogation from the reset conditions specified in the standards referred to in point 3.7.1, once the vehicle has entered into service the values of the lifetime counters shall be preserved, except in the cases referred to in points 3.7.3 and 3.7.4.

3.7.3. The values of the lifetime counters must be preserved including in the case where the battery is disconnected from the vehicle. They may only be erased in the exceptional circumstances defined in point 3.7.4.

3.7.4. Lifetime counters shall be stored in Non-Volatile Random Access Memory (NVRAM) and may not be erasable by any scan tool command or by disconnecting power to the on-board computer, or when the control module containing the counters is reprogrammed. Lifetime counters may only be erased in conjunction with the reprogramming of the Vehicle Identification Number (VIN) or Engine Serial Number (ESN). Only in these cases may each number of the OBFCM device be reset simultaneously to ensure that the values remain fully synchronised.

4. ACCURACY REQUIREMENTS

4.1. With regard to the information specified in section 3 the manufacturer shall ensure that the OBFCM device provides the most accurate values that can be achieved by the measurement and calculation system of the engine control unit.

4.2. Notwithstanding paragraph 4.1, the performance of the OBEM determined on the monitoring tests in accordance with Table 1 shall fulfil the conditions specified in Table 7. The accuracy of the fuel consumption as determined by the OBFCM device shall be between the lower and upper accuracy bounds.

Table 7

OBEM consumption accuracy requirements

Test	Fuel Consumption $Accuracy_{Test,FC}$ (lower) [1] [2]	Fuel Consumption $Accuracy_{Test,FC}$ (upper) [1] [2]	Distance accuracy $Accuracy_{TEST,Distance}$ [1]
WHTC	– 0,10	0,05	—
WHSC	– 0,10	0,05	—
FCMC	– 0,10	0,05	—
PEMS	– 0,15	0,10	± 0,05
VTP	– 0,15	0,075	± 0,05
Battery durability	– 0,15	0,075	± 0,05

[1] 'Accuracy' here means the deviation determined by the OBFCM device compared to a measured reference during a test, as calculated for fuel consumption in accordance with point 4.3 and for the total distance travelled in accordance with point 4.4.

[2] Accuracy requirements shall be determined for dual-fuel vehicles based on an evaluation of the monitoring data.

4.3. The accuracy of the lifetime fuel consumption determined by the OBFCM device shall be calculated with three decimals using the following formula:

$$Accuracy_{TEST,FC} = \frac{Fuel\_Consumed_{TEST} - Fuel\_Consumed_{OBEM}}{Fuel\_Consumed_{TEST}}$$

where:

$Accuracy_{TEST,FC}$ is the accuracy determined by taking the difference of the fuel consumption determined over the duration of the test and the fuel consumption as determined by the OBFCM device during this same test over the same time interval. For the WHTC test this is $Accuracy_{WHTC}$, for the FCMC test this is $Accuracy_{FCMC}$, for the VTP test this is $Accuracy_{VTP,FC}$ and for the PEMS test this is $Accuracy_{PEMS,FC}$.

$Fuel\_Consumed_{TEST}$ (kilograms)	is the fuel consumption determined in accordance with point 5.2, using the measurement data shared in accordance with paragraph 5.1. For the WHTC test this is $Fuel\_Consumed_{WHTC}$, for the WHSC test this is $Fuel\_Consumed_{WHSC}$, for the FCMC test this is $Fuel\_Consumed_{FCMC}$, for the VTP test this is $Fuel\_Consumed_{VTP}$ and for the PEMS test this is $Fuel\_Consumed_{PEMS}$.
$Fuel\_Consumed_{WHTC}$ (kilograms)	is the fuel consumption determined at the WHTC test carried out in accordance with point 4.3.3 of Annex V to Regulation (EU) 2017/2400, and calculated in accordance with point 5.2.1 of this Annex.
$Fuel\_Consumed_{WHSC}$ (kilograms)	is the fuel consumption determined at the WHSC test carried out in accordance with point 4.3.4 of Annex V to Regulation (EU) 2017/2400, and calculated in accordance with point 5.2.1 of this Annex.
$Fuel\_Consumed_{FCMC}$ (kilograms)	is the fuel consumption determined at the FCMC test carried out in accordance with point 4.3.5 of Annex V to Regulation (EU) 2017/2400, and calculated in accordance with point 5.2.1 of this Annex.
$Fuel\_Consumed_{VTP}$ (kilograms)	is the fuel consumption measured at the verification test procedure, in accordance with point 6.1.5.5 of Annex Xa to Regulation (EU) 2017/2400 and reported in the test report in accordance with point 8.13.15.11 of that Annex.
$Fuel\_Consumed_{PEMS}$ (kilograms)	is the fuel consumption during the test procedure for vehicle emissions testing with portable emissions measurement systems in accordance with Appendix 1 to Annex II to Regulation (EU) No 582/2011 or Appendix 1 to Annex VI to Regulation (EU) No 582/2011, as calculated in accordance with point 5.2.2 of this Annex. If the fuel consumption is measured in accordance with point 5.1.3(2), then the total fuel consumed shall be calculated in accordance with point 5.2.1 of this Annex.
$Fuel\_Consumed_{OBEM}$ (kilograms)	is the fuel consumption determined for the same test using the differentials of the parameter 'Total fuel consumed (lifetime) (kilograms)' as provided by the OBFCM device over the same period as the $Fuel\_Consumed_{TEST}$ and collected in accordance with point 5.1.

4.4. The accuracy of the total distance travelled (lifetime) (km) determined by the OBFCM device shall be calculated with three decimals using the following formula:

$$Accuracy_{TEST,Distance} = \frac{Total\_Distance_{TEST} - Total\_Distance_{OBEM}}{Total\_Distance_{TEST}}$$

where:

$Accuracy_{TEST,Distance}$	is the accuracy determined by taking the difference of the distance determined at a test and the distance as determined by the OBFCM device during this same test over the same time interval. For the VTP test this is $Accuracy_{VTP,Distance}$ and for the PEMS test this is $Accuracy_{PEMS,Distance}$.
$Total\_Distance_{TEST}$ (kilometres)	is the total distance determined at the test carried out to verify the accuracy of the OBFCM device. For the VTP test this is $Total\_Distance_{VTP}$, for the PEMS test this is $Total\_Distance_{PEMS}$.

$Total\_Distance_{VTP}$ (kilometres)	is the total distance determined by taking the differentials of the odometer reading between the test end and the test start of the verification test procedure as reported in the test reporting procedure in accordance with points 8.1.7 and 8.13.15.10 of Annex Xa to Regulation (EU) 2017/2400 and shared in accordance with point 5.1.2 of this Annex.
$Total\_Distance_{PEMS}$ (kilometres)	is the total distance determined by taking the differentials of the odometer reading between the test end and the test start of the test procedure for vehicle emissions testing with portable emissions measurement systems in accordance with Appendix 1 to Annex II to Regulation (EU) No 582/2011 or Appendix 1 to Annex VI to that Regulation, as reported in accordance with points 10.1.7.1 and 10.1.7.1a of Annex II to that Regulation and shared in accordance with point 5.1.3 of this Annex.
$Total\_Distance_{OBEM}$ (kilometres)	is the total distance determined for the same test using the differentials of the parameter 'Total distance travelled (lifetime)' as provided by the OBFCM device over the same period as the $Total\_Distance_{TEST}$ and collected in accordance with points 5.1.2 and 5.1.3.

4.5. **Evaluation of deviations of the vehicle total mass (TM) signal to the reference mass**

The reference mass (TM_{ref}) for verification of the OBMM system accuracy shall be the value as determined by weighing the vehicle on the weighbridge as set out in point 2.5.2 of Annex III.

4.5.1. *Division of the measurement data into evaluation windows (EW)*

The *TM* signal is evaluated on the basis of non-overlapping periods of 10 minutes that follow each other seamlessly and are referred to as EWs. The first EW is defined as the 10-minute time period starting 15 minutes after the first movement of the vehicle as recorded in the measuring run. The last part of the data recording in the measuring run that is shorter than 10 minutes shall not be considered in the evaluation.

The *TM* signal is shared with the GAA in accordance with point 5.1.2. for the VTP test performed in accordance with Annex Xa to Regulation (EU) 2017/2400, and in accordance with point 5.1.3 for the PEMS test as performed in accordance with Annex II to Regulation (EU) No 582/2011.

4.5.2. *Calculation of relative and absolute deviation for each EW*

For each EW which contains n recorded data points $TM_{EW,i}$ the relative deviation $\mu_{rel,j}$ and the absolute deviation $\mu_{abs,j}$ shall be calculated as follows:

relative deviation for the EW j [%]:

$$\mu_{rel,j} = \frac{1}{600} \sum_{i=1}^{n} \frac{TM_{EW,i} - TM_{ref}}{TM_{ref}}$$

absolute deviation for the EW j [kg]:

$$\mu_{abs,j} = \frac{1}{600} \sum_{i=1}^{n} (TM_{EW,i} - TM_{ref})$$

where:

i represents the index of a single recorded data point in an EW.

j represents the index of evaluation windows.

4.5.3. *Calculation of the average relative and average absolute standard deviation for the entire test*

Average relative deviation:

$$\overline{\mu_{rel}} = \frac{1}{N} \sum_{j=1}^{N} \mu_{rel,j}$$

Average relative standard deviation:

$$\overline{\sigma_{rel}} = \sqrt{\frac{1}{N-1} \sum_{j=1}^{N} |\mu_{rel,j} - \overline{\mu_{rel}}|^2}$$

Average absolute deviation (kg):

$$\overline{\mu_{abs}} = \frac{1}{N} \sum_{j=1}^{N} \mu_{abs,j}$$

Average absolute standard deviation:

$$\overline{\sigma_{abs}} = \sqrt{\frac{1}{N-1} \sum_{j=1}^{N} |\mu_{abs,j} - \overline{\mu_{abs}}|^2}$$

where *N* represents the number of measured EW.

4.5.4. *Pass/fail criteria*

A vehicle passes the OBMM accuracy requirements in case of

$$\overline{|\mu_{rel}|} + f_\sigma \times \overline{\sigma_{rel}} \leq Tol_{rel}$$

or

$$\overline{|\mu_{abs}|} + f_\sigma \times \overline{\sigma_{abs}} \leq Tol_{abs}$$

whereby only the criterion is to be fulfilled for which the tolerance results in the higher value in kilograms.

where:

Tol_{rel} represents the relative tolerance.

Tol_{abs} represents the absolute tolerance.

f_σ represents the factor to take into account the standard deviation.

The parameters listed above are set out Table 8 depending on the vehicle group set as defined in point 2.1 and the propulsion system referred to in Table 1.

Table 8

Parameters for pass/fail criteria

Propulsion system [1]	Vehicle group set											
	#1 (groups 4, 5, 9 and 10)			#2 (groups 1, 1s, 2, and 3)			#3 (11, 12 and 16)			Coaches and interurban buses		
	Tol_{rel} [-]	Tol_{abs} [kg]	f_σ	Tol_{rel} [-]	Tol_{abs} [kg]	f_σ	Tol_{rel} [-]	Tol_{abs} [kg]	f_σ	Tol_{rel} [-]	Tol_{abs} [kg]	f_σ
ICE Diesel CI	10 %	1 500	1	10 %	1 500	0	10 %	2 500	0	10 %	1 500	0
ICE NG PI and ICE NG CI (dual-fuel)	10 %	2 500	0	10 %	1 500	0	10 %	2 500	0	10 %	2 500	0
PEVs	10 %	1 500	1	10 %	1 500	0	10 %	2 500	0	10 %	1 500	0

[1] Systems with ICE include HEV configurations.

5. MONITORING AND VERIFICATION OF ACCURACY REQUIREMENTS

5.1. **Collection of accuracy monitoring data**

5.1.1. *WHTC/WHSC/FCMC accuracy monitoring data collection*

(1) The approval authority performing the WHTC test in accordance with point 4.3.3 of Annex V to Regulation (EU) 2017/2400 shall share with the GAA the following information:

(a) information set out in Table 9 of this Annex for the WHTC test;

(b) information over the same test period on actual fuel mass flow consumed by the engine in accordance with point 3.4 of Annex V to Regulation (EU) 2017/2400 during the entire WHTC test and referred to in point 4.3.3.1 of that Annex.

(2) The approval authority performing the WHSC test in accordance with point 4.3.4 of Annex V to Regulation (EU) 2017/2400 shall share with the GAA the following information:

(a) information set out in in Table 9 as recorded for the WHSC test;

(b) information over the same test period on actual fuel mass flow consumed by the engine in accordance with point 3.4 of Annex V to Regulation (EU) 2017/2400 during the entire WHSC test and referred to in point 4.3.4.1 of that Annex.

(3) The approval authority performing the FCMC test in accordance with Point 4.3.5 of Annex V to Regulation (EU) 2017/2400 shall share with the GAA the following information:

(a) information set out in Table 9 as recorded for the FCMC test;

(b) information over the same test period on actual fuel mass flow consumed by the engine in accordance with point 3.4 of Annex V to Regulation (EU) 2017/2400 during the entire FCMC test and referred to in point 4.3.5.3(3) of that Annex;

(c) information for each point of the fuel mass flow recorded in accordance with 4.3.5.3(3) of Annex V to Regulation (EU) 2017/2400 the OBFCM instantaneous value of the engine fuel rate referred to in point 5.13 of Annex Xa to that Regulation and referred to in point 4.3.5.3(5)(b) of Annex V to that Regulation;

(d) information on the time intervals between the different points of the fuel mass flow as referred to in point 4.3.5.3(5)(c) of Annex V to Regulation (EU) 2017/2400.

Table 9

Data to be shared from WHTC/WHSC/FCMC with the GAA, as recorded in accordance with point 4.3.5.3(5)(a) of Annex V to Regulation (EU) 2017/2400

OBFCM ref	Parameter	Parameter reported in Engine information document as specified in Appendix 2 to Annex V to Regulation (EU) 2017/2400, where applicable
—	Engine type as separate technical unit/engine as separate technical unit/vehicle with an approved engine with regards to emissions/vehicle with regards to emissions	0.2.
—	Heavy duty vehicles Diesel/Petrol/LPG/NG/ Ethanol (ED95)/Ethanol (E85)/Hydrogen (T)/ Hydrogen (TD)/Hydrogen (U)/Hydrogen(UD)/ Diesel B100	3.2.2.2.
1	Total fuel consumed (lifetime) (kilograms) at the beginning of the fuel consumption measurement and at the end of the fuel consumption measurement	—
3.0	Engine fuel rate (grams/second)	—
3.1	Vehicle fuel rate (grams/second)	—

(4) The approval authority referred to in points (1), (2) and (3) shall ensure that sufficient data is shared with the GAA to allow for the evaluation of the monitoring data as specified in point 4.2, and to determine the accuracy requirements in accordance with points 4.2, 4.3 and 4.4. The approval authority may share additional information on a voluntary basis with the GAA or at the request of the GAA.

5.1.2. *Collection of VTP monitoring data*

(1) The approval authority that granted the licence to operate the simulation tool responsible for the VTP test in accordance with Annex Xa to Regulation (EU) 2017/2400 shall share with the GAA the information set out in Table 10 of this Annex, in addition to the instantaneous values as recorded from the OBFCM device and set out in Table 4 of Annex Xa to Regulation (EU) 2017/2400.

(2) The approval authority referred to in point (1) shall ensure that sufficient data is shared with the GAA to allow for the evaluation of the monitoring data as specified in point 5.2, and to determine the accuracy requirements in accordance with points 4.2, 4.3 and 4.4. The approval authority may share additional relevant information on a voluntary basis with the GAA or at the request of the GAA.

Table 10

Data to be shared with the GAA from the VTP, as recorded in accordance with Annex Xa to Regulation (EU) 2017/2400

OBFCM ref	Parameter	Parameter reported in Annex Xa to Regulation (EU) 2017/2400
—	Engine type as separate technical unit/engine as separate technical unit/vehicle with an approval engine with regards to emissions/vehicle with regards to emissions	8.1.4.

OBFCM ref	Parameter	Parameter reported in Annex Xa to Regulation (EU) 2017/2400
—	Engine reference fuel type (diesel/LPG/CNG…)	8.3.5.
1	Total fuel consumed (lifetime) (kilograms) at the beginning of the fuel consumption measurement	8.13.15.3.
1	Total fuel consumed (lifetime) (kilograms) at the end of the fuel consumption measurement	8.13.15.4.
2	Total distance travelled (lifetime) (kilometres) at the test start of the fuel consumption measurement	8.13.15.1.
2	Total distance travelled (lifetime) (kilometres) at the test end of the fuel consumption measurement	8.13.15.2.
3.0	Engine fuel rate (grams/second)	8.13.15.7.
5	Average vehicle total mass (kilograms)	8.13.15.9.
—	Actual mass of the vehicle for VTP (kilograms)	8.12.1.
—	Actual mass of the vehicle for VTP with payload (kilograms)	8.12.2.
—	Odometer reading at test start of the fuel consumption measurement (kilometres)	8.1.7.
—	Odometer reading at test end of the fuel consumption measurement (kilometres)	8.13.15.10.
—	Total mass fuel consumption value in the verification test measured (kilograms)	8.13.15.11.
—	Fuel consumption measurement duration (minutes)	8.12.5.

5.1.3. *Collection of PEMS monitoring data*

(1) The approval authority responsible for the PEMS test in accordance with Annex II to Regulation (EU) No 582/2011 and Appendix 1 of Annex VI to that Regulation shall share with the GAA the information set out in Table 11 of this Annex, in addition to the instantaneous measured data for the OBFCM device signals 1, 2, 3.0, 3.1, and 5 as recorded in accordance with points 10.1.8a.1 to 10.1.8a.5 of Annex II to Regulation (EU) No 582/2011.

(2) The manufacturer may use a fuel measurement system in accordance with point 5.7 of Annex Xa to Regulation (EU) 2017/2400 to measure the fuel consumed during the PEMS test. In this case the data to be transmitted by the approval authority to the GAA shall be the instantaneous values as measured by the fuel measurement system and the total fuel consumed is to be calculated in accordance with point 5.2.1 of this Annex.

(3) If the PEMS test has been performed in accordance with Annex 8 to UN Regulation No 49, the approval authority responsible for this test shall share with the GAA the information set out in Table 11, in addition to the instantaneous measured data for the OBFCM device signals 1, 2, 3.0, 3.1, and 5 as recorded in point A.1.2.2, Table 1, of Appendix 1 to Annex 8 to UN Regulation No 49.

(4) For vehicles with a B100 type-approval following the requirements set out in point 1.4 of Annex I to Regulation (EU) No 582/2011, the manufacturer may request for an additional PEMS test to be performed only for the purpose of evaluating the OBFCM and OBMM accuracy using the reference fuel according to Annex IX to Regulation (EU) No 582/2011 on which the parent engine has been type-approved under Article 3 of that Regulation. In this case, the information to be shared with the GAA in accordance with paragraph 1 and paragraph 3 shall relate to the additional PEMS test performed on the reference fuel.

(5) The approval authority shall ensure that sufficient data is shared with the GAA to allow for the evaluation of the monitoring data as specified in point 5.2, and to determine the accuracy requirements in accordance with point 4.2, 4.3 and 4.4. The approval authority may share additional relevant information on a voluntary basis with the GAA or at the request of the GAA.

Table 11

Data to be shared with the GAA from the PEMS test performed in accordance with Annex II to Regulation (EU) No 582/2011

OBFCM ref	Parameter	Parameter reported in Annex II to Regulation (EU) No 582/2011
—	Engine family	10.1.1.5.
—	Engine family members	10.1.1.7.
—	Type of engine: petrol, ethanol (E85), diesel/NG/LPG/ethanol (ED95), B100 (*Delete as appropriate*)	10.1.1.11.
—	Type-approval number	10.1.5.3.
—	Vehicle type (e.g. M_3, N_3) and application (e.g. rigid or articulated truck, city bus)	10.1.6.2.
—	Vehicle production year and month	10.1.6.7.
—	Transmission type (e.g. manual, automatic or other)	10.1.6.8.
1	Total fuel consumed (lifetime) (kilograms) at the beginning of the fuel consumption measurement	10.1.10a.1.
1	Total fuel consumed (lifetime) (kilograms) at the end of the fuel consumption measurement	10.1.10a.2.
2	Total distance travelled (lifetime) (kilometres) at the test start of the fuel consumption measurement	10.1.10a.3.
2	Total distance travelled (lifetime) (kilometres) at the test end of the fuel consumption measurement	10.1.10a.4.
3.0	Engine fuel rate (grams/second)	10.1.10a.5.
3.1	Vehicle fuel rate (grams/second)	10.1.10a.6.
5	Average vehicle total mass (kilograms)	10.1.10a.7.
—	Actual mass of the vehicle for the PEMS test with payload (kilograms)	10.1.7.8.
—	Odometer reading at test start (kilometres)	10.1.7.1.
—	Odometer reading at test end of the fuel consumption measurement (kilometres)	10.1.7.1a.
—	THC emissions [g]	10.1.10.8.
—	CO emissions [g]	10.1.10.9.
—	CO_2 emissions [g]	10.1.10.11.
—	CH_4 emissions [g] for gas engines only	10.1.10.12.
—	Duration [s]	10.1.7.2.

5.2. **Evaluation of monitoring data**

(1) The GAA shall evaluate the monitoring data received by the approval authority by calculating the accuracy of the parameters in accordance with point 4.

(2) The GAA shall evaluate the accuracy of the 'total fuel consumed (lifetime) (kilograms)' of the OBFCM device against the accuracy requirements for fuel consumption as set out in Table 7.

(3) The GAA shall evaluate the accuracy of the total lifetime distance travelled (kilometres) of the OBFCM device during the PEMS and VTP test against the accuracy requirements for distance travelled as set out in Table 7.

(4) The GAA shall evaluate the accuracy of the 'vehicle total mass (kilograms)' as determined by the OBFCM device during the PEMS and VTP test against the accuracy requirements for vehicle total mass as set out in Table 8.

5.2.1. *Calculation of integrated fuel consumption for the evaluation of (WHTC, WHSC, FCMC) monitoring data*

Any recorded negative values for the fuel consumption shall be used directly and shall not be set equal to zero for the calculations of the integrated value.

The total fuel mass (kilograms) consumed by the engine over a complete testcycle ($Fuel\_Consumed_{WHTC}$, $Fuel\_Consumed_{WHSC}$, $Fuel\_Consumed_{FCMC}$) shall be determined by integrating recorded values of fuel massflow over the same start point and end point of the fuel consumption measurement, using the following formula:

$$\sum_{FC_{meas,i}} = \frac{\left(\frac{1}{2}mf_{fuel,0} + mf_{fuel,1} + mf_{fuel,2} + \ldots + mf_{fuel,n-2} + mf_{fuel,n-1} + \frac{1}{2}mf_{fuel,n}\right)h}{1\ 000}$$

where:

$\sum_{FC_{meas,i}}$	is the total fuel mass consumed by the engine over the time period from t_0 to t_1 in kilograms.
t_0	is the time at the start of the time period.
t_1	is the time at the end of the time period.
n	is the number of recorded values over the period from t_0 to t_1.
$mf_{fuel,k\ [0\ \ldots\ n]}$	is the recorded fuel massflow values over the time period from t_0 to t_1 in chronological order, where k runs from 0 at t_0 to n at t_1.
h	is the interval width between two adjacent recorded values defined by $h = \frac{t_1 - t_0}{n}$

5.2.2. *Evaluation of PEMS monitoring data*

5.2.2.1. The fuel consumption determined from the PEMS test is evaluated following the accuracy requirement in point 4, where the fuel consumption is measured during the PEMS test and shared with the GAA in accordance with point 5.1.3, and the fuel consumption is calculated using the properties of the appropriate reference fuels, as specified in Annex IX to Regulation (EU) No 582/2011, regardless of the actual fuel used.

5.2.2.2. For all equations in points 5.2.2.3 to 5.2.2.10 the integrated data of the points 10.1.10.8 to 10.1.10.12 of Table 11 from test start to test end shall be used, where:

FC is the fuel consumption of a specific fuel, g/test;

HC are the emissions of hydrocarbons, g/test;

CO are the emissions of carbon monoxide, g/test;

CO_2 are the emissions of carbon dioxide, g/test.

5.2.2.3. For vehicles with a positive ignition engine fuelled with petrol (E10)

$$FC = 1{,}20 \times [(0{,}831 \times HC) + (0{,}429 \times CO) + (0{,}273 \times CO_2)]$$

5.2.2.4. For vehicles with a positive ignition engine fuelled with LPG

$$FC = 1{,}212 \times [(0{,}825 \times HC) + (0{,}429 \times CO) + (0{,}273 \times CO_2)]$$

If the composition of the fuel used for the test differs from the composition that is assumed for the calculation of the normalised consumption, a correction factor *cf* may be applied at the manufacturer's request, as follows:

$$FC\_norm = 1{,}212 \times cf \times [(0{,}825 \times HC) + (0{,}429 \times CO) + (0{,}273 \times CO_2)]$$

The correction factor *cf*, which may be applied, is determined as follows:

$$cf = 0{,}825 + 0{,}0693\ n_{actual}$$

where:

n_{actual} is the actual H/C ratio of the fuel used.

5.2.2.5. For vehicles with a positive ignition engine fuelled with NG/biomethane

$$FC = 1{,}336 \times [(0{,}749 \times HC) + (0{,}429 \times CO) + (0{,}273 \times CO_2)]$$

5.2.2.6. For vehicles with a positive ignition engine fuelled with ethanol (E85)

$$FC = 1{,}742 \times [(0{,}574 \times HC) + (0{,}429 \times CO) + (0{,}273 \times CO_2)]$$

5.2.2.7. For vehicles with a compression ignition engine fuelled with diesel

$$FC = 1{,}165 \times [(0{,}859 \times HC) + (0{,}429 \times CO) + (0{,}273 \times CO_2)]$$

5.2.2.8. For vehicles with a compression ignition engine fuelled with ethanol (ED95)

$$FC = 1{,}86 \times [(0{,}538 \times HC) + (0{,}429 \times CO) + (0{,}273 \times CO_2)]$$

5.2.2.9. For vehicles with a compression ignition engine fuelled with biodiesel (B100)

$$FC = 1{,}331 \times [(0{,}770 \times HC) + (0{,}429 \times CO) + (0{,}273 \times CO_2)]$$

5.2.2.10. If there is an exceedance of the accuracy requirements for a B100 vehicle using the formula in 5.2.2.9 of this Annex, where the test fuel used is FAME B100, the manufacturer may request that the conversion is recalculated based on an analysis of the fuel sample taken in accordance with point 4.4.2.2 of Annex II to Regulation (EU) No 582/2011. In that case, the manufacturer shall determine the FAME content and communicate it to the GAA together with the supporting documents.

The GAA shall calculate the fuel consumption, using the following formula:

$$FC = 1{,}331 \times cf \times [(0{,}770 \times HC) + (0{,}429 \times CO) + (0{,}273 \times CO_2)]$$

For the purposes of this correction, the correction factor *cf* is determined as follows:

$$cf = \frac{NCV_{meas}}{NCV_{std}}$$

where:

NCV_{meas} is the *NCV* of the fuel used during the test and determined in accordance with point 3.2 of Annex V to Regulation (EU) 2017/2400 [MJ/kg].

NCV_{std} is the standard *NCV* in accordance with Table 4 of Annex V to Regulation (EU) 2017/2400 [MJ/kg].

5.3. **Verification test**

5.3.1. The GAA shall conduct a statistical verification test in accordance with Annex II if any of the accuracy requirements in any of the tests set out in Table 7 are exceeded.

5.3.2. The GAA shall conduct a statistical verification test in accordance with Annex III if any of the accuracy requirements in any of the tests set out in Table 8 are exceeded.

5.3.3. Notwithstanding point 5.3.1, for those vehicle groups where only a surveillance of the accuracy applies for the fuel consumption or total distance applies ('SE') as set out in Table 1, the accuracy shall be determined, and an exceedance of the accuracy shall not lead to a statistical verification test as set out in Annex II. An exceedance of the accuracy shall be communicated to the manufacturer and to the Commission.

5.3.4. Notwithstanding point 5.3.2, for those vehicle groups where only a surveillance of the accuracy applies for vehicle total mass ('SM') as set out in Table 1, the accuracy shall be determined, and an exceedance of the accuracy shall not lead to a statistical verification test as set out in Annex III. An exceedance of the accuracy shall be communicated to the manufacturer and to the Commission.

6. MANUFACTURER'S DECLARATION

The following declaration shall be supplied in addition to the Information document set out in Appendix 4 of Annex I to Regulation (EU) No 582/2011. Any drawings shall be supplied in appropriate scale and in sufficient detail on size A4 or on a folder of A4 format. Photographs, if any, shall show sufficient detail.

If the systems, components or separate technical units referred to in the declaration of conformity have electronic controls, information concerning their performance shall be supplied.

Explanatory notes (regarding filling in the table):

Letters A, B, C, D and E corresponding to OBFCM family members in accordance with point 2.2 shall be replaced by the actual OBFCM family members' names.

In case when for a certain OBFCM characteristic same value/description applies for all OBFCM family members the cells corresponding to A-E shall be merged.

The OBFCM device requirement level shall be based on the requirements set out in Table 1.

In case the family consists of more than five members new columns may be added.

6.1. **Manufacturer's declaration of compliance with regard to requirements for devices for monitoring the consumption of fuel and/or electric energy**

		Parent Engine or Engine Type	OBFCM Family Members				
			A	B	C	D	E

(Manufacturer): …..

(Address of the manufacturer): …..

Certifies that

The engine type(s), Engine Family(ies) and/or Vehicle Type(s) listed below comply with the requirements of Article 3 of Commission Implementing Regulation (EU) 2025/2161, as regards the devices for monitoring the consumption of fuel and/or electric energy.

0	GENERAL						
0.1	Make (trade name of manufacturer):						
0.2	Engine Type(s) / Engine Family(ies), Vehicle Type(s)						
0.2.0.3	Engine type as separate technical unit/engine family as separate technical unit/vehicle with an approved engine with regard to emissions/vehicle with regard to emissions						
0.2.0.3.1	Engine type approval number (to be completed after approval), if applicable						
0.2.0.3.2	Engine approval type (UN/EU/IVA), if applicable						
3.2.13.1	Engine fitted with an on-board fuel and/or energy consumption monitoring device: yes/no If no, reason why that engine is not fitted with an on-board fuel and/or energy consumption monitoring device						
3.2.13.2	Description of the working principle of the on-board fuel and/or energy consumption monitoring device						

		Parent Engine or Engine Type	OBFCM Family Members				
			A	B	C	D	E
3.2.13.3	Declared compliance with OBFCM device requirement level: Euro VI E+/Euro 7						
3.2.13.4	On-board mass monitoring system: yes/no If no, provide the description of the requirements to ensure the communication of the vehicle total mass signal to the OBFCM device						
3.2.13.5	Description of the working principle of the on-board mass monitoring system						

Done at [*Place*]

On [*Date*]

[Name and signature of the Manufacturer's Representative]

6.2. **Manufacturer's declaration of compliance with regard to requirements for devices for monitoring the total vehicle mass on-board the vehicle**

(Manufacturer): …..

(Address of the manufacturer): …..

Certifies that

The engine type(s), Engine Family(ies) and/or Vehicle Type(s) listed below comply with the requirements of Article 3 of Commission Implementing Regulation (EU) 2025/2161, as regards the devices for monitoring the consumption of fuel and/or electric energy and payload/mass.

0	GENERAL	
0.1	Make (trade name of manufacturer):	
0.2	Engine Type(s) / Engine Family(ies), Vehicle Type(s)	
0.2.0.3	Engine type as separate technical unit/engine family as separate technical unit/vehicle with an approved engine with regard to emissions/vehicle with regard to emissions	
3.2.13.6	On-board mass monitoring system: yes/no If no, reason why that engine is not fitted with an on-board mass monitoring device	
3.2.13.5	Description of the working principle of the on-board mass monitoring system	
3.2.13.6	Declaration that the requirements to ensure the communication of the vehicle total mass signal to the OBFCM device (as referred to in the declaration of compliance as set out in point 6.1) have been met	

Done at [*Place*]

On [*Date*]

[Name and signature of the Manufacturer's Representative]

ANNEX II

STATISTICAL TESTING PROCEDURE TO VERIFY THE FUEL CONSUMPTION AND DISTANCE DETERMINED BY THE OBFCM DEVICE

1. INTRODUCTION

1.1. This Annex sets out the statistical testing procedure to verify the accuracy of the total fuel consumption and total distance as determined by the OBFCM device.

2. STATISTICAL VERIFICATION TESTING PROCEDURE FOR FUEL CONSUMPTION AND DISTANCE

2.1. **Vehicle selection**

The vehicle shall be selected from the OBFCM family which exceeded the accuracy requirements in any of the monitoring tests set out in point 4.2. of Annex I, or from the OBFCM family that was selected by the granting approval authority based on a suspicion of non-compliance. A minimum of 3 and maximum of 8 vehicles shall be selected from this family for testing.

2.2. **Vehicle conditions**

Vehicle conditions are described in point 4 of Annex Xa to Regulation (EU) 2017/2400. For the fuel consumption measurement as described in point 6.1.5.5 of Annex Xa to Regulation (EU) 2017/2400, the fuel used shall be the one set out in point 2.3 of this Annex.

2.3. **Test fuel**

The test procedure shall be performed with a reference fuel specified in Annex IX to Regulation (EU) No 582/2011 on which the parent engine has been type-approved under that Regulation.

2.4. **Measurement equipment specifications**

The actual fuel mass consumed shall be measured on-board with a measurement device as set out in point 5.7 of Annex Xa to Regulation (EU) 2017/2400. If a run-in phase took place in accordance with point 6.1.2 of that Annex Xa, the vehicle shall be equipped with the fuel consumption measurement system after the run-in phase.

2.5. **Vehicle preparation**

The vehicle preparation is described in points 6.1.2, 6.1.3, and 6.1.4 of Annex Xa to Regulation (EU) 2017/2400. The vehicle shall be equipped with the fuel measurement system as specified in point 5.7 of that Annex.

The vehicle tested shall be equipped with the on-board fuel consumption device as type-approved for that vehicle family.

2.5.1. *Vehicle warm-up*

Before start of statistical verification test sequence the vehicle may be driven for warm up in accordance with Table 3 of Annex Xa to Regulation (EU) 2017/2400. The warm up phase shall not be considered in the evaluation of the verification test.

2.5.2. *Measurement signals*

The fuel measurement signals to be measured are described in point 5.9 in Annex Xa to Regulation (EU) 2017/2400. Those include the 'fuel mass flow for liquid fuels', 'fuel mass flow for gaseous fuels'.

The engine fuel rate signals as determined by the OBFCM device shall also be recorded.

2.5.2.1. Vehicle speed

The recorded vehicle speed shall be the CAN signal for vehicle speed in the unit km/h as provided by a digital tachograph complying with Regulation (EU) No 165/2014 of the European Parliament and of the Council ([1]).

2.5.2.2. Global positioning system

The longitudinal and latitudinal position shall be provided via a global positioning system.

Required accuracy:

Position: < 3 m 95 % Circular Error Probable

Update rate: ≥ 4 Hz

2.5.2.3. Ambient temperature

Required accuracy: ± 1 °C

Update rate: ≥ 1 Hz

2.5.3. *Fuel consumption measurement*

The fuel consumption measurement shall start at vehicle stand still directly before the measuring run. The vehicle shall be driven during the measurement in a driving style avoiding unnecessary braking of the vehicle, gas pedal pumping and aggressive cornering. The setting for the advanced driver assistance systems which is activated automatically at key-on shall be used, and gear shifts shall be performed by the automated system (in the case of AMT or APT transmissions) and the cruise control shall be used (if applicable). The duration of the fuel consumption measurement shall be within the tolerances set out in Table 3 of Annex Xa to Regulation (EU) 2017/2400. The fuel consumption measurement shall end at vehicle stand still directly after the measuring run.

2.5.4. *OBFCM data read-out during the measuring run*

The recording of the total distance travelled (lifetime), total fuel consumed (lifetime) (kilograms), vehicle fuel rate, engine fuel rate, as determined by the OBFCM device, shall start no later than when the fuel consumption measurement has started and end together with the fuel consumption measurement.

The odometer reading shall be taken at vehicle stand still directly before the measuring run and shall be taken at vehicle stand still directly after the end of the fuel consumption measurement.

2.5.5. *Measuring run*

The route selected shall fulfil the requirements described in point 6.1.5.1 of Annex Xa to Regulation (EU) 2017/2400.

([1]) Regulation (EU) No 165/2014 of the European Parliament and of the Council of 4 February 2014 on tachographs in road transport, repealing Council Regulation (EEC) No 3821/85 on recording equipment in road transport and amending Regulation (EC) No 561/2006 of the European Parliament and of the Council on the harmonisation of certain social legislation relating to road transport (OJ L 60, 28.2.2014, p. 1, ELI: http://data.europa.eu/eli/reg/2014/165/oj).

2.5.6. *Boundary conditions for the verification test*

The boundary conditions to be met for a valid verification test are set out in point 6.1.5.7 of Annex Xa to Regulation (EU) 2017/2400.

2.6. **Data evaluation**

The recorded data shall be synchronised and aligned to 1 Hz temporal resolution, either by arithmetical average, nearest neighbour or linear interpolation.

2.6.1. *Evaluation of the accuracy of the fuel consumption determined by the OBFCM device*

The fuel consumption from the OBFCM device shall be compared with the fuel consumption measured on-board with a measurement device reporting the total amount of fuel consumed in grams.

The accuracy ratio $C_{OBFCM,FUEL}$ shall be calculated as follows:

$$C_{OBFCM,FUEL} = \frac{Fuel\_Consumed_{TEST}(kg)}{Fuel\_Consumed_{OBFCM}(kg)}$$

where:

$Fuel\_Consumed_{TEST}$ is the fuel consumption measured during the statistical test procedure, in accordance with point 2.5.3.

$Fuel\_Consumed_{OBFCM}$ is the fuel consumption measured by the OBFCM device during the statistical test, as specified in point 2.5.4, and calculated by taking the difference between the total fuel consumed (lifetime) reading from the OBFCM device at the end of the test and the total fuel consumed (lifetime) reading from the OBFCM device at the start.

This ratio shall be calculated for each of the statistical tests and shall be used to perform the statistical evaluation as set out in point 3.

2.6.2. *Evaluation of the accuracy of the distance determined by the OBFCM device*

The accuracy ratio $C_{OBFCM,DISTANCE}$ shall be calculated as follows:

$$C_{OBFCM,DISTANCE} = \frac{D_{OBFCM}}{D_{ODOMETER}}$$

where:

$D_{ODOMETER}$ is the difference between the odometer reading at the end of the test and the odometer reading at the start of the test referred to in point 2.5.4.

D_{OBFCM} is the difference between the lifetime distance reading from the OBFCM device at the end of the test and the lifetime distance reading from the OBFCM device at the start of the test as recorded in point 2.5.4.

That ratio shall be calculated for each of the statistical tests, and shall be used to perform the statistical evaluation as set out in point 3.

The lifetime distance of the OBFCM device shall be compared with the distance read from the odometer, and in the case of a discrepancy over ± 5 %, the manufacturer shall provide an explanation of that discrepancy to the approval authority, which shall notify the Commission of the discrepancy and the explanation thereto.

3. EVALUATION OF THE STATISTICAL TESTING PROCEDURE FOR FUEL CONSUMPTION AND DISTANCE

3.1. **Starting point**

The starting point for the statistical evaluation are the values for C_{OBFCM} calculated for 3 individual test vehicles ($N = 3$) in accordance with point 2.6.1 for fuel consumption and in accordance with point 2.6.2 for the total distance.

The criteria set out under point 3.3(3) determine if additional vehicles need to be tested, which shall be verified separately for fuel consumption and total distance.

3.2. **Statistical parameters**

For the total number of vehicles tested (N), the average (X_{tests}) and the standard deviation (s) of the test results shall be determined:

$$X_{tests} = \frac{(x_1 + x_2 + \ldots + x_N)}{N}$$

and

$$s = \sqrt{\frac{(x_1 - X_{tests})^2 + (x_2 - X_{tests})^2 + \ldots + (x_N - X_{tests})^2}{N - 1}}$$

where:

x_i is the value C_{OBFCM} calculated for the individual test vehicle i according to point 2.6.1 of this Annex for fuel consumption, and according to point 2.6.2 of this Annex for the total distance.

3.3. **Evaluation**

For the 3 vehicles initially tested and after each additional vehicle tested, the value X_{tests} shall be assessed as set out below in order to reach one of the following conclusions for the in-service verification family or road load family concerned:

(1) Pass the family if:

$$X_{tests} \leq A - t_P \times s$$

(2) Fail the family if:

$$X_{tests} > A + t_F \times s$$

(3) Test an additional vehicle if:

$$A - t_P \times s < X_{tests} \leq A + t_F \times s$$

where:

t_P and t_F are as set out in the table below.

s is the standard deviation determined in accordance with point 3.2.

A is 1,03.

Table 1

Values for the pass/fail decision t-parameters for the fuel consumption and distance verification

Number of vehicles tested	t_P	t_F
3	1,5889	Highest value of 1,1060 and (0,02/s) [1]
4	0,9279	0,5068
5	0,6117	0,2836
6	0,3758	0,1528
7	0,1734	0,0646
8	0,0000	0,0000

[1] Where *s* is the standard deviation determined in accordance with point 3.2. In the case where the standard deviation *s* is equal to zero, then the value used for t_F will be 1,1060.

3.4. **Calculation of the size of the deviation**

For the calculation of the size of the deviation, the average (C_{OBFCM}) is defined as X_{tests} for the total number of vehicles tested, after the family has failed according to point 3:

$$average\ (C_{OBFCM}) = X_{tests}$$

ANNEX III

STATISTICAL TESTING PROCEDURE TO VERIFY THE TOTAL MASS AS DETERMINED BY THE OBMM

1. INTRODUCTION

1.1. This Annex sets out the statistical testing procedure to verify the accuracy of the on-board mass monitoring system. The vehicle total mass as determined by the OBMM system shall be compared with the mass measured by a weighbridge in kg during the verification test set out in this Annex.

2. MASS MONITORING VERIFICATION TESTING PROCEDURE

2.1. **Vehicle selection**

The vehicle shall be selected from the OBFCM family which exceeded the total vehicle mass accuracy requirements in any of the monitoring tests set out in Annex I, or from the OBFCM family that was selected by the granting approval authority based on a suspicion of non-compliance. A minimum of 3 and maximum of 8 vehicles shall be selected from this family for testing.

2.2. **Measurement equipment specifications**

The actual mass of the vehicle and the actual mass of the vehicle with payload shall be measured with equipment fulfilling the requirements set out in Table 1.

Table 1

Requirements of measurement systems

Measurement system	Accuracy
Weighbridge	50 kg or 0,5 % of max. calibration whichever is smaller

Where:

'Accuracy' means the deviation of the measurement reading from a reference value which is traceable to a national or international standard.

A verification of the demanded requirements shall be performed for each measurement system. At least 10 reference values between the minimum and the maximum calibration value shall be introduced to the measurement system and the response of the measurement system shall be recorded as analyser reading.

2.3. **Vehicle conditions**

2.3.1. *General conditions*

The vehicle shall be in the condition resembling its intended placing on the market. No changes in hardware or in the software are allowed. The tyres may be replaced by measurement tyres of similar size (± 10 %). The requirements as set out in points 3.3 to 3.5 of Annex II to Regulation (EU) No 582/2011 shall apply.

Run in of the vehicle is not mandatory. The total mileage of the test vehicle shall be the odometer reading at start of the verification test measurement.

2.3.2. *Test fuel*

If requested by the manufacturer, the test procedure shall be performed using reference fuel according to Annex IX to Regulation (EU) No 582/2011 on which the parent engine has been type-approved under Article 3 of that Regulation.

The fuel tank shall be full at start of the vehicle warm up. Refuelling of the vehicle between start of warm up and end of mass verification test sequence is not allowed.

2.3.3. *Vehicle configuration*

Tractors shall be tested with a semitrailer.

Rigid lorries shall be tested with a 2-axle drawbar or centre axle trailer.

Rigid lorries of the vehicle groups 1, 2, 3 and 16 may be tested with a trailer if a trailer connection is mounted.

Vehicles with an integrated body shall be tested with the final bodies of the complete or completed vehicle.

Any trailers used in the verification test shall be equipped with air suspension and an interface for data transmission to the motor vehicle in accordance with the standard ISO 11992.

2.3.4. *Payload conditions*

For the vehicle or vehicle combination to be tested, the value corresponding to 100 % payload is to be calculated based on the difference of maximum authorised weight in accordance with Council Directive 96/53/EC ([1]) for the specific vehicle or vehicle combination and the sum of actual masses ([2]) of motor vehicle and trailer or semi-trailer if applicable.

The vehicle shall be tested in one of the following payload conditions:

Empty conditions up to max. 25 % payload

Fully loaded conditions in the range of 75 % to 100 % payload

The payload conditions for selected vehicles to be tested shall alternate between empty conditions and fully loaded conditions.

In the case of rigid lorries, the test referring to empty conditions shall be operated without a trailer and with the reference 100 % payload calculated based on the actual mass of the motor vehicle only.

2.3.5. *Settings for PTO*

Additional energy consumers not necessary to run the vehicle shall be switched off. Vehicle or vehicle combinations to be tested shall switch off PTO during the test run at vehicle speeds above 1,6 km/h.

2.4. **Measurement signals**

The following measured signals shall be recorded during the OBMM verification test sequence as described in point 2.6.

([1]) Council Directive 96/53/EC of 25 July 1996 laying down for certain road vehicles circulating within the Community the maximum authorized dimensions in national and international traffic and the maximum authorized weights in international traffic (OJ L 235, 17.9.1996, p. 59, ELI: http://data.europa.eu/eli/dir/1996/53/oj).

([2]) Referring to the definition of 'actual mass of the vehicle' as set out in Article 2(6) of Commission Regulation (EU) No 1230/2012 of 12 December 2012 implementing Regulation (EC) No 661/2009 of the European Parliament and of the Council with regard to type-approval requirements for masses and dimensions of motor vehicles and their trailers and amending Directive 2007/46/EC of the European Parliament and of the Council (OJ L 353, 21.12.2012, p. 31, ELI: http://data.europa.eu/eli/reg/2012/1230/oj).

2.4.1. *Vehicle speed*

The recorded vehicle speed shall be the CAN signal for vehicle speed in the unit km/h as provided by a digital tachograph complying with the requirements set out in Regulation (EU) No 165/2014.

2.4.2. *TM signal*

The recorded TM signal shall meet the requirements as set out in point 3.2 of Annex I.

2.4.3. *Global positioning system*

The longitudinal and latitudinal position shall be provided via a global positioning system.

Required accuracy:

Position: < 3 m 95 % Circular Error Probable

Update rate: ≥ 4 Hz

2.4.4. *Ambient temperature*

Required accuracy: ± 1 °C

Update rate: ≥ 1 Hz

2.5. **OBMM verification test sequence**

For each payload as defined in point 2.3.4 the test sequence shall be executed.

2.5.1. *Warm-up*

Before start of statistical verification test sequence the vehicle may be driven for warm up.

2.5.2. *Weighing the vehicle on the weighbridge*

The vehicle shall be weighed on a weighbridge either directly before starting of the measuring run or directly after the measuring run as set out in point 2.6 has ended.

2.6. **Measuring run**

The boundary conditions to be met for a valid measuring run are set out in Tables 2, 3, 4 and 5. Regarding criteria 11 and 12 in Table 2, it is sufficient if either of them is fulfilled.

If the vehicle passes the OBMM verification test in accordance with the pass/fail criterion as set out in point 3, the measuring run shall be considered valid even if the following conditions are not met:

(i) undershoot of minimum values for parameter No 4, 6, 7, 10, 11 and 12;

(ii) exceedance of maximum values for parameter No 2, 3, 4, 5, 8 and 9.

Table 2

Parameters relevant for all vehicle group sets

No.	Parameter	Min.	Max.
1	Duration [minutes]	40	120
6	Average ambient temperature	5 °C	30 °C
7	Road condition dry asphalt	100 %	—

No.	Parameter	Min.	Max.
8	Road condition snow or ice	—	0 %
9	Sea level of the route [m]	—	800
10	Duration of continuous idling at stand still [minutes]	—	3
11	Dynamics Continuous acceleration phase > 0,5 m/s² (or at vehicle's full-load capabilities) with a duration of at least 10 s ([1])	5	—
12	Hilly conditions The route shall include a continuous section with a cumulative positive altitude gain exceeding 750 metres	30 km	—

([1]) In the accelerations, traction interruptions are allowed for gear shifting. The traction interruption time shall however not be considered when calculating the duration of the acceleration phase.

Table 3

Parameters relevant for vehicle group set #1

No.	Parameter	Min.	Max.
2	Distance based share urban driving	2 %	8 %
3	Distance based share rural driving	7 %	13 %
4	Distance based share motorway driving	79 %	—
5	Time share of idling at stand still	—	5 %

Table 4

Parameters relevant for vehicle group set #2 and #3

No.	Parameter	Min.	Max.
2	Distance based share urban driving	10 %	50 %
3	Distance based share rural driving	15 %	25 %
4	Distance based share motorway driving	25 %	—
5	Time share of idling at stand still	—	10 %

Table 5

Parameters relevant for high floor interurban buses and coaches

No.	Parameter	Min.	Max.
2	Distance based share urban driving	12 %	40 %
3	Distance based share rural driving	10 %	30 %
4	Distance based share motorway driving	30 %	—
5	Time share of idling at stand still	—	10 %

The driven route may include both public and private tracks.

2.7. **Data evaluation**

The recorded data shall be synchronised and aligned to 1 Hz temporal resolution, either by arithmetical average, nearest neighbour or linear interpolation.

2.8. **Verification of a valid measuring run**

To determine the validity of the measuring run, the criteria listed in point 2.6 shall be calculated. Parameter 11 (dynamics) is to be evaluated on the basis of the vehicle speed signal described in point 2.4.1.

The requirements on hilly conditions according to parameter 12 shall be demonstrated to the approval authority by means of commercially available map material, global positioning system data or through an inclination sensor.

2.9. **Evaluation of the accuracy of the OBMM measurement**

The absolute deviation ($OBMM_{DEV}$) and relative deviation ($OBMM_{RD}$) shall be calculated by comparing the average vehicle measured mass (TM_{meas}) and the reference mass (TM_{ref}) as follows:

$$OBMM_{DEV} = TM_{meas} - TM_{ref}$$

and

$$OBMM_{RD} = \frac{TM_{meas} - TM_{ref}}{TM_{ref}} \times 100$$

where:

TM_{ref} is the reference mass for verification of the OBMM system accuracy as determined by weighing the vehicle on the weighbridge as set out in point 2.5.2.

TM_{meas} is the average vehicle total mass as determined by the OBMM system. This shall be one value taken as an average over the trip.

The absolute deviation and relative deviation shall be calculated for each of the statistical tests and shall be used to perform the statistical evaluation as set out in point 3 of this Annex.

3. EVALUATION OF THE STATISTICAL TESTING PROCEDURE FOR MASS MONITORING

3.1. **Starting point**

The starting point for the statistical evaluation are the values for $OBMM_{DEV}$ and $OBMM_{RD}$ calculated for 3 individual test vehicles ($N = 3$) according to point 2.9 of this Annex.

The criteria set out under 3.3(3) determine if additional vehicles need to be tested. This shall be verified separately for fuel consumption and total distance.

3.2. **Statistical parameters**

For the total number of vehicles tested (*N*), the average (X_{tests}) and the standard deviation (*s*) of the test results shall be determined:

$$X_{tests,DEV} = \frac{|(x_{D1} + x_{D2} + \ldots + x_{DN})|}{N}$$

and

$$X_{tests,RD} = \frac{|x_{RD1} + x_{RD2} + \ldots + x_{RDN}|}{N}$$

and

$$s_{DEV} = \sqrt{\frac{(x_{D1} - X_{tests,DEV})^2 + (x_{D2} - X_{tests,DEV})^2 + \ldots + (x_N - X_{tests,DEV})^2}{N-1}}$$

and

$$s_{RD} = \sqrt{\frac{(x_{RD1} - X_{tests,RD})^2 + (x_{RD2} - X_{tests,RD})^2 + \ldots + (x_{RDN} - X_{tests,RD})^2}{N-1}}$$

where:

x_{Di} is the value $OBMM_{DEV}$ calculated for the individual test vehicle *i* according to point 2.9 of this Annex.

x_{RDi} is the value $OBMM_{RD}$ calculated for the individual test vehicle *i* according to point 2.9 of this Annex.

3.3. **Evaluation**

For the 3 vehicles initially tested and after each additional vehicle tested, the value X_{tests} shall be assessed as set out below in order to reach one of the following conclusions for the OBFCM family concerned:

(1) Pass the family if:

$$X_{tests,DEV} \leq Tol_{P,DEV}$$

or

$$X_{tests,RD} \leq Tol_{P,RD}$$

Based on the tolerance for passing calculated as follows:

$$Tol_{P,DEV} = \{A_{DEV} - \min[coef_{P,DEV} \times s_{DEV}, (A_{DEV} - 500)]\} \times coef_{DUR}$$

and

$$Tol_{P,RD} = \{A_{RD} - \min[coef_{P,RD} \times s_{RD}, (A_{RD} - 1)]\} \times coef_{DUR}$$

(2) Fail the family if the pass criterion has not been met and:

$$X_{tests,DEV} > Tol_{F,DEV}$$

or

$$X_{tests,RD} > Tol_{F,RD}$$

Based on the tolerance for failing calculated as follows:

$$Tol_{F,DEV} = \{A_{DEV} + \min[coef_{F,DEV} \times s_{DEV}, (2500 - A_{DEV})]\} \times coef_{DUR}$$

and

$$Tol_{F,RD} = \{A_{RD} + min[coef_{F,RD} \times s_{RD}, (10 - A_{RD})]\} \times coef_{DUR}$$

(3) Test an additional vehicle if:

$$Tol_{P,DEV} < X_{tests,DEV} \leq Tol_{F,DEV}$$

and

$$Tol_{P,RD} < X_{tests,RD} \leq Tol_{F,RD}$$

where:

$coef_{P,RD}$, $coef_{F,RD}$, $coef_{P,DEV}$ and $coef_{F,DEV}$ are as set out in Table 6.

s_{DEV} is the standard deviation of the absolute deviation determined in accordance with point 3.2.

s_{RD} is the standard deviation of the relative deviation determined in accordance with point 3.2.

A_{RD} is 3,00.

A_{DEV} is 1 000.

$coef_{DUR}$ is 1 if the mean of the durations of the measuring run performed under point 2.6 is over 80 minutes, 1,1 if the mean duration is between 60 and 80 minutes, and 1,2 if the mean duration is less than 60 minutes. This mean duration is updated after each additional test.

Table 6

Values for the pass/fail decision coefficients for the mass verification

Tests	$coef_{P,RD}$	$coef_{F,RD}$	$coef_{P,DEV}$	$coef_{F,DEV}$
3	0,67	2,33	0,61	1,81
4	0,50	1,67	0,50	1,47
5	0,33	1,00	0,33	1,10
6	0,17	0,67	0,17	0,92
7	0,10	0,33	0,10	0,53
8	0	0	0	0

3.4. **Calculation of the size of the deviation**

For the calculation of the size of the deviation, the average ($OBMM_{DEV}$) is defined as $X_{tests,DEV}$ for the total number of vehicles tested, after the family has failed according to point 3:

$$average\ (OBMM_{DEV}) = X_{tests,DEV}$$

The average ($OBMM_{RD}$) is defined as $X_{tests,RD}$ for the total number of vehicles tested, after the family has failed according to point 3:

$$average\ (OBMM_{RD}) = X_{tests,RD}$$