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Subject:	ANNEXES to the Commission Regulation (EU) .../... amending Regulation (EU) 2017/2400 and Directive 2007/46/EC of the European Parliament and of the Council as regards the determination of the CO_2 emissions and fuel consumption of heavy-duty vehicles

Delegations will find attached document D058981/02 - Annexes.

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Encl.: D058981/02 - Annexes

Brussels, XXX
D058981/02
[…](2018) XXX draft

ANNEXES 1 to 11

ANNEXES

to the

Commission Regulation (EU) .../...

amending Regulation (EU) 2017/2400 and Directive 2007/46/EC of the European Parliament and of the Council as regards the determination of the CO2 emissions and fuel consumption of heavy-duty vehicles

EN   **EN**

ANNEX I

Table 1 of Annex I to Regulation (EU) 2017/2400 is replaced by the following:

"Table 1

Vehicle groups for vehicles of category N

Description of elements relevant to the classification in vehicle groups			Vehicle group	Allocation of mission profile and vehicle configuration						
Axle configuration	Chassis configuration	Technically permissible maximum laden mass (tons)		Long haul	Long haul (EMS)	Regional delivery	Regional delivery (EMS)	Urban delivery	Municipal utility	Construction
4x2	Rigid lorry	> 3,5 –7,5	(0)							
	Rigid lorry (or tractor)**	> 7,5 – 10	1			R		R		
	Rigid lorry (or tractor)**	> 10 – 12	2	R+T1		R		R		
	Rigid lorry (or tractor)**	> 12 – 16	3			R		R		
	Rigid lorry	> 16	4	R+T2		R		R	R	
	Tractor	> 16	5	T+ST	T+ST+T2	T+ST	T+ST+T2	T+ST		
	Rigid lorry	> 16	4v***						R	R
	Tractor	> 16	5v***							T+ST
4x4	Rigid lorry	> 7,5 – 16	(6)							
	Rigid lorry	> 16	(7)							
	Tractor	> 16	(8)							
6x2	Rigid lorry	all weights	9	R+T2	R+D+ST	R	R+D+ST		R	
	Tractor	all weights	10	T+ST	T+ST+T2	T+ST	T+ST+T2			
	Rigid lorry	all weights	9v***						R	R
	Tractor	all weights	10v***							T+ST
6x4	Rigid lorry	all weights	11	R+T2	R+D+ST	R	R+D+ST		R	R
	Tractor	all weights	12	T+ST	T+ST+T2	T+ST	T+ST+T2			T+ST
6x6	Rigid lorry	all weights	(13)							
	Tractor	all weights	(14)							
8x2	Rigid lorry	all weights	(15)							
8x4	Rigid lorry	all weights	16							R
8x6 8x8	Rigid lorry	all weights	(17)							

* EMS - European Modular System

** in these vehicle classes tractors are treated as rigid lorries but with specific curb weight of tractor

*** sub-group "v" of vehicle groups 4, 5, 9 and 10: these mission profiles are exclusively applicable to vocational vehicles

T	=	Tractor
R	=	Rigid lorry & standard body
T1, T2	=	Standard trailers
ST	=	Standard semitrailer
D	=	Standard dolly".

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ANNEX II

Annex III to Regulation (EU) 2017/2400 is amended as follows:

(1)   in point 2, point (1) is replaced by the following:

(1)   "'"Parameter ID": Unique identifier as used in the simulation tool for a specific input parameter or set of input data";

(2)   point 3 is amended as follows:

(a) Table 1 is replaced by the following:

"Table 1

Input parameters "Vehicle/General"

Parameter name	Parameter ID	Type	Unit	Description/Reference
Manufacturer	P235	token	[-]	
ManufacturerAddress	P252	token	[-]	
Model	P236	token	[-]	
VIN	P238	token	[-]	
Date	P239	dateTime	[-]	Date and time when the component-hash is created
LegislativeClass	P251	string	[-]	Allowed values: "N2", "N3"
VehicleCategory	P036	string	[-]	Allowed values: "Rigid Lorry", "Tractor"
AxleConfiguration	P037	string	[-]	Allowed values: "4x2", "6x2", "6x4", "8x4"
CurbMassChassis	P038	int	[kg]	
GrossVehicleMass	P041	int	[kg]	
IdlingSpeed	P198	int	[1/min]	
RetarderType	P052	string	[-]	Allowed values: "None", "Losses included in Gearbox", "Engine Retarder", "Transmission Input Retarder", "Transmission Output Retarder"
RetarderRatio	P053	double, 3	[-]	
AngledriveType	P180	string	[-]	Allowed values: "None", "Losses included in Gearbox", "Separate Angledrive"
PTOShaftsGearWheels[1]	P247	string	[-]	Allowed values: "none", "only the drive shaft of the PTO", "drive shaft and/or up to 2 gear wheels", "drive shaft and/or more than 2 gear wheels", "only one engaged gearwheel above oil level"
PTOOtherElements[1]	P248	string	[-]	Allowed values: "none", "shift claw, synchronizer, sliding gearwheel", "multi-disc clutch", "multi-disc clutch, oil pump"
CertificationNumberEngine	P261	token	[-]	
CertificationNumberGearbox	P262	token	[-]	
CertificationNumberTorqueconverter	P263	token	[-]	

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CertificationNumberAxlegear	P264	token	[-]	
CertificationNumberAngledrive	P265	token	[-]	
CertificationNumberRetarder	P266	token	[-]	
CertificationNumberTyre	P267	token	[-]	
CertificationNumberAirdrag	P268	token	[-]	
ZeroEmissionVehicle	P269	boolean	[-]	
VocationalVehicle	P270	boolean	[-]	
NgTankSystem	P275	string	[-]	Allowed values: "Compressed", "Liquefied" Only relevant for vehicles with engines of fuel type "NG PI" (P193)
Sleeper cab	P276	boolean	[-]	

(1) In case of multiple PTOs mounted to the transmission, only the component with the highest losses according to point 3.6 of Annex IX, for its combination of criteria "PTOShaftsGearWheels" and "PTOShaftsOtherElements", shall be declared.";

(b) in Table 3, the last row "HVAC/Technology" is replaced by the following:

"HVAC/Technology	P185	string	[-]	Allowed values: "None", "Default"";

(c) the following Table 5 is added:

"Table 5

Input parameters for ZE-HDVs, He-HDVs and dual-fuel vehicles

Parameter name	Parameter ID	Type	Unit	Description/Reference
Manufacturer	P235	token	[-]	
ManufacturerAddress	P252	token	[-]	
Model	P236	token	[-]	
VIN	P238	token	[-]	
Date	P239	dateTime	[-]	Date and time when the component-hash is created
LegislativeClass	P251	string	[-]	Allowed values: "N2", "N3"
VehicleCategory	P036	string	[-]	Allowed values: "Rigid Lorry", "Tractor"
CurbMassChassis	P038	int	[kg]	
GrossVehicleMass	P041	int	[kg]	
MaxNetPower1	P277	int	[W]	If He-HDV = Y: highest maximum net power of all energy converters, which are linked to the vehicle driveline or the wheels
MaxNetPower2	P278	int	[W]	If He-HDV = Y: second highest maximum net power of all energy converters, which are linked to the vehicle driveline or the wheels
ZE-HDV	P269	boolean	[-]	
He-HDV	P279	boolean	[-]	
DualFuelVehicle	P280	boolean	[-]	";

(c) the following Table 6 is added:

"Table 6

Input parameters "Advanced driver assistance systems"

Parameter name	Parameter ID	Type	Unit	Description/Reference
EngineStopStart	P271	boolean	[-]	In accordance with point 8.1.1
EcoRollWithoutEngineStop	P272	boolean	[-]	In accordance with point 8.1.2
EcoRollWithEngineStop	P273	boolean	[-]	In accordance with point 8.1.3
PredictiveCruiseControl	P274	string	[-]	In accordance with point 8.1.4, allowed values: '1,2', '1,2,3'";

(3)   in point 4.3, in the second paragraph ("For vehicles of groups 1, 2 and 3"), point (d) is deleted;

(4)   the following points 8 to 8.3 are added:

"8.   Advanced driver assistance systems

8.1   The following types of advanced driver assistance systems, which are primarily aiming for reduction of fuel consumption and CO_2 emissions, shall be declared in the input to the simulation tool:

8.1.1   Engine stop-start during vehicle stops: system which automatically shuts down and restarts the internal combustion engine during vehicle stops to reduce engine idling time. For automatic engine shut down the maximum time delay after the vehicle stop shall be not longer than 3 seconds.

8.1.2   Eco-roll without engine stop-start: system which automatically decouples the internal combustion engine from the drivetrain during specific downhill driving conditions with low negative gradients. During these phases the internal combustion engine is operated in engine idling. The system shall be active at least at all cruise control set speeds above 60 km/h.

8.1.3   Eco-roll with engine stop-start: system which automatically decouples the internal combustion engine from the drivetrain during specific downhill driving conditions with low negative slopes. During these phases the internal combustion engine is shut down after a short time delay and keeps shut down during the main share of the eco-roll phase. The system shall be active at least at all cruise control set speeds of above 60 km/h.

8.1.4   Predictive cruise control (PCC): systems which optimise the usage of potential energy during a driving cycle based on an available preview of road gradient data and the use of a GPS system. A PCC system declared in the input to the simulation tool shall have a gradient preview distance longer than 1 000 meters and cover all following functionalities:

1) Crest coasting
   Approaching a crest the vehicle velocity is reduced before the point where the vehicle starts accelerating by gravity alone compared to the set speed of the cruise control so that the braking during the following downhill phase can be reduced.

2) Acceleration without engine power
   During downhill driving with a low vehicle velocity and a high negative slope the vehicle acceleration is performed without any engine power usage so that the downhill braking can be reduced.

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3) Dip coasting

During downhill driving when the vehicle is braking at the overspeed velocity, PCC increases the overspeed for a short period of time to end the downhill event with a higher vehicle velocity. Overspeed is a higher vehicle speed than the set speed of the cruise control system.

A PCC system can be declared as input to the simulation tool if either the functionalities set out in points 1) and 2) or points 1), 2) and 3) are covered.

8.2   The eleven combinations of the advanced driver assistance systems as set out in Table 7 are input parameters into the simulation tool:

Table 7

Combinations of advanced driver assistance systems as input parameters into the simulation tool

Combination no	Engine stop-start during vehicle stops	Eco-roll without engine stop-start	Eco-roll with engine stop-start	Predictive cruise control
1	yes	no	no	no
2	no	yes	no	no
3	no	no	yes	no
4	no	no	no	yes
5	yes	yes	no	no
6	yes	no	yes	no
7	yes	no	no	yes
8	no	yes	no	yes
9	no	no	yes	yes
10	yes	yes	no	yes
11	yes	no	yes	yes

8.3   Any advanced driver assistance system declared in the input into the simulation tool shall by default be set to fuel economy mode after each key-off/key-on cycle.

8.4   If an advanced driver assistance system is declared in the input into the simulation tool, it shall be possible to verify the presence of such a system based on real world driving and the system definitions as set out in point 8.1. If a certain combination of systems is declared, also the interaction of functionalities (e.g. predictive cruise control plus eco-roll with engine stop-start) shall be demonstrated. In the verification procedure it shall be taken into consideration, that the systems need certain boundary conditions to be "active" (e.g. engine at operation temperature for engine stop-start, certain vehicle speed ranges for PCC, certain ratios of road gradients with vehicle mass for eco-roll). The vehicle manufacturer needs to submit a functional description of boundary conditions when the systems are "inactive" or their efficiency is reduced. The approval authority may request the technical justifications of these boundary conditions from the applicant for approval and assess them for compliance.".

ANNEX III

Annex IV to Regulation (EU) 2017/2400 is amended as follows:

(1)   PART I is amended as follows:

(a)   the following points 1.1.9 to 1.1.13 are inserted:

"1.1.9.   Vocational vehicle (yes/no)…………………………………..

1.1.10.   Zero emission heavy-duty vehicle (yes/no)……………………………..

1.1.11   Hybrid electric heavy-duty vehicle (yes/no)………………………………

1.1.12   Dual-fuel vehicle (yes/no)……………………………………………….

1.1.11.   Sleeper cab (yes/no)………………………………..";

(b)   points 1.2.7 and 1.2.8 are replaced by the following:

"1.2.7.   Fuel type (Diesel CI/CNG PI/LNG PI...)………….

1.2.8.   Hash of the engine input data and input information……………";

(c)   point 1.3.9 is replaced by the following:

"1.3.9.   Hash   of   the   transmission   input   data   and   input information………………";

(d)   point 1.4.4 is replaced by the following:

"1.4.4.   Hash of the other torque transferring components input data and input information……………";

(e)   point 1.5.4 is replaced by the following:

"1.5.4.   Hash   of   the   torque   converter   input   data   and   input information………………..";

(f)   point 1.6.5 is replaced by the following:

"1.6.5.   Hash of the additional driveline components input data and input information……………";

(g)   point 1.7.6 is replaced by the following:

"1.7.6.   Hash of the axle input data and input information………………";

(h)   point 1.8.5 is replaced by the following:

"1.8.5.   Hash of the air drag input data and input information………………";

(i)   the following point 1.9.3a is inserted:

"1.9.3a.   Hash of the tyre input data and input information axle 1………………";

(j)   the following point 1.9.7a is inserted:

"1.9.7a.   Hash of the tyre input data and input information axle 2………………";

(k)   the following point 1.9.11a is inserted:

"1.9.11a.   Hash of the tyre input data and input information axle 3………………";

(l)   the following point 1.9.16 is inserted:

"1.9.16.   Hash of the tyre input data and input information axle 4………………";

(m)   the following points 1.12. to 1.12.4. are inserted:

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"1.12.   Advanced driver assistance systems (ADAS)

1.12.1.   Engine stop-start during vehicle stops (yes/no)…………………..

1.12.2.   Eco-roll without engine stop-start (yes/no)………………………

1.12.3.   Eco-roll with engine stop-start (yes/no)…………………………..

1.12.4.   Predictive cruise control (yes/no)………………………………";

(n)   point 2.1.1 is replaced by the following:

"2.1.1.   Mission profile (long haul/long haul (EMS)/regional/regional (EMS)/urban/municipal/construction)…………………..";

(o)   point 3.1.4 is replaced by the following:

"3.1.4.   Cryptographic hash of the manufacturer's records file………….";

(2)   PART II is amended as follows:

(a)   point 1.1.7 is replaced by the following:

"1.1.7.   Model…………………..";

(b)   the following points 1.1.9 to 1.1.13 are inserted:

"1.1.9.   Vocational vehicle (yes/no)……………………………..

1.1.10.   Zero emission heavy-duty vehicle (yes/no)……………………………..

1.1.11   Hybrid electric heavy-duty vehicle (yes/no)…………………………….

1.1.12   Dual-fuel vehicle (yes/no)…………………………………………….

1.1.13.   Sleeper cab (yes/no)………………………………………………..";

(c)   point 1.2.3 is replaced by the following:

"1.2.3.   Fuel type (Diesel CI/CNG PI/LNG PI...)………………….";

(d)   point 1.2.9 is replaced by the following:

"1.2.9.   Average rolling resistance coefficient (RRC) of all tyres of the motor vehicle: …………………..";

(e)   the following points 1.2.10 to 1.2.14 are inserted:

"1.2.10.   Average fuel efficiency labelling class of all tyres of the motor vehicle in accordance with Regulation (EC) No 1222/2009……………….

1.2.11.   Engine stop-start during vehicle stops (yes/no)…………………

1.2.12.   Eco-roll without engine stop-start (yes/no)………………………

1.2.13.   Eco-roll with engine stop-start (yes/no)…………………………….

1.2.14.   Predictive cruise control (yes/no)…………………………………..";

(f)   the following points 2 to 3 are added:

"2. CO_2 emissions and fuel consumption of the vehicle (for each payload/mission profile)

2.1.   Payload low [kg]:

	Average vehicle speed	CO₂ emissions			Fuel consumption		
Long haul	…..km/h	……g/km	……g/t-km	……g/m³-km	……l/100km	……l/t-km	……l/m³-km

	Average vehicle speed	CO₂ emissions			Fuel consumption		
Long haul (EMS)	.....km/h	......g/km	......g/t-km	......g/m³-km	......l/100km	......l/t-km	......l/m³-km
Regional delivery	.....km/h	......g/km	......g/t-km	......g/m³-km	......l/100km	......l/t-km	......l/m³-km
Regional delivery (EMS)	.....km/h	......g/km	......g/t-km	......g/m³-km	......l/100km	......l/t-km	......l/m³-km
Urban delivery	.....km/h	......g/km	......g/t-km	......g/m³-km	......l/100km	......l/t-km	......l/m³-km
Municipal utility	.....km/h	......g/km	......g/t-km	......g/m³-km	......l/100km	......l/t-km	......l/m³-km
Construction	.....km/h	......g/km	......g/t-km	......g/m³-km	......l/100km	......l/t-km	......l/m³-km

2.2. Payload representative [kg]:

	Average vehicle speed	CO₂ emissions			Fuel consumption		
Long haul	.....km/h	......g/km	......g/t-km	......g/m³-km	......l/100km	......l/t-km	......l/m³-km
Long haul (EMS)	.....km/h	......g/km	......g/t-km	......g/m³-km	......l/100km	......l/t-km	......l/m³-km
Regional delivery	.....km/h	......g/km	......g/t-km	......g/m³-km	......l/100km	......l/t-km	......l/m³-km
Regional delivery (EMS)	.....km/h	......g/km	......g/t-km	......g/m³-km	......l/100km	......l/t-km	......l/m³-km
Urban delivery	.....km/h	......g/km	......g/t-km	......g/m³-km	......l/100km	......l/t-km	......l/m³-km
Municipal utility	.....km/h	......g/km	......g/t-km	......g/m³-km	......l/100km	......l/t-km	......l/m³-km
Construction	.....km/h	......g/km	......g/t-km	......g/m³-km	......l/100km	......l/t-km	......l/m³-km

2.3. Specific CO₂ emissions [gCO₂/tkm]…………………………………………..

2.4. Average payload value [t]……………………………………………………..

2.5. Software and user information

Simulation tool version	[X.X.X]
Date and time of the simulation	[-]

3. Cryptographic hash of the manufacturer's records file…………………..";

(3) PART III is deleted.

ANNEX IV

Annex V to Regulation (EU) 2017/2400 is amended as follows:

(1)   in point 3.1.5, point (4) is replaced by the following:

"

(1)   The engine coolant flow rate (or alternatively the pressure difference across the engine side of the heat exchanger) and the engine coolant temperature shall be set to a value representative for in-vehicle application at reference ambient conditions when the engine is operated at rated speed and full load with the engine thermostat in fully open position. This setting defines the coolant reference temperature. For all testruns performed for the purpose of certification of one specific engine within one engine CO_2-family, the cooling system setting shall not be changed, neither on the engine side nor on the test bed side of the cooling system. The temperature of the test bed side cooling medium shall be kept reasonably constant by good engineering judgement. The cooling medium on the test bed side of the heat exchanger shall not exceed the nominal thermostat opening temperatur downstream of the heat exchanger.";

(2)   point 3.2 is amended as follows:

(a)   the fifth paragraph is replaced by the following:

"The mean value of the two separate NCV that are not deviating by more than 440 Joule per gram fuel shall be documented in MJ/kg rounded to 2 places to the right of the decimal point in accordance with ASTM E 29-06.";

(b)   the following paragraph is added:

"For gas fuels, switches between fuel tanks of different production batches are allowed exceptionally; in that case, the NCV of each used fuel batch should be calculated and the highest value should be documented."

(c) in Table 1, the last row "Natural gas / PI" is replaced by the following:

"

Natural gas / PI	G_{25} or G_R	ISO 6976 or ASTM 3588";

(3)   in point 4.3.5.2.1, the seventh paragraph is replaced by the following:

"The 6 additional target engine speed setpoints shall be determined in accordance with the following provisions:

(1)   If dn_{44} is smaller than or equal to $(dn_{35}+5)$ and also smaller than or equal to $(dn_{53}+5)$, the 6 additional target engine speeds shall be determined by dividing each of the two ranges, one from n_{idle} to n_A and the other from n_B to n_{95h}, into 4 equidistant sections.

(2)   If $(dn_{35}+5)$ is smaller than dn_{44} and also dn_{35} is smaller than dn_{53}, the 6 additional target engine speeds shall be determined by dividing the range from n_{idle} to n_A into 3 equidistant sections and the range from n_B to n_{95h}, into 5 equidistant sections.

(3)   If $(dn_{53}+5)$ is smaller than dn_{44} and also dn_{53} is smaller than dn_{35}, the 6 additional target engine speeds shall be determined by dividing the range from n_{idle} to n_A into 5 equidistant sections and the range from n_B to n_{95h}, into 3 equidistant sections.";

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(4)   in point 4.3.5.2.2, the second paragraph is replaced by the following:

"All target torque setpoints at a particular target engine speed setpoint that exceed the limit value defined by the full load torque value at this particular target engine speed setpoint minus 5 percent of $T_{max\_overall}$, shall be replaced by one single target torque setpoint at full load torque at this particular target engine speed setpoint. Each of these replacement setpoints shall be measured only once during the FCMC test sequence defined in accordance with paragraph 4.3.5.5. Figure 2 exemplarily illustrates the definition of the target torque setpoints.";

(5)   in point 5.1, the first paragraph is replaced by the following:

"Total engine work over a cycle or a defined period shall be determined from the recorded values of engine power determined in accordance with paragraph 3.1.2 of this Annex and paragraphs 6.3.5. and 7.4.8. of Annex 4 to UN/ECE Regulation 49 Rev.06.";

(6)   in point 5.3.3.1, in Table 4, the last row "Natural gas / PI" is replaced by the following:

"

Natural gas / PI	G_{25} or G_R	45,1";

(7)   in point 6.1.8, the second paragraph below the title is replaced by the following:

"The value shall be rounded to 2 places to the right of the decimal point in accordance with ASTM E 29-06.";

(8)   in Appendix 2, PART 1 is amended as follows:

(a) the row "point 3.2.2.2" is replaced by the following:

"3.2.2.2.	Heavy duty vehicles Diesel/Petrol/LPG/NG/Ethanol (ED95)/ Ethanol (E85)[1]					";

(b) the row "point 3.2.17.8.1.0.2" is deleted;

(c) in Appendix to information document, the following point 4.4 is inserted:

"4.4. Reference fuel type (type of reference fuel used for testing in accordance with point 3.2 of Annex V to Commission Regulation (EU) 2017/2400)";

(9)   Appendix 3 is amended as follows:

(a) the following point 1.7.3 is inserted:

"1.7.3.   Torque values within a tolerance band related to the reference described in points 1.7.1 and 1.7.2. are considered as equal. The tolerance band is defined as + 20 Nm or + 2 percent of the CO_2 parent engine torque at the particular engine speed, whichever is greater.";

(b) point 1.8.1 is replaced by the following:

"1.8.1.   The engine idle speed, n_{idle}, of the CO_2-parent engine as declared by the manufacturer at the application for certification in the information document in accordance with point 3.2.1.6 of Appendix 2 to this Annex shall be equal or lower than for all other engines within the same CO_2-family.";

(10)   Appendix 4 is amended as follows:

(a) point 4 is amended as follows:

(i) the first paragraph is replaced by the following:

"The minimum number of engines to be tested for each engine CO_2-family, $n_{COP,min}$, shall be determined by dividing $n_{COP,base}$ by $n_{COP,fam}$, both values determined in accordance with point 2. The result for $n_{COP,min}$ shall be rounded to the nearest integer. If the resulting value for $n_{COP,min}$ is smaller than 4 it shall be set to 4, if it is greater than 19 it shall be set to 19.";

(ii) in the fifth paragraph, in point (3), the third sentence is replaced by the following:

"NCV for reference gas fuels (G_{25}/G_R, LPG fuel B) shall be calculated in accordance with the applicable standards in Table 1 of this Annex from the fuel analysis submitted by the reference gas fuel supplier.";

(b) point 8 is replaced by the following:

"8.   Limit for conformity of one single test

For diesel engines, the limit values for the assessment of conformity of one single engine tested shall be the target value determined in accordance with point (6) +4 percent.

For gas engines, the limit values for the assessment of conformity of one single engine tested shall be the target value determined in accordance with point (6) +5 percent.";

(11)   in Appendix 5, point 1 is amended as follows:

(a) in the first paragraph, point (iii) is replaced by the following:

"(iii) Stabilization phase: After the warm-up or optional warm-up step (v) is completed the engine shall be operated with minimum operator demand (motoring) at engine speed n_{pref} for 130 ± 2 seconds with the fan disengaged ($n_{fan\_disengage} < 0,75*n_{engine}*r_{fan}$). The first 60 ± 1 seconds of this period are considered as a stabilization period, during which the actual engine speed shall be held within ± 5 min^{-1} of $n_{pref.}$";

(b) in the second paragraph, in the legend, the last row r_{fan} is replaced by the following:

"r_{fan} ratio of the speed of the engine-side of the fan clutch to the speed of the crankshaft";

(12)   Appendix 6 is amended as follows:

(a) point 1.1 is replaced by the following:

"1.1   The manufacturer's name or trade mark"

(b) points 1.5 and 1.5.1 are replaced by the following:

"1.5   In the case that the certification in accordance with this Regulation is granted at the same time as the type approval for an engine as separate technical unit in accordance with Regulation (EU) No 582/2011, the marking requirements laid down in point 1.4 may follow, separated by '/', the marking requirements laid down in Appendix 8 to Annex I to Regulation (EU) No 582/2011.

1.5.1 Example of the certification mark (joined marking)
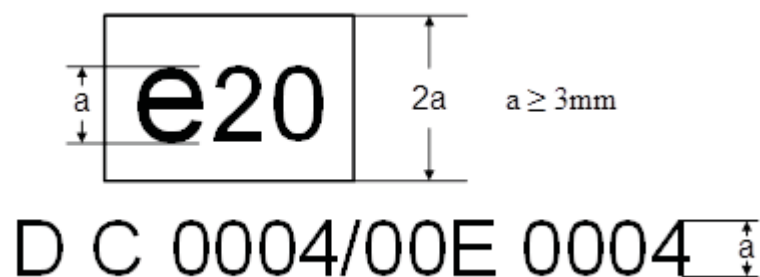
The above certification mark affixed to an engine shows that the type concerned has been certified in Poland (e20), pursuant to Regulation (EU) No 582/2011. The "D" indicates Diesel followed by a "C" for the emission stage followed by four digits (0004) which are those allocated by the approval authority to the engine as the base approval number for Regulation (EU) No 582/2011. After the slash the first two figures are indicating the sequence number assigned to the latest technical amendment to this Regulation, followed by a letter "E" for engine, followed by four digits allocated by the approval authority for the purpose of certification in accordance with this Regulation ('base approval number` to this regulation).";

(c) point 2.1 is replaced by the following:

"2.1   Certification number for engines shall comprise the following:

eX*YYYY/YYYY*ZZZZ/ZZZZ*E*0000*00

section 1	section 2	section 3	Additional letter to section 3	section 4	section 5
Indication of country issuing the certification	HDV CO$_2$ certification Regulation (2017/2400)	Latest amending Regulation (ZZZZ/ZZZZ)	E - engine	Base certification number 0000	Extension 00";

(13)   Appendix 7 is amended as follows:

(a) in the 'Definitions', point (1) is replaced by the following:

"

(1)   "Parameter ID": Unique identifier as used in the simulation tool for a specific input parameter or set of input data";

(b) Table 1 is amended as follows:

the third row "TechnicalReportId" below the title and the last row "FuelType" are replaced by the following:

"CertificationNumber	P202	token	[-]	
FuelType	P193	string	[-]	Allowed values: "Diesel CI", "Ethanol CI", "Petrol PI", "Ethanol PI", "LPG PI", "NG PI", "NG CI"";

(14)   in Appendix 8, point 8.1 is replaced by the following:

"8.1   If the average logging frequency of the engine speed of the originally recorded full load curve is smaller than 6, the conversion is performed by arithmetical averaging over intervals of ± 4 min^{-1} of the given setpoint for the output data based on the full load curve input in originally recorded resolution. If the average logging frequency of the engine speed of the originally recorded full load curve is greater

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than or equal to 6, the conversion is performed by linear interpolation based on the full load curve input in originally recorded resolution.".

Annex VI to Regulation (EU) 2017/2400 is amended as follows:

(1)   in point 3.1.2.1, the fourth paragraph below the title is replaced by the following:

"Total tested time per transmission individual and gear shall not exceed 5 times the actual testing time per gear (allowing re-testing of transmission if needed due to measuring or rig error).";

(2)   in point 3.3.8.2, the second sentence is replaced by the following:

"The measured and averaged torque at the input shaft shall be below ± 5 Nm or ± 0,5 % of the torque set point whichever value is larger for each measured operating point for the complete torque loss series.";

(3)   in point 5.1.6.2.2.4, point (1) is replaced by the following:

"

(1)   The load-independent torque loss for the complete transmission including retarder shall be measured as defined in point 3.1. for transmission testing in one of the higher transmission gears

$$= T_{l,in,withret}";$$

(4)   in point 8.1.3, the third paragraph is replaced by the following:

"**X** shall be replaced by 1,5% for SMT/AMT/DCT transmissions and 3% for APT transmissions or transmission with more than 2 friction shift clutches.";

(5)   Appendix 2 is amended as follows:

(a) on the cover page of the Transmission information document, the words "Transmission type:" are replaced by the words " Transmission type / family (if applicable):";

(b) in PART 1, points 0.0 to 0.9 are deleted;

(6)   Appendix 3 is amended as follows:

(a) on the cover page of the Hydrodynamic torque converter (TC) information document, the words "TC type:" are replaced by the words "TC type / family (if applicable):";

(b) in PART 1, points 0.0 to 0.9 are deleted;

(7)   Appendix 4 is amended as follows:

(a) on the cover page of the Other torque transferring components (OTTC) information document, the words "OTTC type:" are replaced by the words " OTTC type / family (if applicable):";

(b) in PART 1, points 0.0 to 0.9 are deleted;

(8)   Appendix 5 is amended as follows:

(a) on the cover page of the Additional driveline components (ADC) information document, the words "ADC type:" are replaced by the words " ADC type / family (if applicable):";

(b) in PART 1, points 0.0 to 0.9 are deleted;

(9)   Appendix 7 is amended as follows:

(a) points 1.1 and 1.2 are replaced by the following:

"1.1 The manufacturer's name or trade mark

1.2 The make and identifying type indication as recorded in the information referred to in point 0.2 and 0.3 of Appendices 2 - 5 to this Annex";

(b) in point 1.4, in Table 1, the first row is replaced by the following:

"

G	Transmission";

(c) point 1.5 is replaced by the following:

"1.5 Example of the certification mark
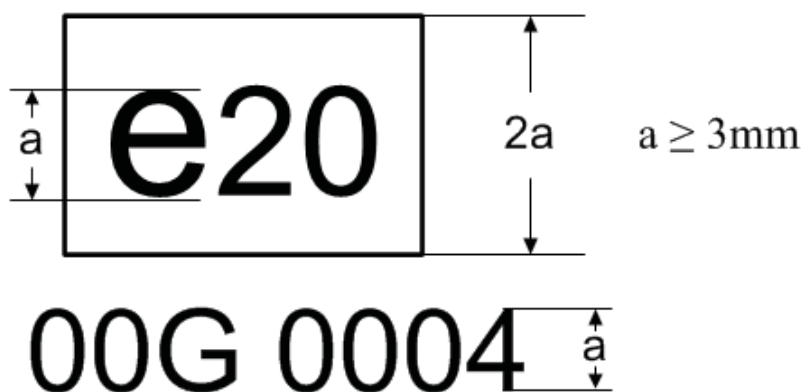
The above certification mark affixed to a transmission, torque converter (TC), other torque transferring component (OTTC) or additional driveline component (ADC) shows that the type concerned has been certified in Poland (e20), pursuant to this Regulation. The first two digits (00) are indicating the sequence number assigned to the latest technical amendment to this Regulation. The following digit indicates that the certification was granted for a transmission (G). The last four digits (0004) are those allocated by the approval authority to the transmission, as the base approval number.";

(d) point 2.1 is replaced by the following:

"2.1. Certification number for transmissions, torque converter, other torque transferring component and additional driveline component shall comprise the following:

eX*YYYY/YYYY*ZZZZ/ZZZZ*X*0000*00

section 1	section 2	section 3	Additional letter to section 3	section 4	section 5
Indication of country issuing the certificate	HDV CO_2 certification Regulation (2017/2400)	Latest amending Regulation (ZZZZ/ZZZZ)	See Table 1 of this appendix	Base certification number 0000	Extension 00";

(10) Appendix 12 is amended as follows:

(a) Table 1 is replaced by the following:

"Table 1

Input parameters "Transmission/General"

Parameter name	Parameter ID	Type	Unit	Description/Reference
Manufacturer	P205	token	[-]	
Model	P206	token	[-]	
CertificationNumber	P207	token	[-]	
Date	P208	dateTime	[-]	Date and time when the component-hash is created
AppVersion	P209	token	[-]	
TransmissionType	P076	string	[-]	Allowed values[1]: "SMT", "AMT", "APT-S", "APT-P"
MainCertificationMethod	P254	string	[-]	Allowed values: "Option 1", "Option 2", "Option 3", "Standard values"

[1]DCT shall be declared as transmission type AMT";

(b) in Table 4, the third row "TechnicalReportId" below the title is replaced by the following:

"CertificationNumber	P212	token	[-]	";

(c) in Table 6, the third row "TechnicalReportId" below the title is replaced by the following:

"CertificationNumber	P222	token	[-]	";

(d) in Table 8, the third row "TechnicalReportId" below the title is replaced by the following:

"CertificationNumber	P227	token	[-]	".

Annex VII to Regulation (EU) 2017/2400 is amended as follows:

(1)   in point 4.3, the second sentence below the title is replaced by the following:

"The torque loss results shall be complemented in accordance with 4.4.8 and formatted in accordance with Appendix 6 for the further processing by the simulation tool.";

(2)   in point 4.4.1, in the first paragraph below the title, the following sentence is added:

"The torque measurement sequence shall be performed and recorded twice.";

(3)   in point 4.4.2, the paragraph below the title is replaced by the following:

"The measurement duration for each single grid point shall be 5-20 seconds.";

(4)   in point 4.4.3, the first paragraph below the title is replaced by the following:

"The recorded values for each grid point within the 5-20 seconds interval in accordance with point 4.4.2. shall be averaged to an arithmetic mean.";

(5)   point 4.4.5.1. is replaced by the following:

"4.4.5.1   The averaged speed values per grid point (5-20 s interval) shall not deviate from the setting values by more than ± 5 rpm for the output speed.";

(6)   point 4.4.8.5 is replaced by the following:

"4.4.8.5   In case of a tandem axle, the combined torque loss map for both axles shall be calculated out of the test results for the single axles at the input side. The input torques shall also be added.

$$T_{loss,rep,tdm} = T_{loss,rep,1} + T_{loss,rep,2}$$

$$T_{in,tdm} = T_{in,1} + T_{in,2}$$

";

(7)   in point 6.2.1, Figure 2 is replaced by the following:

"*Figure 2*

Speed and torque range for conformity of the certified CO_2 emissions and fuel consumption related properties testing

1 = low speed / high torque	
2 = low speed / mid torque	
3 = low speed / low torque	
4 = mid speed / high torque	
5 = mid speed / mid torque	
6 = mid speed / low torque	
7 = high speed / high torque	
8 = high speed / mid torque	
9 = high speed / low torque	

";
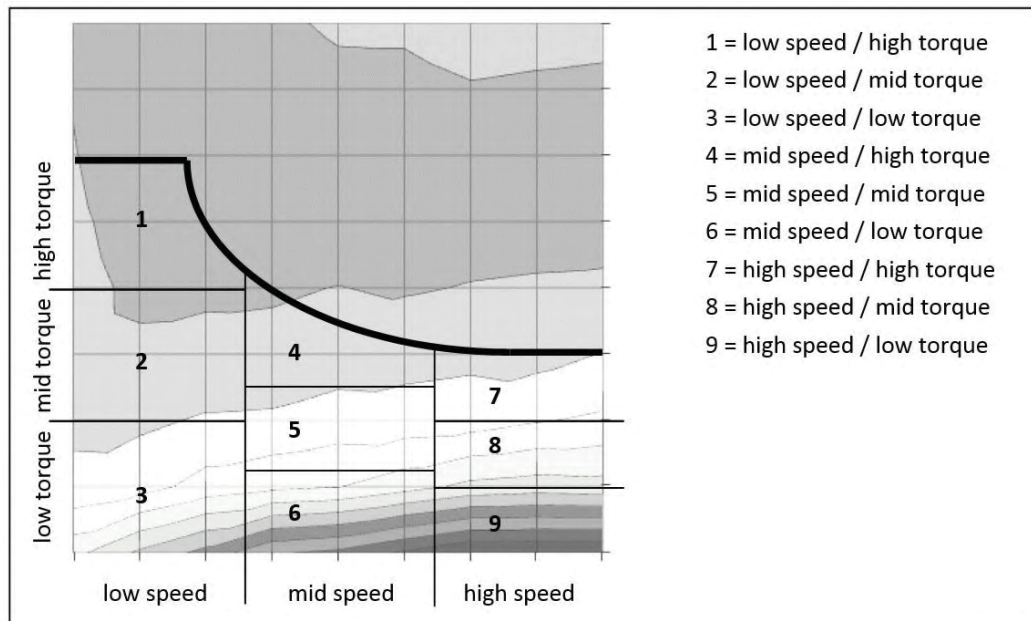
(8) in point 6.4.1, points (a) and (b) are replaced by the following:

"

(a) If a torque loss measurement in accordance with points 6.1(a) or (b) is conducted, the average efficiency of the tested axle during conformity of the certified CO_2 emissions and fuel consumption related properties procedure shall not be lower than 1,5 % for SR axles and 2,0 % for all other axles lines below the corresponding average efficiency of the type approved axle.

(b) If a measurement of drag torque in accordance with point 6.1(c) is conducted, the drag torque of the tested axle during conformity of the certified CO_2 emissions and fuel consumption related properties procedure shall be lower than the corresponding drag torque of the type approved axle or within the tolerance indicated in Table 2.";

(9) Appendix 2 is amended as follows:

(a) on the cover page of the Axle information document, the words "Axle type:" are replaced by the words "Axle type / family (if applicable):";

(b) in PART 1, points 0.0 to 0.9 are deleted;

(10) in Appendix 4, point 3.1 is amended as follows:

(a) point (g) is replaced by the following:

"(g) Crown wheel diameter (+1,5 % / -8 % ref. to the largest drawing diameter)";

(b) point (l) is replaced by the following:

"(l) Gear ratio of every gear step within an axle in a range of 2, as long as only one gear set is changed";

(c) point (p) is deleted;

(11) Appendix 5 is amended as follows:

(a) point 1.1 is replaced by the following:

"1.1 The manufacturer's name or trade mark";

(b) point 2.1 is replaced by the following:

"2.1. Certification number for axles shall comprise the following:

eX*YYYY/YYYY*ZZZZ/ZZZZ*L*0000*00

section 1	section 2	section 3	Additional letter to section 3	section 4	section 5
Indication of country issuing the certificate	HDV CO$_2$ certification Regulation (2017/2400)	Latest amending Regulation (ZZZZ/ZZZZ)	L = Axle	Base certification number 0000	Extension 00";

(12)   Appendix 6 is amended as follows:

(a) in the 'Definitions', point (1) is replaced by the following:

"(1)   "Parameter ID": Unique identifier as used in the simulation tool for a specific input parameter or set of input data";

(b) in Table 1, the third row "TechnicalReportId" below the title is replaced by the following:

"CertificationNumber	P217	token	[-]	";

ANNEX VII

Annex VIII to Regulation (EU) 2017/2400 is amended as follows:

(1)   in point 3, second paragraph below the title is replaced by the following:

"Vehicles which are not member of a family shall use the standard values for $C_d \cdot A_{declared}$ as described in Appendix 7 to this Annex. In this case no input data on air drag shall be provided. The allocation of standard values is done automatically by the simulation tool.";

(2)   points 3.3.1. and 3.3.2. are replaced by the following:

"3.3.1.   The vehicle chassis shall fit to the dimensions of the standard body or semi-trailer as defined in Appendix 4 of this Annex.

3.3.2. The vehicle height determined in accordance with 3.5.3.1 item vii. shall be within the limits as specified in Appendix 3 to this Annex.";

(3)   in point 3.3.7, point iii. is replaced by the following:

"iii.   Tyres inflated to the highest allowable pressure of the tyre manufacturer within a tolerance of ± 0,2 bar";

(4)   in point 3.5.3.1, point (vii) is replaced by the following:

"(vii) Check of vehicle setup regarding the height and geometry, with running engine. The maximum height of the vehicle shall be determined by measuring at the four corners of the box/semi-trailer.";

(5)   in point 3.5.3.2, after the paragraph below the title, the following text is added:

"In case it is not possible to maintain high speed for a complete round, e.g. due to curves being too narrow, it is allowed to deviate from target speed requirement during the curves, including the nearby straight portions that are needed for slowing down and accelerating the vehicle.

Deviations shall be minimized as far as possible.

Alternatively, the warm-up phase may be performed on a nearby road, if the target speed is maintained within ± 10km/h for 90% of the warm-up time. The part of the warm-up phase used for driving from the road to the standstill area of the test track for zeroing of the torque meters shall be included in the other warm-up phase set out in point 3.5.3.4. The time for this part shall not exceed 20 minutes. The speed and time during the warm-up phase shall be recorded by the measurement equipment.";

(6)   point 3.5.3.4. is replaced by the following:

"3.5.3.4.   Drive another warm-up phase of minimum 10 minutes plus, if applicable, the driving from the road to the standstill area of the test track for zeroing of the torque meters at the target speed of the high speed test. The warm-up phase in accordance with this point shall not exceed 20 minutes.";

(7)   in point 3.6.5, point d. is replaced by the following:

"d.   the air drag family has been changed";

(8)   point 3.9 is amended as follows:

(a) the title is replaced by the following:

"Input data for air drag pre-processing tool";

(b) in the second paragraph below the title, the first sentence is replaced by the following:

"A detailed description of the requested data formats, the input files and the evaluation principles can be found in the technical documentation of the air drag pre-processing tool.";

(9)   Table 2 is amended as follows:

the fourth row "Gross vehicle mass" and tenth row "Gear box type" below the title are replaced by the following:

"Gross vehicle mass	[kg]	gross vehicle mass of the rigid lorry or tractor (w/o trailer or semitrailer)
Gear box type	[-]	manual or automated transmission: "SMT", "AMT", "DCT", automatic transmission with torque converter: "APT"";

(10)   in Table 4, the title is replaced by the following:

"Table 4: Input data for air drag pre-processing tool – measurement section configuration file";

(11)   in point 3.10.1.1, point xi is replaced by the following:

"xi.   plausibility check for engine speed or cardan speed whichever is applicable passed:

Engine speed check for high speed test:

$$\frac{30 \cdot i_{gear} \cdot i_{axle} \cdot \frac{(v_{hms,avrg} - 0.3)}{3.6}}{r_{dyn,ref,HS} \cdot \pi} \cdot (1 - 0.02) \le n_{eng,1s}$$

$$\le \frac{30 \cdot i_{gear} \cdot i_{axle} \cdot \frac{(v_{hms,avrg} + 0.3)}{3.6}}{r_{dyn,ref,HS} \cdot \pi} \cdot (1 + 0.02)$$

$$r_{dyn,avrg} = \frac{30 \cdot i_{gear} \cdot i_{axle} \cdot \frac{v_{hms,avrg}}{3.6}}{n_{eng,avrg} \cdot \pi}$$

$$r_{dyn,ref,HS} = \frac{1}{n} \sum_{j=1}^{n} r_{dyn,avrg,j}$$

where:

i_{gear}	=	transmission ratio of the gear selected in high speed test [-]
i_{axle}	=	axle transmission ratio [-]
$v_{hms,avrg}$	=	average vehicle speed (high speed measurement section) [km/h]
$n_{eng,1s}$	=	1 s central moving average of engine speed (high speed measurement section) [rpm]
$n_{eng,avrg}$	=	average engine speed (high speed measurement section) [rpm]
$r_{dyn,avrg}$	=	average effective rolling radius for a single high speed measurement section [m]

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$r_{dyn,ref,HS}$ = reference effective rolling radius calculated from all valid high speed measurement sections (number = n) [m]

Engine speed check for low speed test:

$$\frac{30 \cdot i_{gear} \cdot i_{axle} \cdot \dfrac{(v_{lms,avrg} - 0.5)}{3.6}}{r_{dyn,ref,LS1/LS2} \cdot \pi} \cdot (1 - 0.02) \leq n_{eng,float}$$

$$\leq \frac{30 \cdot i_{gear} \cdot i_{axle} \cdot \dfrac{(v_{lms,avrg} + 0.5)}{3.6}}{r_{dyn,ref,LS1/LS2} \cdot \pi} \cdot (1 + 0.02)$$

$$r_{dyn,avrg} = \frac{30 \cdot i_{gear} \cdot i_{axle} \cdot \dfrac{v_{lms,avrg}}{3.6}}{n_{eng,avrg} \cdot \pi}$$

$$r_{dyn,ref,LS1/LS2} = \frac{1}{n} \sum_{j=1}^{n} r_{dyn,avrg,j}$$

where:

i_{gear}	=	transmission ratio of the gear selected in low speed test [-]
i_{axle}	=	axle transmission ratio [-]
$v_{lms,avrg}$	=	average vehicle speed (low speed measurement section) [km/h]
$n_{eng,float}$	=	central moving average of engine speed with X_{ms} seconds time base (low speed measurement section) [rpm]
$n_{eng,avrg}$	=	average engine speed (low speed measurement section) [rpm]
X_{ms}	=	time needed to drive 25 meter distance at low speed [s]
$r_{dyn,avrg}$	=	average effective rolling radius for a single low speed measurement section [m]
$r_{dyn,ref,LS1/LS2}$ =		reference effective rolling radius calculated from all valid measurement sections for low speed test 1 or low speed test 2 (number = n) [m]

The plausibility check for cardan speed is performed in an analogue way with $n_{eng,1s}$ replaced by $n_{card,1s}$ (1 s central moving average of cardan speed in the high speed measurement section) and $n_{eng,float}$ replaced by $n_{card,float}$ (moving average of cardan speed with X_{ms} seconds time base in the low speed measurement section) and i_{gear} set to a value of 1.";

(12)   in point 3.11, the second paragraph below the title is replaced by the following:

"Several declared values $C_d \cdot A_{declared}$ can be created based on a single measured $C_d \cdot A_{cr}$ *(0)* as long as the family provisions in accordance with point 4 of Appendix 5 are fulfilled.";

(13)   Appendix 2 is replaced by the following:

"Appendix 2

Air drag information document

pursuant to …

Air Drag type or family (if applicable):

General remark: For simulation tool input data an electronic file format needs to be defined which can be used for data import to the simulation tool. The simulation tool input data may differ from the data requested in the information document and vice versa (to be defined). A data file is especially necessary wherever large data such as efficiency maps need to be handled (no manual transfer / input necessary).

…

0.0   GENERAL

0.1   Name and address of manufacturer

0.2   Make (trade name of manufacturer)

0.3   Air drag type (family if applicable)

0.4   Commercial name(s) (if available)

0.5   Means of identification of type, if marked on the vehicle

0.6   In the case of components and separate technical units, location and method of affixing of the certification mark

0.7   Name(s) and address(es) of assembly plant(s)

0.8   Name and address of the manufacturer's representative

PART 1

ESSENTIAL CHARACTERISTICS OF THE (PARENT) AIR DRAG AND THE AIR DRAG TYPES WITHIN AN AIR DRAG FAMILY

	Parent air drag or air drag type	Family member #1	#2	#3
1.0 SPECIFIC AIR DRAG INFORMATION				
1.1.0 VEHICLE				
1.1.1 HDV group according to HDV CO_2 scheme				
1.2.0 Vehicle model				
1.2.1 Axle configuration				
1.2.2 Max. gross vehicle weight				
1.2.3 Cabin line				
1.2.4 Cabin width (max. value in Y direction)				
1.2.5 Cabin length (max. value in X direction)				
1.2.6 Roof height				

1.2.7   Wheel base

1.2.8   Height cabin over frame

1.2.9   Frame height

1.2.10   Aerodynamic accessories or add-ons (e.g. roof spoiler, side extender, side skirts, corner vanes)

1.2.11   Tyre dimensions front axle

1.2.12   Tyre dimensions driven axles(s)

1.3   Body specifications (according to standard body definition)

1.4   (Semi-) Trailer specifications (according to (semi-) trailer specification by standard body)

1.5   Parameter defining the family in accordance with the description of the applicant (parent criteria and deviated family criteria)

LIST OF ATTACHMENTS

No.:	Description:	Date of issue:
1	Information on test conditions	…
2	…	

Attachment 1 to Information Document

Information on test conditions (if applicable)

1.1   Test track on which tests have been conducted

1.2   Total vehicle mass during measurement [kg]

1.3   Maximum vehicle height during measurement [m]

1.4   Average ambient conditions during first low speed test [°C]

1.5   Average vehicle speed during high speed tests [km/h]

1.6   Product of drag coefficient (C_d) by cross sectional area (A_{cr}) for zero crosswind conditions $C_dA_{cr}(0)$ [m²]

1.7   Product of drag coefficient (C_d) by cross sectional area (A_{cr}) for average crosswind conditions during constant speed test $C_dA_{cr}(\beta)$ [m²]

1.8   Average yaw angle during constant speed test β [°]

1.9   Declared air drag value $C_d{\cdot}A_{declared}$ [m²]

1.10   Version number of air drag pre-processing tool".

(14)   in Appendix 3, in Table 7, the sixth row "Vehicle group 9" below the title is replaced by the following:

"9	similar values as for rigid lorry with same maximum gross vehicle weight (group 1, 2, 3 or 4)";

(15)   in Appendix 4, in Table 15, the title is replaced by the following:

"Specifications standard semitrailer "ST1"";

(16)   Appendix 5 is amended as follows:

(a) point 3. is deleted;

(b) point 5.5 is amended as follows:

(i) the paragraph above Table 16 is replaced by the following:

"5.5. The declared value $C_d{\cdot}A_{declared}$ can be used for creation of families in other vehicle classes if the family criteria in accordance with point 5 of this Appendix are met based on the provisions given in Table 16.";

(ii) in Table 16, the last row "Vehicle group 16" is replaced by the following:

"16	Vehicle Group 9 + 0,3 m^2	Applicable vehicle group for transfer has to match with gross vehicle weight. Transfer to already transferred values allowed.";

(17)   in Appendix 6, point 2 is amended as follows:

(a) the third sentence is replaced by the following:

"Where the measured $C_d\,A_{cr}\,(0)$ value of all performed tests is higher than the $C_d{\cdot}A_{declared}$ value declared for the parent vehicle plus 7,5 % tolerance margin, Article 23 of this Regulation shall apply.";

(b) the following paragraph is added:

"For calculation of $C_d\,A_{cr}\,(0)$ value the air drag pre-processing tool version of the parent air drag in accordance with Attachment 1 of Appendix 2 to this Annex shall be used.";

(18)   in Appendix 7, in point 2, the paragraph above Table 19 is replaced by the following:

"2.   For vehicle configurations "rigid lorry + trailer" the overall air drag value is calculated by the simulation tool by adding standard delta values for trailer influence as specified in Table 19 to the $C_d{\cdot}A_{declared}$ value for the rigid lorry.";

(19)   Appendix 8 is amended as follows:

(a) point 1.1. is replaced by the following:

"1.1   The manufacturer's name or trade mark";

(b) in point 1.5, the third sentence is replaced by the following:

"The markings, labels, plates or stickers must be durable for the useful life of the cabin and must be clearly legible and indelible.";

(c) point 2.1 is replaced by the following:

"2.1   Certification number for air drag shall comprise the following:

eX*YYYY/YYYY*ZZZZ/ZZZZ*P*0000*00

Section 1	Section 2	Section 3	Additional letter to section 3	Section 4	Section 5
Indication of country issuing the certificate	HDV CO_2 certification Regulation	Latest amending Regulation (ZZZZ/ZZZZ)	P =Air drag	Base certification number 0000	Extension 00";

	(2017/2400)				

(20) Appendix 9 is replaced by the following:

"Appendix 9

Input parameters for the simulation tool

Introduction

This Appendix describes the list of parameters to be provided by the vehicle manufacturer as input to the simulation tool. The applicable XML schema as well as example data are available at the dedicated electronic distribution platform.

The XML is automatically generated by the air drag pre-processing tool.

Definitions

(1) "Parameter ID": Unique identifier as used in the simulation tool for a specific input parameter or set of input data

(2) "Type": Data type of the parameter

string …….. sequence of characters in ISO8859-1 encoding

token …….. sequence of characters in ISO8859-1 encoding, no leading/trailing whitespace

date ……… date and time in UTC time in the format: YYYY-MM-DD*T*HH:MM:SS*Z* with italic letters denoting fixed characters e.g. "2002-05-30T09:30:10Z"

integer …… value with an integral data type, no leading zeros, e.g. "1800"

double, X .... fractional number with exactly X digits after the decimal sign (".") and no leading zeros e.g. for "double, 2": "2345.67"; for "double, 4": "45.6780"

(3) "Unit" … physical unit of the parameter

Set of input parameters

Table 1

Input parameters "AirDrag"

Parameter name	Parameter ID	Type	Unit	Description/Reference
Manufacturer	P240	token		
Model	P241	token		
CertificationNumber	P242	token		Identifier of the component as used in the certification process
Date	P243	date		Date and time when the component hash is created
AppVersion	P244	token		Number identifying the version of the air drag pre-processing tool
CdxA_0	P245	double, 2	[m²]	Final result of the air drag pre-processing tool.
TransferredCdxA	P246	double, 2	[m²]	CdxA_0 transferred to related families in other vehicle groups in accordance with Table 16 of Appendix 5. In case no transfer rule was applied CdxA_0 shall be provided.

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DeclaredCdxA	P146	double, 2	[m²]	Declared value for air drag family

In case standard values in accordance with Appendix 7 shall be used in the simulation tool, no input data for air drag component shall be provided. The standard values are allocated automatically in accordance with the vehicle group scheme.".

Annex IX to Regulation (EU) 2017/2400 is amended as follows:

(1)   point 1 is amended as follows:

(a) in the second paragraph below the title, the introductory sentence is replaced by the following:

"The power consumption of the following auxiliaries shall be considered within the simulation tool by using technology specific average standard power values:";

(b) the last paragraph is replaced by the following:

"The standard values are integrated in the simulation tool and automatically used by choosing the corresponding technology.";

(2)   in point 2, point (17) is replaced by the following:

"(17) 'Electric steering pump' means a hydraulic pump driven by an electric motor;";

(3)   point 3.2 is amended as follows:

(a) Table 2 is replaced by the following:

"Table 2

Mechanical power demand of steering pump

Number of axles	Axle configuration	Chassis configuration	Technically permissible maximum laden mass (tons)	Vehicle group	Long haul			Regional delivery			Urban delivery			Municipal utility			Construction		
					U+F	B	S	U+F	B	S	U+F	B	S	U+F	B	S	U+F	B	S
2	4x2	Rigid lorry + (Tractor)	> 7,5 - 10	1				240	20	20	220	20	30						
		Rigid lorry + (Tractor)	> 10 - 12	2	340	30	0	290	30	20	260	20	30						
		Rigid lorry + (Tractor)	> 12 - 16	3				310	30	30	280	30	40						
		Rigid lorry	> 16	4	510	100	0	490	40	40	430	40	50	430	30	50	580	30	70
		Tractor	> 16	5	600	120	0	540	90	40							640	50	80
	4x4	Rigid lorry	> 7,5 - 16	6	-														
		Rigid lorry	> 16	7	-														
		Tractor	> 16	8	-														
3	6x2/2-4	Rigid lorry	all	9	600	120	0	490	60	40	440	50	50	430	30	50	640	50	80
		Tractor	all	10	450	120	0	440	90	40							640	50	80
	6x4	Rigid lorry	all	11	600	120	0	490	60	40				430	30	50	640	50	80

	Tractor	all	12	450	120	0	440	90	40						640	50	80
6x6	Rigid lorry	all	13	-													
	Tractor	all	14														
8x2	Rigid lorry	all	15	-													
4 8x4	Rigid lorry	all	16												640	50	80
8x6/8x8	Rigid lorry	all	17	-													

where:

U = Unloaded – pumping oil without steering pressure demand
F = Friction – friction in the pump
B = Banking – steer correction due to banking of the road or side wind
S = Steering – steer pump power demand due to cornering and manoeuvring";

(b) the third paragraph is replaced by the following:

"If a new technology is not listed, the technology "fixed displacement" shall be considered in the simulation tool.";

(4)   in point 3.3, the third paragraph is replaced by the following:

"If the technology used in the vehicle is not listed, the technology "standard alternator" shall be considered in the simulation tool.";

(5)   in point 3.5, Table 9 is replaced by the following:

"Table 9

Mechanical power demand of AC system

Identification of vehicle configuration					AC power consumption [W]				
Number of axles	Axle configuration	Chassis configuration	Technically permissible maximum laden mass (tons)	Vehicle group	Long haul	Regional delivery	Urban delivery	Municipal utility	Construction
2	4x2	Rigid lorry + (Tractor)	> 7,5 - 10	1		150	150		
		Rigid lorry + (Tractor)	> 10 - 12	2	200	200	150		
		Rigid lorry + (Tractor)	> 12 - 16	3		200	150		
		Rigid lorry	> 16	4	350	200	150	300	200
		Tractor	> 16	5	350	200			200
	4x4	Rigid lorry	> 7,5 - 16	6	-				
		Rigid lorry	> 16	7	-				
		Tractor	> 16	8	-				
3	6x2/2-4	Rigid lorry	all	9	350	200	150	300	200
		Tractor	all	10	350	200			200

	6x4	Rigid lorry	all	11	350	200		300	200
		Tractor	all	12	350	200			200
	6x6	Rigid lorry	all	13			-		
		Tractor	all	14					
4	8x2	Rigid lorry	all	15			-		
	8x4	Rigid lorry	all	16					200
	8x6/8x8	Rigid lorry	all	17			-		

".
;

(6)   in point 3.6, in the paragraph below the title, the third sentence is replaced by the following:

"Application related power consumptions at engaged PTO are added by the simulation tool and are not described in the following.".

ANNEX IX

Annex X to Regulation (EU) 2017/2400 is amended as follows:

(1)   point 3.4.1. is replaced by the following:

"3.4.1.   The tyre shall be clearly identifiable in respect to the certificate covering it for the corresponding rolling resistance coefficient.";

(2)   in point 3.4.2., the first sentence is replaced by the following:

"The tyre manufacturer shall use the markings affixed to the side wall of the tyre or affix an additional identifier to the tyre.";

(3)   Appendix 1 is replaced by the following:

"Appendix 1

MODEL OF A CERTIFICATE OF A COMPONENT, SEPARATE TECHNICAL UNIT OR SYSTEM

Maximum format: A4 (210 x 297 mm)

CERTIFICATE ON CO_2 EMISSIONS AND FUEL CONSUMPTION RELATED PROPERTIES OF A TYRE FAMILY

Communication concerning:

– granting[1]	Administration stamp
– extension[1]	
– refusal[1]	
– withdrawal[1]	

(1) 'delete as appropriate'

of a certificate on CO_2 emission and fuel consumption related properties of a tyre family in accordance with Commission Regulation (EU) 2017/2400, as amended by Commission Regulation (EU) [2018/XXX] [*OP, please insert the publication number of this Regulation.*

Certification number:…………………………………………………………………………

Hash:…………………………………………………………………………………………..

Reason for extension:……………………………………………………………………….

1. Manufacturer's name and address:……………………………………...............
2. If applicable, name and address of manufacturer's representative:……………….
3. Brand name/trade mark:………………………………………………………………
4. Tyre type description:…………………………………………………………

     (a) Manufacturer's name……………………………………………………………
     (b) Brand name or trade mark
     (c) Tyre class (in accordance with Regulation (EC) No 661/2009)…………………………
     (d) Tyre-size designation……………………………………………………………
     (e) Tyre structure (diagonal (bias-ply); radial)……………………………………
     (f) Category of use (normal tyre, snow tyre, special use tyre)……………………
     (g) Speed category (categories)……………………………………………………

(h) Load-capacity index (indices)…………………………………………………

(i) Trade description/commercial name…………………………………………

(j) Declared tyre rolling resistance coefficient …………………………………

5. Tyre identification code(s) and technology(ies) used to provide identification code(s), if applicable:

   Technology: Code:

   . . .   . . .

6. Technical Service and, where appropriate, test laboratory approved for purposes of approval or of verification of conformity tests: ....

7. Declared values:

7.1 declared rolling resistance level of the tyre (in N/kN rounded to the first decimal place, in accordance with ISO 80000-1 Appendix B, section B.3, rule B (example 1)) Cr , ……………………………………………………………………………..[N/kN]

7.2 tyre test load in accordance with Regulation (EC) No 1222/2009 Annex I part A (85 % of single load, or 85 % of maximum load capacity for single application specified in applicable tyre standards manuals if not marked on tyre.) F_{ZTYRE}………………………………………………………………………………………[N]

7.3 Alignment equation:………………………………………………………….

8. Any remarks: ....

9. Place: .

10. Date: ...

11. Signature: ....

12. Annexed to this communication are: .... ";

    (4)   Appendix 2 is amended as follows:

    (a) SECTION I is amended as follows:

    points 0.14 and 0.16 are deleted;

    (b) SECTION II is amended as follows:

        (i)   point 4. is replaced by the following:

        "4.   Date of test report:";

        (ii)   point 8.4. is replaced by the following:

        "8.4.   Alignment equation:";

        (iii)   the following point is inserted:

        "8.5.   Rolling resistance level of the tyre (in N/kN rounded to the first decimal place, in accordance with ISO80000-1 Appendix B, section B.3, rule B (example 1)) $C_{r,aligned}$ …………………………………………………….[N/kN]";

    (5)   Appendix 3 is amended as follows:

    (a) the title is replaced by the following:

    "Input parameters for the simulation tool";

    (b) in Definitions, point (1) is replaced by the following:

    (1)   "Parameter ID": Unique identifier as used in the simulation tool for a specific input parameter or set of input data";

(c) in Table 1, the third row "TechnicalReportId" below the title and the last row are replaced by the following:

"CertificationNumber	P232	token		
Dimension	P108	string	[-]	Allowed values (non-exhaustive): "9.00 R20", "9 R22.5", "9.5 R17.5", "10 R17.5", "10 R22.5", "10.00 R20", "11 R22.5", "11.00 R20", "11.00 R22.5", "12 R22.5", "12.00 R20", "12.00 R24", "12.5 R20", "13 R22.5", "14.00 R20", "14.5 R20", "16.00 R20", "205/75 R17.5", "215/75 R17.5", "225/70 R17.5", "225/75 R17.5", "235/75 R17.5", "245/70 R17.5", "245/70 R19.5", "255/70 R22.5", "265/70 R17.5", "265/70 R19.5", "275/70 R22.5", "275/80 R22.5", "285/60 R22.5", "285/70 R19.5", "295/55 R22.5", "295/60 R22.5", "295/80 R22.5", "305/60 R22.5", "305/70 R19.5", "305/70 R22.5", "305/75 R24.5", "315/45 R22.5", "315/60 R22.5", "315/70 R22.5", "315/80 R22.5", "325/95 R24", "335/80 R20", "355/50 R22.5", "365/70 R22.5", "365/80 R20", "365/85 R20", "375/45 R22.5", "375/50 R22.5", "375/90 R22.5", "385/55 R22.5", "385/65 R22.5", "395/85 R20", "425/65 R22.5", "495/45 R22.5", "525/65 R20.5"";

(6)   in Appendix 4, point 2.1 is replaced by the following:

"1.1   Certification number for tyres shall comprise the following:

eX*YYYY/YYYY*ZZZZ/ZZZZ*T*0000*00

Section 1	Section 2	Section 3	Additional letter to section 3	Section 4	Section 5
Indication of country issuing the certificate	HDV CO_2 certification Regulation (2017/2400)	Latest amending Regulation (ZZZZ/ZZZZ)	T = Tyre	Base certification number 0000	Extension 00".

ANNEX X

"Annex Xa

Conformity of simulation tool operation and of CO_2 emissions and fuel consumption related properties of components, separate technical units and systems: verification testing procedure

1.   Introduction

This Annex sets out the requirements for the verification testing procedure which is the test procedure for verifying the CO_2 emissions of new heavy-duty vehicles.

The verification testing procedure consists of an on-road test to verify the CO_2 emissions of new vehicles after production. It shall be carried out by the vehicle manufacturer and verified by the approval authority that granted the licence to operate the simulation tool.

During the verification testing procedure the torque and speed at the driven wheels, the engine speed, the fuel consumption, the engaged gear of the vehicle and the other relevant parameters listed in point 6.1.6 shall be measured. The measured data shall be used as input to the simulation tool, which uses the vehicle-related input data and the input information from the determination of the CO_2 emissions and fuel consumption of the vehicle. For the verification testing procedure simulation, the instantaneously measured wheel torque and the rotational speed of the wheels as well as the engine speed shall be used as input, as described in Figure 1 instead of the vehicle speed, in accordance with point 6.1.6. The fan power during the verification testing procedure shall be calculated in accordance with the measured fan speed. The measured fuel consumption shall be within the tolerances set out in point 7 and compared to the fuel consumption simulated with the verification data set to pass the verification testing procedure.

As part of the verification testing procedure, the correctness of the vehicle input data set from the certification of CO_2 emissions and fuel consumption related properties of the components, separate technical units and systems shall also be reviewed to check the data and the data handling process. The correctness of the input data relating to components, separate technical units and systems relevant for air drag and for rolling resistance of the vehicle shall be verified in accordance with point 6.1.1.
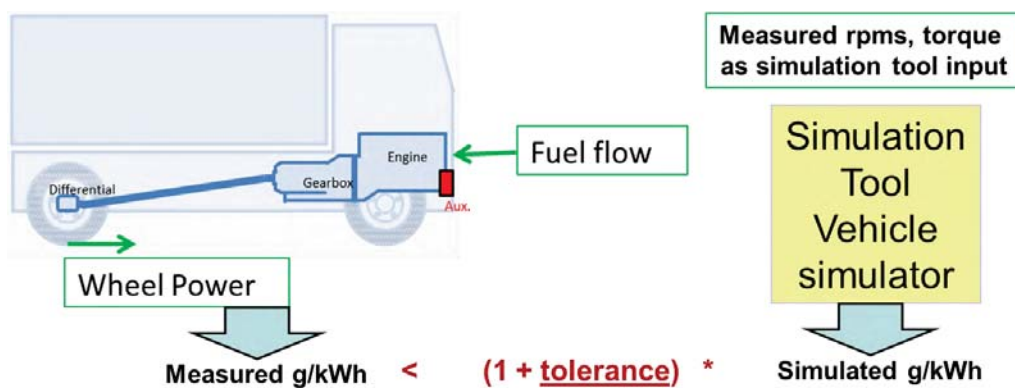

Figure 1: schematic picture of the verification testing procedure method

2.   Definitions

For the purposes of this Annex the following definitions shall apply:

(1)   "verification test relevant data set" means a set of input data for components, separate technical units and systems and input information used for CO_2 determination of a verification testing procedure relevant vehicle;

(2)   "verification testing procedure relevant vehicle" means a new vehicle for which a value of CO_2 emissions and fuel consumption was determined and declared in accordance with Article 9;

(3)   "corrected actual mass of the vehicle" means the corrected actual mass of the vehicle in accordance with point 2(4) of Annex III;

(4)   "actual mass of the vehicle" is as defined in Article 2(6) of Regulation (EU) No 1230/2012;

(5)   "actual mass of the vehicle with payload" means the actual mass of the vehicle with the superstructure and with the payload applied in the verification testing procedure;

(6)   "wheel power" means the total power at the driven wheels of a vehicle to overcome all driving resistances at the wheel, computed in the simulation tool from the measured torque and rotational speed of the driven wheels;

(7)   "control area network signal" or "CAN signal" means a signal from the connection with the vehicle electronic control unit as referred to in paragraph 2.1.5 of Appendix 1 to Annex II to Regulation (EU) No 582/2011;

(8)   "urban driving" means the total distance driven during the fuel consumption measurement at speeds below 50 km/h;

(9)   "rural driving" means the total distance driven during the fuel consumption measurement at speeds from 50 km/h to 70 km/h;

(10)   "motorway driving" means the total distance driven in the fuel consumption measurement at speeds above 70 km/h;

(11)   "crosstalk" means the signal at the main output of a sensor (M_y), produced by a measurand (F_z) acting on the sensor, which is different from the measurand assigned to this output; the coordinate system assignment is defined in accordance with ISO 4130.

3.   Vehicle selection

The number of new vehicles to be tested per year of production ensures that the relevant variations of components, separate technical units or systems used are covered by the verification testing procedure. The vehicle selection for the verification test shall be based on following requirements:

(a)   The vehicles for verification test shall be selected out of the vehicles from the production line for which a value of CO_2 emissions and fuel consumption has been determined and declared in accordance with Article 9. The components, separate technical units or systems mounted in or on the vehicle shall be out of series production and shall correspond to those mounted at production date of the vehicle.

(b)   The vehicle selection shall be made by the approval authority that granted the licence to operate the simulation tool based on proposals from the vehicle manufacturer.

(c)   Only vehicles with one driven axle shall be selected for verification test.

(d)　It is recommended to include in each verification test relevant data set engine, axle and transmission with highest sales numbers per manufacturer. The components, separate technical units or systems may be tested all in one vehicle or in different vehicles, under the condition that each component is covered by minimum one verification test on one vehicle.

(e)　Vehicles which use standard values for CO_2 certification of their components, separate technical units or systems instead of measured values for the transmission and for the axle losses shall not be selected for the verification test as long as vehicles complying with the requirements in points a) to c) and using measured loss maps for these components, separate technical units or systems in the CO_2 certification, are produced.

(f)　The minimum number of different vehicles with different combinations of verification test relevant data sets to be tested by verification test per year shall be based on the sales numbers of the vehicle manufacturer as set out in Table 1:

Table 1

Determination of the minimum number of vehicles to be tested by the vehicle manufacturer

Number of vehicles to be tested	Verification testing procedure relevant vehicles produced / year
1	1 - 25 000
2	25 001 – 50 000
3	50 001-75 000
4	75 001-100 000
5	more than 100 000

(g)　The vehicle manufacturer shall finalize the verification test within a period of 10 months after the date of selection of the vehicle for the verification test.

4　Vehicle conditions

Each vehicle for the verification test shall be in series conditions as typically delivered to the customer. No changes in hardware such as lubricants or in the software such as auxiliary controllers are allowed.

4.1　Vehicle run in

Run in of the vehicle is not mandatory. If the total mileage of the test vehicle is less than 15 000 km, an evolution coefficient for the test result shall be applied as defined in point 7. The total mileage of the test vehicle shall be the odometer reading at start of the fuel consumption measurement. The maximum mileage for the verification testing procedure shall be 20 000 km.

4.2　Fuel and lubricants

All lubricants shall be in line with the series configuration of the vehicle.

For the fuel consumption measurement as described in point 6.1.5, reference fuel as set out in point 3.2 of Annex V shall be used.

The fuel tank shall be full at start of the fuel consumption measurement run.

5   Measurement equipment

All laboratory reference measurement equipment, used for calibration and verification, shall be traceable to national (international) standards. The calibration laboratory shall comply with the requirements of ISO 9000 series and either ISO/TS 16949 or ISO/IEC 17025.

5.1   Torque

The direct torque at all driven axles shall be measured with one of the following measurement systems fulfilling the requirements listed in Table 2:

(a)   hub torque meter;

(b)   rim torque meter;

(c)   half-shaft torque meter.

The calibrated range shall be at least 10 000 Nm; the measurement range shall cover the entire range of torque occurring during the verification testing procedure of the tested vehicle.

The drift shall be measured during the verification test described in point 6 by zeroing the torque measurement system in accordance with point 6.1.5 after the pre-conditioning phase by lifting the axle and measuring the torque at lifted axle directly after the verification test again.

For a valid test result a maximum drift of the torque measurement system over the verification testing procedure of 150 Nm (sum of both wheels) shall be proven.

5.2   Vehicle speed

The vehicle speed shall be used for possible plausibility checks of the gear signal later on and shall be based on the CAN signal.

5.3   Gear engaged

The engaged gear does not need to be measured but shall be calculated by the simulation tool based on measured engine speed, the vehicle speed and the tyre dimensions and transmission ratios of the vehicle in accordance with point 7. The gear position may be provided also from the CAN signal to check possible deviations from the gear position calculated by the simulation tool. In case of deviations of the gear position in more than 5 % of the test duration, the reasons for the deviation shall be investigated and reported by the vehicle manufacturer. The input data on gear position shall be used in the simulation tool to compute the gear dependent losses in the gear box. The engine speed shall be taken by the simulation tool from the input data as defined in point 5.4.

5.4   Rotational speed of the engine

The signal from the connection with the vehicle electronic control unit via the open on-board diagnostic interface shall be used to measure the engine speed. Alternative measurement systems are allowed if they fulfil the requirements set out in Table 2.

5.5   Rotational speed of the wheels at the driven axle

The measurement system for the rotational speed of left and right wheel at the driven axle for the assessment of the power demand at the wheels as input to the simulation tool for the verification test simulation shall fulfil the requirements set out in Table 2.

5.6   Rotational speed of fan

The CAN signal for the fan speed may be used, if available. Alternatively an external sensor fulfilling the requirements set out in Table 2 may be used.

5.7   Fuel measurement system

The fuel consumed shall be measured on-board with a measurement device reporting the total amount of fuel consumed in kilograms. The fuel measurement system shall be based on one of the following measurement methods:

(a)   Measurement of fuel mass. The fuel measuring device shall fulfil the accuracy requirements set out in Table 2 for the fuel mass measurement system.

(b)   Measurement of fuel volume together with correction for the thermal expansion of the fuel. The fuel volume measurement device and fuel temperature measurement device shall fulfil the accuracy requirements set out in Table 2 for the fuel volume measurement system. The fuel mass consumed shall be calculated in accordance with the following equations:

$$m_{fuel} = \sum_{i=1}^{n-1} \Delta V_{fuel,i} \cdot \rho_i$$

$$\Delta V_{fuel,i} = V_{fuel,i+1} - V_{fuel,i}$$

$$\rho_i = \frac{\rho_0}{1 + \beta(t_{i+1} - t_0)}$$

where:

m_{fuel}	=	Calculated fuel mass [kg]
n	=	Total number of samples in measurement.
ρ_0	=	Density of the fuel used for the verification test in (kg/m³). The density shall be determined in accordance with Annex IX of the Regulation (EU) No 582/2011. If diesel fuel is used in the verification test, also the average value of the density interval for the reference fuels B7 in accordance with Annex IX of the Regulation (EU) No 582/2011 may be used.
t_0	=	Fuel temperature that corresponds to density ρ_0 for the reference fuel, as defined in Annex V [°C]
ρ_i	=	Density of the test fuel at sample i [kg/m³]
$V_{fuel,\,i}$	=	Total fuel volume consumed at sample i [m³]
t_{i+1}	=	Measured fuel temperature at sample i+1 [°C]
β	=	Temperature correction factor (0,001 K⁻¹).

5.8   Vehicle weight

The following masses of the vehicle shall be measured with equipment fulfilling the requirements set out in Table 2:

(a)   actual mass of the vehicle;

(b)   actual mass of the vehicle with payload.

5.9   General requirements for the on-board measurements

All data shall be recorded at least in 2 Hz frequency or at recommended frequency from the equipment maker, whichever is the higher value.

The input data for the simulation tool may be composed from different recorders. The following input data shall be provided from measurements:

(a) torque at the driven wheels per wheel;

(b) rotational speed at the driven wheels per wheel;

(c) gear (optional);

(d) engine speed;

(e) fan speed;

(f) vehicle speed;

(g) fuel flow.

The torque and rotational speed at the wheels shall be recorded in one data-logging system. If different data-logging systems are used for the other signals, one common signal, such as vehicle speed, shall be recorded to ensure correct time alignment of the signals.

The accuracy requirements set out in Table 2 shall be met by all measurement equipment used. Any equipment not listed in Table 2 shall fulfil the accuracy requirements set out in Table 2 of Annex V.

Table 2

Requirements of measurement systems

Measurement system	Accuracy	Rise time[1]
Balance for vehicle weight	50 kg or < 0,5 % of max. calibration whichever is smaller	-
Rotational speed wheels	< 0,5 % of max. calibration	≤ 1 s
Fuel mass flow for liquid fuels	< 1,0 % of reading or < 0,5 % of max. calibration whichever is larger	≤ 2 s
Fuel volume measurement system[2]	< 1,0 % of reading or < 0,5 % of max. calibration whichever is larger	≤ 2 s
Temperature of the fuel	± 1°C	≤ 2 s
Sensor for measuring the rotational speed cooling fan	0,4 % of reading or 0,2 % of max. calibration of speed whichever is larger	≤ 1 s
Engine speed	As set out in Annex V	
Wheel torque	For 10 kNm calibration: < 40 Nm accuracy < 20 Nm crosstalk	< 0,1 s

[1] Rise time means the difference in time between the 10 percent and 90 percent response of the final analyser reading (t90 – t10).

[2] The accuracy shall be met for the integral fuel flow over 100 minutes.

The maximum calibration values shall be at least 1,1 times the maximum predicted value expected during all test runs for the respective measurement system. For the torque measurement system the maximum calibration may be limited to 10 kNm.

Accuracy given shall be met by the sum of all single accuracies in the case more than one scale is used.

6 Test procedure

6.1 Vehicle preparation

The vehicle shall be taken from the series production and selected as set out in point 3.

6.1.1 Validation of input data

The manufacturer's records file for the vehicle selected shall be used as basis for validating the input data. The vehicle identification number of the vehicle selected shall be the same as the vehicle identification number in the customer information file.

Upon request by the approval authority that granted the licence to operate the simulation tool, the vehicle manufacturer shall provide, within 15 working days, the manufacturer's records file, the input information and input data necessary to run the simulation tool as well as the certificate of CO_2 emissions and fuel consumption related properties for all relevant components, separate technical units or systems.

6.1.1.1 Verification of components, separate technical units or systems and input data and information

The following checks shall be performed for the components, separate technical units and systems mounted on the vehicle:

(a) Simulation tool data integrity: the integrity of the cryptographic hash of the manufacturer's records file in accordance with Article 9(3) re-calculated during the verification testing procedure with the hashing tool shall be verified by comparison with the cryptographic hash in the certificate of conformity;

(b) Vehicle data: the vehicle identification number, axle configuration, selected auxiliaries and power take off technology shall match the selected vehicle;

(c) Component, separate technical unit or system data: the certification number and the model type imprinted on the certificate of CO_2 emissions and fuel consumption related properties shall match the component, separate technical unit or system installed in the selected vehicle;

(d) The hash of the simulation tool input data and the input information shall match the hash imprinted on the certificate of CO_2 emissions and fuel consumption related properties for the following components, separate technical units or systems:

   (i)   engines;

   (ii)   transmissions;

   (iii) torque converters;

   (iv)   other torque transferring components;

   (v)   additional driveline components;

   (vi)   axles;

   (vii) body or trailer air drag;

   (viii) tyres.

6.1.1.2 Verification of the vehicle mass

If requested by the approval authority that granted the licence to operate the simulation tool, a verification of the corrected actual mass of the vehicle shall be included into the verification of input data.

For the verification of the mass, the mass in running order of the vehicle shall be verified in accordance with point 2 of Appendix 2 to Annex I to Regulation (EC) No 1230/2012.

6.1.1.3 Actions to be taken

In case of discrepancies in the certification number or the cryptographic hash of one or more files regarding the components, separate technical units or systems listed in subpoints (d)(i) to (vii) of point 6.1.1.1 the correct input data file fulfilling the checks in accordance with points 6.1.1.1 and 6.1.1.2 shall replace the incorrect data for all further actions. If no complete input data set with correct certificates of CO_2 emissions and fuel consumption related properties is available for the components, separate technical units or systems listed in subpoints (d)(i) to (vii) of point 6.1.1.1 the verification test shall end and the vehicle fails the verification testing procedure.

6.1.2 Run in phase

After the validation of input data in accordance with point 6.1.1, a run in phase up to maximum 15 000 km odometer reading may take place, with no need to use the reference fuel, if the odometer reading of the vehicle selected is below 15 000 km. In case of damage of any of the components, separate technical units or systems listed in point 6.1.1.1, the component, separate technical units or systems may be replaced by an equivalent component, separate technical units or systems with the same certification number. The replacement shall be documented in the test report.

All relevant components, separate technical units or systems shall be checked before the measurements to exclude unusual conditions, such as incorrect oil fill levels, plugged air filters or on-board diagnostic warnings.

6.1.3 Set up of measurement equipment

All measurement systems shall be calibrated in accordance with the provisions of the equipment maker. If no provisions exist, the recommendations from the equipment maker shall be followed for calibration.

After the run in phase, the vehicle shall be equipped with the measurement systems set out in point 5.

6.1.4 Set up of the test vehicle for the fuel consumption measurement

Tractors of the vehicle groups defined in Table 1 of Annex I shall be tested with any type of semitrailer, providing the loading defined below can be applied.

Rigid lorries of the vehicle groups defined in Table 1 of Annex I shall be tested with trailer, if a trailer connection is mounted. Any body type or other device to carry the loading set out below can be applied.

The bodies of the vehicles may differ from the standard bodies set out in Table 1 of Annex I for the certification of CO_2 emissions and fuel consumption related properties of component, separate technical units or systems.

The vehicle payload shall be at minimum to a mass leading to a total test weight of 90 % of the maximum gross combined weight or gross vehicle weight for rigid lorries without trailer.

The tyre inflation pressure shall be in line with the recommendation of the manufacturer. The tyres of the semitrailer may differ from the standard tyres set out

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in Table 2 of Part B of Annex II to Regulation (EC) No 661/2009 for the CO_2 certification of tyres.

All settings influencing the auxiliary energy demand shall be set to minimum reasonable energy consumption where applicable. The air conditioning shall be switched off and venting of the cabin shall be set lower than medium mass flow. Additional energy consumers not necessary to run the vehicle shall be switched off. External devices to provide energy on board, such as external batteries, are allowed only for running the extra measurement equipment for the verification testing procedure listed in Table 2 but shall not provide energy to serial vehicle equipment.

A particle filter regeneration may be initiated and shall be achieved before the verification test. If an initiated particle filter regeneration cannot be achieved before the verification test, the test is invalid and shall be repeated.

6.1.5   Verification test

6.1.5.1   Route selection]

The route selected for the verification test shall fulfil the requirements set out in Table 3. The routes may include both public and private tracks.

6.1.5.2   Vehicle pre conditioning

No specific pre-conditioning of the vehicle is required.

6.1.5.3   Vehicle warm up

Before the fuel consumption measurement starts, the vehicle shall be driven for warm up as set out in Table 3. The warm up phase shall not be considered in the evaluation of the verification test.

6.1.5.4   Zeroing of the torque measurement equipment

Zeroing of the torque measurement equipment shall follow the instruction of the equipment maker. It shall be ensured for zeroing, that the torque on the driven axle is zero. For zeroing, the vehicle shall be stopped directly after the warm up phase and zeroing shall be performed directly after the vehicle stop to minimise cool down effects. Zeroing shall be finished within less than 20 minutes.

6.1.5.5   Fuel consumption measurement

The fuel consumption measurement shall start directly after the zeroing of the wheel-torque measurement equipment at vehicle stand still and engine idling. 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 electronic control systems which is activated automatically at vehicle start shall be used, and gear shifts shall be performed by the automated system if applicable. If only manual settings for the electronic control systems are available, the settings leading to higher fuel consumption per kilometre shall be selected. The duration of the fuel consumption measurement shall be within the tolerances set out in Table 3. The fuel consumption measurement shall end also at vehicle stand still in idling condition directly before the measurement of the drift of the torque measurement equipment.

6.1.5.6   Measurement of the drift of the torque measurement equipment

Directly after the fuel consumption measurement, the drift of the torque measurement equipment shall be recorded by measuring the torque at the same vehicle conditions as during the zeroing process. If the fuel consumption

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measurement does not end at zero vehicle speed, the vehicle shall be stopped for the drift measurement in moderate deceleration.

6.1.5.7 Boundary conditions for the verification test

The boundary conditions to be met for a valid verification test are set in Table 3.

If the vehicle passes the verification test in accordance with point 7, the test shall be set valid even if the following conditions are not met:

- undercut of minimum values for parameter No 1, 2, 6, 9 in Table 3;

- exceedance of maximum values for parameter No 3, 4, 5, 7, 8, 10, 12 in Table 3.

Table 3

Parameters for a valid verification test

No.	Parameter	Min.	Max.	Applicable for
1	Warm up [minutes]	60		
2	Average velocity at warm up [km/h]	70[1]	100	
3	Fuel consumption measurement duration [minutes]	80	120	
4	Distance based share urban driving	2 %	8 %	vehicle groups 4, 5, 9, 10
5	Distance based share rural driving	7 %	13 %	
6	Distance based share motorway driving	74 %	-	vehicle groups 4, 5, 9, 10
7	Time share of idling at stand still		5 %	
8	Average ambient temperature	5°C	30°C	
9	Road condition dry	100 %		
10	Road condition snow or ice		0 %	
11	Seal level of the route [m]	0	800	
12	Duration of continuous idling at stand still [minutes]		3	

[1] Or maximum vehicle speed if lower than 70 km/h

In case of extraordinary traffic conditions, the verification test shall be repeated.

6.1.6 Data reporting

The data recorded during the verification testing procedure shall be reported to the approval authority that granted the licence to operate the simulation tool as follows:

(a) The data recorded shall be reported in a constant 2 Hz signals as set out in Table 1. The data recorded at higher frequencies than 2 Hz shall be converted into 2 Hz by averaging the time intervals around the 2 Hz nodes. In case of e.g. 10 Hz sampling, the first 2 Hz node is defined by the average from second 0,1 to 0,5, the second node is defined by the average from second 0,6 to 1,0. The

time stamp for each node shall be the last time stamp per node, i.e. 0,5, 1,0, 1,5 etc.

(b)   The wheel power shall be calculated from the measured wheel torque and rotational wheel speed. All values shall first be converted into 2 Hz signals in accordance with point (a). Then the wheel power for each driven wheel shall be calculated from the 2 Hz torque and speed signals as set out in the following equation:

$$P_{wheel-i\,(t)} = \frac{2\ x\ \pi\ x\ n_{wheel-i\,(t)}\ x\ Md_{wheel-i\,(t)}}{60000}$$

where:

i	=	Index standing for left and right wheel of the driven axle
$P_{wheel-i\,(t)}$	=	power at the left and right driven wheel time node (t) [kW]
$n_{wheel-i\,(t)}$	=	rotational speed of driven the left and right driven wheel at time node (t) [rpm]
$Md_{wheel-i\,(t)}$	=	measured torque at the left and right driven wheel at time node (t) [Nm]

The wheel power input data for the verification test simulation with the simulation tool shall be the sum of the power of all driven wheels of the vehicle as set out in the following equation:

$$P_{wheel\,(t)} = \sum_{i=1}^{wd} P_{wheel-i\,(t)}$$

where:

$P_{wheel\,(t)}$	=	total power at a driven wheel at time node (t) [kW]
wd	=	number of driven wheels

Table 4

Data reporting format for measured data for the simulation tool in the verification test

Quantity	Unit	Header input data	Comment
time node	[s]	<t>	
vehicle speed	[km/h]	<v>	
engine speed	[rpm]	<n_eng>	
engine cooling fan speed	[rpm]	<n_fan>	
torque left wheel	[Nm]	<tq_left>	
torque right wheel	[Nm]	<tq_right>	
wheel speed left	[rpm]	<n_wh_left>	

wheel speed right	[rpm]	<n_wh_right>	
gear	[-]	<gear>	optional signal for MT and AMT
fuel flow	[g/h]	<fc>	for standard NCV (point 7.2)

7   Test evaluation

The simulated fuel consumption shall be compared to the measured fuel consumption using the simulation tool.

7.1.   Simulation of the fuel consumption

The input data and input information for the simulation tool for the verification test shall be the following:

(a)   The certified CO_2 emissions and fuel consumption related properties of the following components, separate technical units or systems:

(i)   engines;

(ii)   transmissions;

(iii)   torque converters;

(iv)   other torque transferring components;

(v)   additional driveline components;

(vi)   axles.

(b)   The input data set out in Table 4.

The power calculated by the simulation tool by the equations of longitudinal dynamics from the measured vehicle speed and road gradient course may be used for plausibility checks to test if the total simulated cycle work is similar to the measured value.

The simulation tool shall calculate the gears engaged during the verification test by calculating the engine speeds per gear at the actual vehicle speed and selecting the gear that provides the engine speed closest to the measured engine speed.

The measured wheel power shall replace in the verification test mode of the simulation tool the simulated power demand at the wheels. The measured engine speed and the gear defined in the verification test input data shall replace the corresponding simulation part. The standard fan power in the simulation tool shall be replaced by the fan power calculated from the measured fan speed in the simulation tool as follows:

$$P_{fan} = C1 \times \left(\left(\frac{RPM_{fan}}{C2} \right)^3 \times \left(\frac{D_{fan}}{C3} \right)^5 \right)$$

where:

P_{fan}	=	fan power to be used in the simulation for the verification test [kW]
RPM_{fan}	=	measured rotational speed of the fan [1/s]
D_{fan}	=	diameter of the fan [m]
C1, C2, C3 =		generic parameters in the simulation tool:
C1	=	7 320 W

C2 = 1 200 rpm

C3 = 810 mm

The steering pump, compressor and generator shall be attributed standard values in accordance with Annex IX.

All other simulation steps and data handling concerning axle, transmission and engine efficiency shall be identical to the application of the simulation tool to determine and declare the CO_2 emissions and fuel consumption of new vehicles.

The simulated fuel consumption value shall be the total fuel flow over the verification test relevant test distance, from the end of the zeroing after the warm up phase to the end of the test. The total verification test relevant test distance shall be calculated from the vehicle speed signal.

The results from the simulation tool for the verification test shall be calculated as follows:

$$FC_{sim} = \frac{\sum_{t=0}^{end}(FC_{sim (t)} : fs)}{VT\ work}$$

where:

VT work = Verification test work calculated by the simulation tool for the complete fuel consumption measurement phase [kWh]
$$VT\ work = \sum_{t=0}^{end} \frac{P_{wheel-i}}{3600 * fs}$$

FC_{sim} = Fuel consumption simulated by the simulation tool over the complete fuel consumption measurement phase [g/kWh]

fs = Simulation rate [Hz]

$FC_{sim (t)}$ = Instantaneous fuel consumption simulated by the simulation tool over the test [g/s]

7.2. Calculation of the measured fuel consumption

The measured fuel flow shall be integrated for the same time span as the simulated fuel consumption. The measured fuel consumption for the total test shall be calculated as follows:

$$FC_m = \frac{\sum_{t=0}^{end} FC_{m(t)} : fs}{VT\ work_m}$$

where:

FC_m = Fuel consumption measured by integrating fuel mass flow over the complete fuel consumption measurement phase [g/kWh]

$FC_{m (t)}$ = Instantaneous fuel mass flow measured during the fuel consumption measurement phase [g/s]

fs = Sampling rate [Hz]

$VT\ work_m$ = Verification test work at the wheel calculated from the measured wheel torque and wheel rotational speeds over the complete fuel consumption measurement phase [kWh]

$$VT\ work_m = \sum_{t=0}^{end} \frac{\sum_{i=1}^{2} P_{wheel-i-measured,t}}{3600 * fs}$$

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$P_{wheel-i-measured,t}=$ Positive power at the left (i=l) and right (i=2) wheel calculated from the measured wheel torque and wheel rotational speeds at time step t where only power values greater zero are considered

$$P_{wheel-i-measured,t} = 0,001 \text{ x torque}_i \text{ x rpm}_i \text{x} \frac{2x\pi}{60}$$

Torque$_i$ = instantaneously measured torque at the wheel "i" in time step "t" [Nm]

rpm$_i$ = instantaneously measured rotational speed at the wheel "i" in time step "t" [min^{-1}]

The measured fuel consumption values shall be corrected for the net calorific value (NCV) as set out in point 3 of Annex V to calculate the verification test results.

$$FC_{m,corr} = FC_m * \frac{NCV_{meas}}{NCV_{std}}$$

where:

NCV$_{meas}$ = NCV of the fuel used in the verification test determined in accordance with point 3.2 of Annex V [MJ/kg]

NCV$_{std}$ = Standard NCV in accordance with Table 4 of Annex V [MJ/kg]

FC$_{m,corr}$ = Fuel consumption measured by integrating fuel mass over the complete fuel consumption measurement phase corrected for the test fuel NCV [g/kWh]

7.3. Pass/Fail check

The vehicle shall pass the verification test if the ratio of corrected measured fuel consumption to simulated fuel consumption is below the tolerances set out in Table 5.

In the case of a shorter run-in phase than 15 000 km the influence on the fuel efficiency of the vehicle may be corrected with the following evolution coefficient:

$$FC_{m-c} = FC_{m,corr} \times \left(ef + mileage * \frac{1-ef}{15000 \text{ km}}\right) \text{ [g/kWh]}$$

where:

FC$_{m-c}$ = Fuel consumption measured and corrected of a shorter run-in phase

mileage = run-in distance [km]

ef = Evolution coefficient of 0,98

For vehicle odometer reading above 15 000 km, no correction shall be applied.

The ratio of measured and simulated fuel consumption for the total verification test relevant trip shall be calculated as verification test ratio in accordance with the following equation:

$$C_{VTP} = \frac{FC_{m-c}}{FC_{sim}}$$

Where:

C$_{VTP}$ = Ratio of fuel consumption measured and simulated in the verification testing procedure

For a comparison with the declared CO_2 emissions of the vehicle in accordance with Article 9, the verified CO_2 emissions of the vehicle are determined as follows:

$$CO2_{verified} = C_{VTP} \times CO2_{declared}$$

where:

$CO2_{verified}$ = verified CO_2 emissions of the vehicle in [g/t-km]

$CO2_{declared}$ = declared CO_2 emissions of the vehicle in [g/t-km]

If a first vehicle fails the tolerances for C_{VTP}, two more tests may be performed on the same vehicle or two more similar vehicles may be tested on request of the vehicle manufacturer. For the evaluation of the pass criterion set out in Table 5, the averages of the verification testing procedure ratio from the up to three tests shall be used. If the pass criterion is not reached, the vehicle fails the verification testing procedure.

Table 5

Pass fail criterion for the verification test

	C_{VPT}
Pass criterion for the verification testing procedure	< 1,075

8   Reporting procedures

The test report shall be established by the vehicle manufacturer for each vehicle tested and shall include at least the following results of the verification test:

8.1.   General

8.1.1. Name and address of the vehicle manufacturer

8.1.2. Address(es) of assembly plant(s)

8.1.3. The name, address, telephone and fax numbers and e-mail address of the vehicle manufacturer's representative

8.1.4. Type and commercial description

8.1.5. Selection criteria for vehicle and CO_2 relevant components (text)

8.1.6. Vehicle owner

8.1.7. Odometer reading at test start of the fuel consumption measurement (km)

8.2.   Vehicle information

8.2.1. Vehicle model

8.2.2. Vehicle identification number (VIN)

8.2.3. Vehicle category (N_2, N_3)

8.2.4. Axle configuration

8.2.5. Maximum gross vehicle weight (t)

8.2.6. Vehicle group

8.2.7. Corrected actual mass of the vehicle (kg)

8.2.8. Cryptographic hash of the manufacturer's records file

8.2.9. Vehicle combination's gross combined weight in the verification test (kg)

8.3.   Main engine specifications

8.3.1. Engine model

8.3.2. Engine certification number

8.3.3. Engine rated power (kW)

8.3.4. Engine capacity (l)

8.3.5. Engine reference fuel type (diesel/LPG/CNG...)

8.3.6. Hash of the fuel map file/document

8.4. Main transmission specifications

8.4.1. Transmission model

8.4.2. Transmission certification number

8.4.3. Main option used for generation of loss maps (Option1/Option2/Option3/Standard values)

8.4.4. Transmission type

8.4.5. Number of gears

8.4.6. Transmission ratio final gear

8.4.7. Retarder type

8.4.8. Power take off (yes/no)

8.4.9. Hash of the efficiency map file/document

8.5. Main retarder specifications

8.5.1. Retarder model

8.5.2. Retarder certification number

8.5.3. Certification option used for generation of a loss map (standard values/measurement)

8.5.4. Hash of the retarder efficiency map file/document

8.6. Torque converter specification

8.6.1. Torque converter model

8.6.2. Torque converter certification number

8.6.3. Certification option used for generation of a loss map (standard values/measurement)

8.6.4. Hash of the efficiency map file/document

8.7. Angle drive specifications

8.7.1. Angle drive model

8.7.2. Axle certification number

8.7.3. Certification option used for generation of a loss map (standard values/measurement)

8.7.4. Angle drive ratio

8.7.5. Hash of the efficiency map file/document

8.8. Axle specifications

8.8.1. Axle model

8.8.2. Axle certification number

8.8.3. Certification option used for generation of a loss map (standard values/measurement)

8.8.4. Axle type (e.g. standard single driven axle)

8.8.5.   Axle ratio

8.8.6.   Hash of the efficiency map file/document

8.9.   Aerodynamics

8.9.1.   Model

8.9.2.   Certification option used for generation of CdxA (standard values /measurement)

8.9.3.   CdxA Certification number (if applicable)

8.9.4.   CdxA value

8.9.5.   Hash of the efficiency map file/document

8.10.   Main tyre specifications

8.10.1.   Tyre certification number on all axles

8.10.2.   Specific rolling resistance coefficient of all tyres on all axles

8.11.   Main auxiliary specifications

8.11.1.   Engine cooling fan technology

8.11.2.   Steering pump technology

8.11.3.   Electric system technology

8.11.4.   Pneumatic system technology

8.12.   Test conditions

8.12.1.   Actual mass of the vehicle (kg)

8.12.2.   Actual mass of the vehicle with payload (kg)

8.12.3.   Warm up time (minutes)

8.12.4.   Average velocity at warm up (km/h)

8.12.5.   Fuel consumption measurement duration (minutes)

8.12.6.   Distance based share urban driving (%)

8.12.7.   Distance based share rural driving (%)

8.12.8.   Distance based share motorway driving (%)

8.12.9.   Time share of idling at stand still (%)

8.12.10. Average ambient temperature (°C)

8.12.11. Road condition (dry, wet, snow, ice, others please specify)

8.12.12. Maximum seal level of the route (m)

8.12.13. Maximum duration of continuous idling at stand still (minutes)

8.13.   Results of the verification test

8.13.1.   Average fan power calculated for the verification test by the simulation tool (kW)

8.13.2.   Work over the verification test calculated by the simulation tool (kW)

8.13.3.   Work over the verification test measured (kW)

8.13.4.   NCV of the fuel used in the verification test (MJ/kg)

8.13.5.   Fuel consumption in the verification test measured (g/km)

8.13.6.   Fuel consumption in the verification test measured, corrected (g/kWh)

8.13.7.   Fuel consumption in the verification test simulated (g/km)

8.13.8.   Fuel consumption in the verification test simulated (g/kWh)

8.13.9.   Mission profile (long haul/long haul(EMS)/regional/regional(EMS)/urban/municipal/construction)

8.13.10. Verified CO_2 emissions of the vehicle (g/tkm)

8.13.11. Declared CO_2 emissions of the vehicle (g/tkm)

8.13.12. Ratio of fuel consumption measured and simulated in the verification testing procedure in (-)

8.13.13. Passed the verification test (yes/no)

8.14.   Software and user information

8.14.1.   Simulation tool version (X.X.X)

8.14.2.   Date and time of the simulation".

Annexes I, IV and IX to Directive 2007/46/EC are amended as follows:

(1)   Annex I is amended as follows:

(a) point 3.5.7 is replaced by the following:

"3.5.7. Manufacturer's declared values";

(b) the following points 3.5.9 and 3.5.9.1 are inserted:

"3.5.9 CO_2 emissions and fuel consumption certification (for heavy-duty vehicles, as specified in Article 6 of Commission Regulation (EU) 2017/2400)

3.5.9.1 Simulation tool license number:";

(2)   in Annex IV, Part I, explanatory note 16 is replaced by the following:

'([16]) For vehicles with a technically permissible maximum laden mass exceeding 7 500 kg';

(3)   Annex IX is amended as follows:

(a) in Part I, Models A1 and B, SIDE 2, VEHICLE CATEGORY N_2 (complete and completed vehicles), is amended as follows:

(i) point 49 is replaced by the following:

"49. CO_2 emissions/fuel consumption/electric energy consumption [m] [r]:";

(ii) the following points 49.1 to 49.6 are inserted:

'49.1 Cryptographic hash of the manufacturer's records file drawn up in accordance with the model set out in Part I of Annex IV to Regulation (EU) 2017/2400: ....

49.2 Zero emission heavy-duty vehicle as defined in Regulation (EU) 2017/2400: yes/no (1), (t)

49.3 Vocational vehicle as defined in Regulation (EU) 2017/2400: (yes/no) (1), (u)

49.4 Cryptographic hash of the customer information file drawn up in accordance with the model set out in Part II of Annex IV to Regulation (EU) 2017/2400:……………………(u)

49.5 Specific CO_2 emissions as indicated in point 2.3 of the customer information file drawn up in accordance with the model set out in Part II of Annex IV to Regulation (EU) 2017/2400:…………..gCO_2/tkm

49.6 Average payload value as indicated in point 2.4 of the customer information file drawn up in accordance with the model set out in Part II of Annex IV to Regulation (EU) 2017/2400:…………..t';

(b)   in Part I, Models A1 and B, SIDE 2, VEHICLE CATEGORY N_3 (complete and completed vehicles), is amended as follows:

(i) point 49 is deleted;

(ii) the following points 49.1 to 49.6 are inserted:

'49.1 Cryptographic hash of the manufacturer's records file drawn up in accordance with the model set out in Part I of Annex IV to Regulation (EU) 2017/2400: ....

49.2 Zero emission heavy-duty vehicle as defined in Regulation (EU) 2017/2400: yes/no (1), (t)

49.3 Vocational vehicle as defined in Regulation (EU) 2017/2400: (yes/no) (1), (u)

49.4 Cryptographic hash of the customer information file drawn up in accordance with the model set out in Part II of Annex IV to Regulation (EU) 2017/2400:……………………(u)

49.5 Specific CO_2 emissions as indicated in point 2.3 of the customer information file drawn up in accordance with the model set out in Part II of Annex IV to Regulation (EU) 2017/2400:…………..gCO_2/tkm

49.6 Average payload value as indicated in point 2.4 of the customer information file drawn up in accordance with the model set out in Part II of Annex IV to Regulation (EU) 2017/2400:…………..t';

(c)   in Part II, Model C1, SIDE 2, VEHICLE CATEGORY N_2 (incomplete vehicles), is amended as follows:

the following points 49.1 to 49.6 are inserted:

'49.1 Cryptographic hash of the manufacturer's records file drawn up in accordance with the model set out in Part I of Annex IV to Regulation (EU) 2017/2400: ....

49.2 Zero emission heavy-duty vehicle as defined in Regulation (EU) 2017/2400: yes/no (1), (t)

49.3 Vocational vehicle as defined in Regulation (EU) 2017/2400: (yes/no) (1), (u)

49.4 Cryptographic hash of the customer information file drawn up in accordance with the model set out in Part II of Annex IV to Regulation (EU) 2017/2400:……………………(u)

49.5 Specific CO_2 emissions as indicated in point 2.3 of the customer information file drawn up in accordance with the model set out in Part II of Annex IV to Regulation (EU) 2017/2400:…………..gCO_2/tkm

49.6 Average payload value as indicated in point 2.4 of the customer information file drawn up in accordance with the model set out in Part II of Annex IV to Regulation (EU) 2017/2400:…………..t';

(d)   in Part II, Model C1, SIDE 2 VEHICLE CATEGORY N_3 (incomplete vehicles), the following points 49.1 to 49.6 are inserted:

"49.1 Cryptographic hash of the manufacturer's records file drawn up in accordance with the model set out in Part I of Annex IV to Regulation (EU) 2017/2400:..

49.2 Zero emission heavy-duty vehicle as defined in Regulation (EU) 2017/2400: yes/no (1), (t)

49.3 Vocational vehicle as defined in Regulation (EU) 2017/2400: (yes/no) (1), (u)

49.4 Cryptographic hash of the customer information file drawn up in accordance with the model set out in Part II of Annex IV to Regulation (EU) 2017/2400:……………………(u)

49.5 Specific CO_2 emissions as indicated in point 2.3 of the customer information file drawn up in accordance with the model set out in Part II of Annex IV to Regulation (EU) 2017/2400:…………..gCO_2/tkm

49.6 Average payload value as indicated in point 2.4 of the customer information file drawn up in accordance with the model set out in Part II of Annex IV to Regulation (EU) 2017/2400:…………..t';

(e) the following explanatory notes relating to Annex IX are added:

"(t) Only applicable if the vehicle is approved in accordance with Regulation (EC) No 595/2009.

(u) Only applicable if the vehicle is approved in accordance with Regulation (EC) No 595/2009 and a customer information file has been drawn up in accordance with the model set out in Part II of Annex IV to Regulation (EU) 2017/2400.".