Commission Regulation (EU) 2017/2400 of 12 December 2017 implementing Regulation (EC) No 595/2009 of the European Parliament and of the Council as regards the determination of the CO2 emissions and fuel consumption of heavy-duty vehicles and amending Directive 2007/46/EC of the European Parliament and of the Council and Commission Regulation (EU) No 582/2011 (Text with EEA relevance)

[F1ANNEX 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

Textual Amendments

F1 Inserted by Commission Regulation (EU) 2019/318 of 19 February 2019 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 (Text with EEA relevance).

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:

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

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

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

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/m^3). 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/m^3]

$V_{fuel, i}$ = Total fuel volume consumed at sample i [m^3]
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[a]
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	≤ 2 s

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

b The accuracy shall be met for the integral fuel flow over 100 minutes.

	whichever is larger	
Fuel volume measurement system[b]	< 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

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

b 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.**]**

Changes to legislation:
There are outstanding changes not yet made to Commission Regulation (EU) 2017/2400. Any changes that have already been made to the legislation appear in the content and are referenced with annotations.
View outstanding changes

Changes and effects yet to be applied to the whole legislation item and associated provisions

- Signature words omitted by S.I. 2022/1273 reg. 82(18)
- Annex 5 Appendix 6 point 1.3 substituted by S.I. 2022/1273 reg. 83(4)(b)(i)
- Annex 5 Appendix 6 point 1.4.1 image substituted by S.I. 2022/1273 reg. 83(4)(b)(iii)(aa)
- Annex 5 Appendix 6 point 1.5.1 image substituted by S.I. 2022/1273 reg. 83(4)(b)(iv)(aa)
- Annex 5 Appendix 4 point 7.4 word substituted by S.I. 2022/1273 reg. 83(4)(a)
- Annex 5 Appendix 6 point 2.1 word substituted by S.I. 2022/1273 reg. 83(4)(b)(v)
- Annex 5 Appendix 6 point 1.4.1 words omitted by S.I. 2022/1273 reg. 83(4)(b)(iii)(bb)
- Annex 5 Appendix 6 point 1.5.1 words omitted by S.I. 2022/1273 reg. 83(4)(b)(iv)(bb)
- Annex 5 Appendix 6 point 1.4 words substituted by S.I. 2022/1273 reg. 83(4)(b)(ii)
- Annex 5 Appendix 6 point 2.1 table words substituted by S.I. 2022/1273 reg. 83(4)(b)(vi)
- Annex 10 Appendix 4 point 1.1 word substituted by S.I. 2022/1273 reg. 83(8)(d)(i)
- Annex 10 Appendix 1 words substituted by S.I. 2022/1273 reg. 83(8)(c)
- Annex 10 Appendix 4 point 1.1 table words substituted by S.I. 2022/1273 reg. 83(8)(d)(ii)
- Annex 7 Appendix 5 point 1.3 substituted by S.I. 2022/1273 reg. 83(6)(c)(i)
- Annex 7 Appendix 5 point 1.4.1 image substituted by S.I. 2022/1273 reg. 83(6)(c)(iii)(aa)
- Annex 7 Appendix 1s. 1 point 000.5 word substituted by S.I. 2022/1273 reg. 83(6)(b)(ii)
- Annex 7 Appendix 1 words inserted by S.I. 2022/1273 reg. 83(6)(b)(i)(aa)
- Annex 7 Appendix 1 words omitted by S.I. 2022/1273 reg. 83(6)(b)(i)(bb)
- Annex 7 Appendix 5 point 1.4.1 words omitted by S.I. 2022/1273 reg. 83(6)(c)(iii)(bb)
- Annex 7 Appendix 5 point 1.4 words substituted by S.I. 2022/1273 reg. 83(6)(c)(ii)
- Annex 7 Appendix 5 point 2.1 words substituted by S.I. 2022/1273 reg. 83(6)(c)(iv)
- Annex 7 Appendix 5 point 2.1 table words substituted by S.I. 2022/1273 reg. 83(6)(c)(v)
- Annex 8 Appendix 8 point 1.3 substituted by S.I. 2022/1273 reg. 83(7)(d)(i)
- Annex 8 Appendix 8 point 1.4.1 image substituted by S.I. 2022/1273 reg. 83(7)(d)(iii)(aa)
- Annex 8 Appendix 4 table 11 word omitted by S.I. 2022/1273 reg. 83(7)(c)(i)
- Annex 8 Appendix 4 table 13 word omitted by S.I. 2022/1273 reg. 83(7)(c)(i)
- Annex 8 Appendix 4 table 15 word omitted by S.I. 2022/1273 reg. 83(7)(c)(ii)(aa)
- Annex 8 Appendix 4 table 15 word omitted by S.I. 2022/1273 reg. 83(7)(c)(ii)(bb)
- Annex 8 Appendix 1s. 1 point 000.6 word substituted by S.I. 2022/1273 reg. 83(7)(b)(ii)
- Annex 8 Appendix 8 point 2.1 word substituted by S.I. 2022/1273 reg. 83(7)(d)(iv)
- Annex 8 Appendix 1 words inserted by S.I. 2022/1273 reg. 83(7)(b)(i)(aa)
- Annex 8 Appendix 1 words omitted by S.I. 2022/1273 reg. 83(7)(b)(i)(bb)
- Annex 8 Appendix 8 point 1.4.1 words omitted by S.I. 2022/1273 reg. 83(7)(d)(iii)(bb)
- Annex 8 Appendix 8 point 1.4 words substituted by S.I. 2022/1273 reg. 83(7)(d)(ii)
- Annex 8 Appendix 8 point 2.1 table words substituted by S.I. 2022/1273 reg. 83(7)(d)(v)

- Annex 2 Appendix 2s. 2 point 2 omitted by S.I. 2022/1273 reg. 83(2)(b)(ii)
- Annex 2 Appendix 2 words inserted by S.I. 2022/1273 reg. 83(2)(b)(i)
- Annex 6 Appendix 7 point 1.3 substituted by S.I. 2022/1273 reg. 83(5)(e)(i)
- Annex 6 Appendix 7 point 1.5 image substituted by S.I. 2022/1273 reg. 83(5)(e)(iii)(aa)
- Annex 6 Appendix 7 point 2.1 word substituted by S.I. 2022/1273 reg. 83(5)(e)(iv)
- Annex 6 Appendix 1 words omitted by S.I. 2022/1273 reg. 83(5)(c)
- Annex 6 Appendix 7 point 1.5 words omitted by S.I. 2022/1273 reg. 83(5)(e)(iii)(bb)
- Annex 6 Appendix 2 point 8 words substituted by S.I. 2022/1273 reg. 83(5)(d)
- Annex 6 Appendix 3 point 8 words substituted by S.I. 2022/1273 reg. 83(5)(d)
- Annex 6 Appendix 4 point 8 words substituted by S.I. 2022/1273 reg. 83(5)(d)
- Annex 6 Appendix 5 point 8 words substituted by S.I. 2022/1273 reg. 83(5)(d)
- Annex 6 Appendix 7 point 1.4 words substituted by S.I. 2022/1273 reg. 83(5)(e)(ii)
- Annex 6 Appendix 7 point 2.1 table words substituted by S.I. 2022/1273 reg. 83(5)(e)(v)
- Art. 3(5) omitted by S.I. 2022/1273 reg. 82(4)(a)
- Art. 3(16) words substituted by S.I. 2022/1273 reg. 82(4)(b)
- Art. 3(20) words substituted by S.I. 2022/1273 reg. 82(4)(c)
- Art. 10(1a) inserted by S.I. 2022/1273 reg. 82(8)(b)
- Annex 10a para. 3(f) words inserted by S.I. 2022/1273 reg. 83(9)(a)
- Annex 10a para. 3(f) table words substituted by S.I. 2022/1273 reg. 83(9)(b)(c)
- Art. 12(8) inserted by S.I. 2022/1273 reg. 82(10)