

VECTO Air Drag

3.2.0 – Release Candidate

for 2nd amendment of Reg. (EU) 2017/2400

Release Notes

2022-05-31

General

This version of VECTO Air Drag is the release candidate version related to certification of air drag in accordance with the 2nd amendment of Regulation (EU) 2017/2400.

The 2nd amendment of Regulation (EU) 2017/2400 comes into force on the 1st of July 2022.

Sequence of steps until official release:

- Release candidate testing during June
- An official XML can only be generated once the second amendment of Regulation (EU) 2017/2400 comes into force and thus is not possible with this release candidate version. Thus, the XMLs created with the current tool contain the following info for app version:
`<AppVersion>VECTOAirDrag_3.2.0 - RELEASE CANDIDATE VERSION, NOT FOR CERTIFICATION!</AppVersion>`
- The official release will be done on the 30st of June 2022. From 1st of July on, only this updated version shall be used for any official purposes!

The release notes give a documentation of all changes compared to the latest official version (V3.1.9) in [blue colour](#).

Overview new features compared to official version

- Additional vehicle groups medium lorries (53, 54)
 - Specific criteria for torque stability low speed test (tq_sum_float_delta_LS)
 - Specific parameters for cross wind correction (each for rigids and vans)
 - For medium “van” lorries (group 54) no height correction applies
- Additional vehicle groups heavy buses (31b2 to 40f)
 - Specific criteria for torque stability low speed test (tq_sum_float_delta_LS)
 - Specific parameters for cross wind correction
 - For heavy buses (all groups) no height correction applies
- Drift correction
 - Readin of torque drift (left, right) plus time stamp and related correction of test evaluation (assumption linear drift over test)
- Change of torque stability low speed test (tq_sum_float_delta_LS) for heavy lorries of groups 1 and 2
- New options for vehicle speed determination (wheel speed or electric motor speed, see Annex VIII point 3.4.3 options 2 and 3)

1) Updated content of vehicle data file (1/2)

Blue parts are new/changed elements compared to “BETA 1.0.0.0” as released for 2019/20 pilot phase

Input data	Unit	Remarks	
Vehicle group code	[-]	"1" – "17" for heavy lorry groups "HB" for heavy buses 31b1 to 40f (only those where air drag certification is allowed, see to the right) "MLvan" for Medium van lorries 54 "MLr" for Medium rigid lorries 53 "MB" for medium buses	31b2 32a 32b 32c 32d 32e 32f 33b2 34a 34b 34c 34d 34e 34f
Vehicle configuration with trailer	[-]	if the vehicle was measured without trailer (input “No”) or with trailer i.e. as a tractor semitrailer combination (input “Yes”)	35b2 36a 36b 36c
Vehicle test mass	[kg]	actual mass during measurements	36d 36e 36f
Technically permissible maximum laden mass (TPMLM)	[kg]	heavy lorries: technically permissible maximum laden mass of the rigid lorry or tractor (w/o trailer or semitrailer) all other vehicle types: no entry	37b2 38a 38b 38c 38d
Axle ratio	[-]	axle transmission ratio* ¹ , * ²	38e 38f
Gear ratio high speed	[-]	transmission ratio of gear engaged during high speed test* ¹ , * ⁴	39b2 40a 40b
Gear ratio low speed	[-]	transmission ratio of gear engaged during low speed test* ¹ , * ⁴	40c 40d 40e 40f

*1 specification of transmission ratios with at least 3 digits after decimal separator

*2 if either the wheel cardan speed signal or the average wheel speed signal is provided to the air drag pre-processing tool (see point 3.4.3; option 1 for vehicles with torque converters or option 2, see section 3.4.3) the input parameter on axle ratio shall be set to “1.000”.

*4 if the average wheel speed is provided to the air drag pre-processing tool (see point 3.4.3 option 2) the input parameters on gear ratios shall be set to “1.000”.

1) Updated content of vehicle data file (2/2)

Blue parts are new/changed elements

Input data	Unit	Remarks
Fixed transmission ratio in low speed test ^{*5}	[-]	“yes” / “no” (for vehicles which cannot drive with locked torque converter in the low speed test)
Vehicle maximum speed	[km/h]	maximum speed the vehicle can be practically operated at the test track ^{*3}
Torque meter drift left wheel	[Nm]	Average torque meter readings according to point 3.5.3.9.
Torque meter drift right wheel	[Nm]	
Time stamp zeroing of torque meters	[s] since day start (of first day)	
Time stamp drift check torque meters		

*3 input only required if value is lower than 88 km/h

*5 this input now replaces the „transmission type“ in previous versions

2) Updated content of measurement data file (1/1)

Blue parts are new/changed elements

Signal	Column identifier in input file	Unit	Measurement rate	Remarks
Engine speed, cardan speed, average wheel speed or electric motor speed	<n_eng>, <n_card>, <n_wheel_ave> or <n_EM>	[rpm]	≥ 20 Hz	See provisions in point 3.4.3;

For the new quantities the calculations dont change i.e.:

- it is used as <n_eng> for determination of calibrated vehicle speed, using gear and axle ratio (which are specified to be set to 1 for certain options)
- it is used as <n_eng> or <n_card> for the stability check n_eng1s / n_float_1s
- Only one signal out of <n_eng>, <n_card>, <n_wheel_ave> and <n_EM> shall be provided as input, otherwise VECTO Air Drag won't know what to actually use

3) Additional / updated parameters

Vehicle category	Group identifiers	yaw polar curve			reference height	critierion "tq_sum_float_delt a_LS" *1
		a1	a2	a3	[m]	[-]
Medium lorries	"53" (rigids)	-0.0015	0.0086	-0.00029	3.5	0.5
	"54" (vans)	0.0032	0.00532	-0.00028	not applicable (no height correction)	0.5
Heavy lorries	"1", "2"	no change	no change	no change	no change	0.5 (was 0.3)
	"3" and higher	no change	no change	no change	no change	no change
Heavy buses	"31b2" to "40f"	-0.000794	0.02109	-0.00109	not applicable (no height correction)	0.3

4) Formulas to consider for drift of torque meters in the evaluation algorithms

Symbol	Explanations
t	time
tq_l (t), tq_r (t)	Torque signal left/right
tq_l_c (t), tq_r_c (t)	Torque signal left/right corrected for drift influence
tqDriftLeft, tqDriftRight	Torque meter drift left wheel
tDriftZero	Time stamp zeroing of torque meters
tDriftCheck	Time stamp drift check torque meters

Correction algorithm:

$$tq_l_c(t) = tq_l(t) - tqDriftLeft * (t-tDriftZero)/(tDriftCheck-tDriftZero)$$

$$tq_r_c(t) = tq_r(t) - tqDriftRight * (t-tDriftZero)/(tDriftCheck-tDriftZero)$$

tq_l_c time series are also given in the 100Hz / 1Hz output files.

The tool does not start the calculation if:

- $Abs(tqDriftLeft) > 25$ (i.e. above drift limit as specified in Annex VIII)
- $Abs(tqDriftRight) > 25$ (i.e. above drift limit as specified in Annex VIII)
- $tDriftZero > \text{start LS1}$
- $tDriftCheck < \text{start LS2}$

BACKUP

2nd amendment: New options for speed inputs

3.4.3. Reference signal for calculation of rotational speed of the wheels at the driven axle

One out of three options shall be selected:

Option 1: Engine speed based

The CAN engine speed signal together with the transmission ratios (gears for low speed test and high speed test, axle ratio) shall be made available. For the CAN engine speed signal it shall be demonstrated that the signal provided to the air drag pre-processing tool is identical to the signal to be used for in-service testing as set out in Annex I of Regulation (EU) 582/2011.

For vehicles with torque converter which are not able to drive the low speed test with closed lockup clutch in option 1 additionally the cardan shaft speed signal and the axle ratio or the average wheel speed signal for the driven axle shall be provided to the air drag pre-processing tool. It shall be demonstrated that the engine speed calculated from this additional signal is within 1% range compared to the CAN engine speed. This shall be demonstrated for the average value over a measurement section driven at the lowest possible vehicle speed in the torque converter locked mode and at the applicable vehicle speed for the high speed test.

Option 2: Wheel speed based

The average of the CAN signals for the rotational speed of left and right wheel at the driven axle shall be made available. Alternatively external sensors may be used. Any method shall fulfill the requirements set out in Table 2 of Annex Xa.

Following option 2 the input parameters for gear ratios and axle ratio shall be set to 1, independent of the powertrain configuration.

Option 3: Electric motor speed based

In case of PEV and HEV the CAN speed electric motor speed together with the transmission ratios (gears for low speed test and high speed test and if applicable axle ratio) shall be made available. It shall be demonstrated that the powertrain configuration is such that the wheel speed of the driven axle in the low and high speed test is uniquely defined by these specifications.

2nd amendment: new provisions for vehicle torque

Low speed test:

$$(T_{lms,avg} - T_{grd}) * 0.7(1 - tol) \leq (T_{lm,avg} - T_{grd}) \\ \leq (T_{lms,avg} - T_{grd}) * 1.3(1 + tol)$$

$$T_{grd} = F_{grd,avg} * r_{dyn,avg}$$

where:

$T_{lms,avg}$	=	average of T_{sum} per measurement section
T_{grd}	=	average torque from gradient force
$F_{grd,avg}$	=	average gradient force over measurement section
$r_{dyn,avg}$	=	average effective rolling radius over measurement section (formula see item ix.) [m]
T_{sum}	=	$T_L + T_R$; sum of corrected torque values left and right wheel [Nm]
$T_{lm,avg}$	=	central moving average of T_{sum} with X_{ms} seconds time base
X_{ms}	=	time needed to drive 25 m distance at actual vehicle speed [s]
<u>tol</u>	=	<u>relative torque tolerance: 0.5 for medium lorries, and heavy lorries in groups 1s, 1 and 2, 0.3 for heavy lorries in groups 3 and higher other groups and heavy buses</u>