

VECTO-Air Drag V3.1.3

Release Notes

2017-11-07

VECTO Air Drag Release updates

1. Licensing removed

Running VECTO Air Drag tool does not require a valid *license.dat* file

2. Vehicle speed check

Upper limit for a valid HS measurement section now always set to 95 km/h (parameter *v_veh_ave_max_HS*).

Previous versions checked if vehicle speed was < max. vehicle speed from vehicle file or 88 km/h if max. vehicle speed was not provided in vehicle file.

3. Direct start

Now the VECTO input file can be created if the direct start of VECTO AirDrag is used

VECTO-Air Drag V3.1.0

Release Notes

2017-07-14

VECTO Air Drag Release updates

1. Bugfix

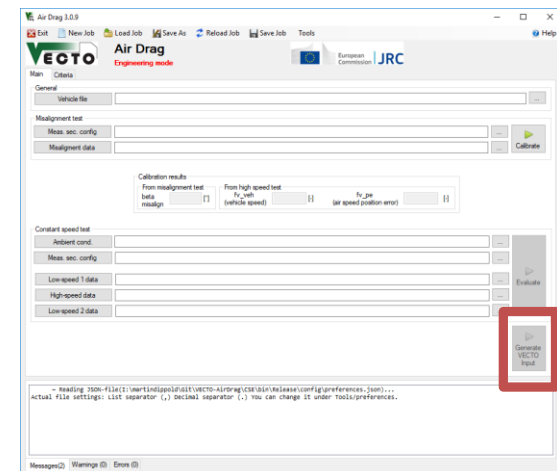
- a) If the first/last data point of the input data lies inside of a MS the program now sets the incomplete data for this MS to invalid automatically.

2. Export of XML input file for VECTO

- a) A button for the automatic generation of the “.xml” input file for VECTO is added. The VECTO file only can be generated if:
 - i. The calculation was done in the declaration mode
 - ii. The evaluation ended successfully (valid CdxA value according technical annex)

For XML export several information have to be provided by user input (see next slide).

The generated XML file also contains the hash value that is produced by the hashing method from VECTO



VECTO Air Drag Release updates

2. Export of XML input file for VECTO (continued)

The following information has to be provided by user input:

- Manufacturer name
- Model name (name of air drag family)
- Certification number
- **delta** CdxA value [m²] applied to the $C_d \cdot A_{cr} (0)$ value as calculated by VECTO Air Drag from “transfer rules” to other vehicle groups according to Table 16 of Appendix 5 in Annex VIII (e.g. **-0.2 m²** if a result measured at a group 4 vehicle shall be applied to a family in vehicle group 3).
- **delta** CdxA value [m²] applied to the $C_d \cdot A_{cr} (0)$ value as calculated by VECTO Air Drag from declaration of worst case parent [m²] according to point 3.11 of the main body of Annex III. **This input is checked to be in the range of 0 to 0.2 m².**

VECTO-Air Drag V3.0.8

Release Notes

2017-03-22

VECTO Air Drag Release updates

1. Updates program

- a) Change of needed digits after the decimal separator (DGPS: DD.DD[7]/MM.MM[5]; GPS: DD.DD[5]/MM.MM[3])
- b) Modifications regarding misalignment calibration test:
 - i. Now also uneven numbers of datasets per heading are evaluated
 - ii. Additional validity checks for vehicle speed range, vehicle speed stability (parameter: "v_veh_1s_delta_CAL") and difference of vehicle speed between the two headings implemented (Parameter: "v_veh_ave_delta_CAL") implemented (according to update of technical annex)
- c) Input-field for ambient conditions file shifted in GUI from "General" group box to "Constant speed test" group box

2. Updates file formats

- a) Update of criteria file (new criteria according to 1. b) ii.)
- b) Update of job-file (new criteria according to 1. b) ii.)

IF SCRIPTS ARE USED TO GENERATE VECTO AIR DRAG JOB-FILES PLEASE ADAPT

VECTO Air Drag Release updates

3. Bug fixes

- a) Detection algorithm for measurement sections updated (for some *.csms file configurations the measurement sections were not identified correctly)
- b) Update of validity check algorithms (in some cases “invalid” sections in the iterative check process have been set to “valid”)
- c) Correction of maximum allowed vehicle height for class 1 and class 2 (incorrect data in previous versions)

4. Update of DemoData

VECTO-Air Drag V3.0.0

Release Notes

2016-11-16

VECTO Air Drag Release updates

1. Updates program

- a) Update of needed signals in calibration run (t_ground is now not required for the calibration run)

2. Bug fixes

- a) Correction of rolling resistance correction factor (from 1.143 back to 1)
- b) Correction of digit check after the separator for coordinates (now matching with technical annex)

3. Update versioning and licenses

- a) New version number (3.0.0)
- b) A license valid until 16th of March is distributed with the code. Please apply for a new longer valid license at vecto@jrc.ec.europa.eu. The Commission wants to keep track of the use of VECTO Air Drag.

VECTO-Air Drag V2.0.7-beta7

Release Notes

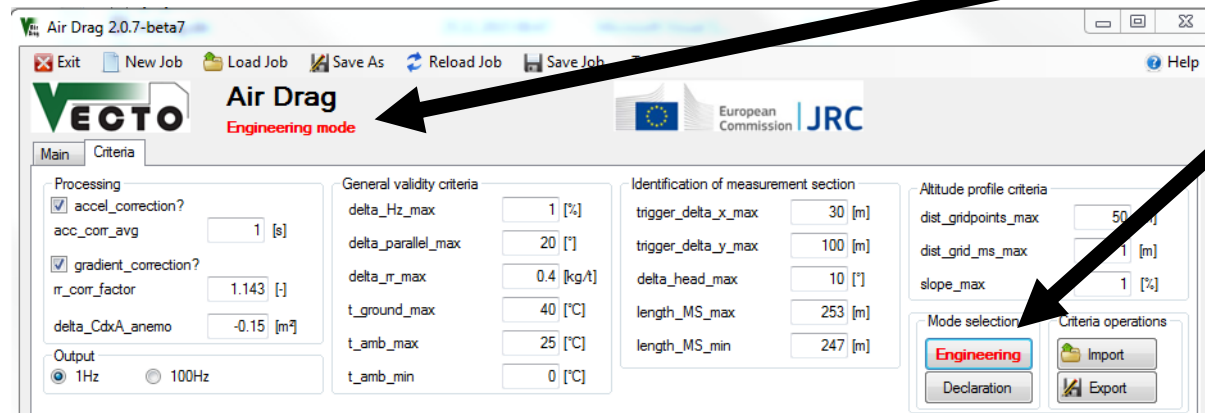
2016-10-20

VECTO Air Drag Release updates

1. Updates program

a) Include of “Declaration” and “Engineering” Mode

- “Declaration” Mode:
 - It is not possible to change the criteria values (They will be set to default values specified in the technical annex)
 - Result file only written if calculation ended without errors.
- “Engineering” Mode:
 - Criteria values can be changed
 - Result files always written
- Switch between “Declaration” and “Engineering” Mode over click on **written text** or **buttons on criteria tab**.



VECTO Air Drag Release updates

- b) Gradient correction implemented (by default deactivated)
 - New altitude profile input: Lat/Long/Altitude
 - Requirements:
 - Distance between grid points of altitude profile $\leq 50\text{m}$ (dist_gridpoints_max)
 - Altitude grid point before/after MS start/end must be available
 - Altitude grid point does not differ from MS center line by more than $< 1\text{m}$ (dist_grid_ms_max)
 - Gradient correction can be activated/deactivated also in Declaration mode
- c) Include of new variables for validity criteria for each MS
 - t_amb: Ambient temperature (measured at the vehicle) during the tests
 - t_ground: Ground temperature
 - Length_MS_max/min: Allowed range of the length of the MS (checked based on *.csms)
- d) Displacement of Genshape file into code
 - Add reference vehicle height (h_ref) per vehicle class (except for buses)
 - Add minimum/maximum vehicle height (h_min / h_max) (except for buses)
 - Control of min/max height with vehicle height only in Declaration mode

VECTO Air Drag Release updates

e) Change of vehicle file data:

- Definition of vehicle configuration changed: Field “Configuration with trailer”: (no/yes) replaces “rigid” or “tractor”
- Include vVehMax value: vehicle maximum design speed. Set on default value (88 km/h) if not given in vehicle file
- Include GVMMMax value: maximum gross vehicle mass (needed for allocation of reference height for class 9 vehicles)
- Deletion of vehWidth and wheelsInertia (not used in calculation)

f) Change of calculation of F_{acc} ($F_{acc} = 1.03 \cdot m \cdot a$)

VECTO Air Drag Release updates

f) Include check for vehicle height and class code. Only the following are allowed:

Vehicle class	Axle config.	Chassis configuration	Maximum GVM [kg]	Configuration with trailer*		reference vehicle height [m]	minimum vehicle height [m]	maximum vehicle height [m]
				no (0)	yes (1)			
1	4x2	Rigid or Tractor	7500 - 10000	X	-	3.60	3.40	3.60
2		Rigid or Tractor	>10000 - 12000	X	-	3.75	3.50	3.75
3		Rigid or Tractor	>12000 - 16000	X	-	3.90	3.70	3.90
4		Rigid	>16000	X	!	4.00	3.85	4.00
5		Tractor	>16000	-	X	4.00	3.90	4.00
9	6x2/2-4	Rigid	all weights	X	!	= class 1 to 4 according GVM		
10		Tractor	all weights	-	X	4.00	3.90	4.00
21	-	Class I (Citybus)	all weights	X	-	no correction		
22		Class II (Interurban bus)	all weights	X	-			
23		Class III (Coach)	all weights	X	-			

! Only in Engineering mode supported

* for selection of generic curve for cross wind influence

h) Update standard criteria values to new specification (see technical annex)

VECTO Air Drag Release updates

- i) Change of calculation of calibration factor for vehicle speed f_{v_veh} with DGPS (option 2 no longer calculated)
 - $f_{v_veh} = (s/\Delta t)/v_{veh_CAN}$ (average over all used MS)
 - Δt determined over trigger or GPS signal; s from MS length definition in .csms file
- j) Change of handling from uneven numbers of datasets per direction/heading
 - HS test: uneven numbers are now allowed
 - LS test: the first measurement(s) will be now excluded instead of the last one(s).
- k) Check of digits after decimal separator for all coordinates, transmission ratios (gear + axle) and altitudes
 - In “Engineering” mode → warning if not fulfilled
 - In “Declaration” mode → Error and abort of the calculation
- l) Calculation of additional Result values
 - ΔC_{dxA_height} : correction of C_{dxA} to reference vehicle height (**not** for coaches/buses)
 - $v_{avg_LS/HS}$: average vehicle speed from used datasets low/high speed tests
 - t_{amb_LS1} : average ambient temperature during first low speed test
- m) New design of criteria tab

VECTO Air Drag Release updates

- n) Change of calculation of final $C_{dxA}(\beta)$ and beta values (averaging over all sections/directions)
 - 1. Calculation of weighted average per heading with weighting factor = number of used datasets per MS
 - 2. Calculation of average over both headings
- o) Expansion of the job-File due to additional results
- p) Update DEMOData
- q) Update of Excel DemoData file
- r) Deletion of unused variables (ω_{wh} ; ω_{wh_acc} ; $\omega_{p_wh_acc}$; t_{tire} ; p_{tire} ; ...)
- s) Deletion of [ss.ss] coordinate input

VECTO-Air Drag V2.0.6-beta6

Release Notes

2016-01-21

VECTO Air Drag Release updates

1. Bug fixes

1. Correction of the heading calculation in the *.csms file for controlling of the right heading (**No influence on old results but makes the calculation in some cases impossible**)
2. All functions of the developed day change features deleted (**No influence on old results but makes in some cases an calculation break-off**)

2. Update of the Excel-Tool

1. Correction of the calculation of the control heading

VECTO-Air Drag V2.0.5-beta6

Release Notes

2015-11-25

VECTO Air Drag Release updates

1. Renaming of VECTO CSE into VECTO Air Drag
Version numbering not changed, no further consequences
2. Bug fix
Former versions did not calculate correctly the quantities “distance”, “a_veh_avg” and “omega_p_wh_acc” if input data frequency was not exactly 100Hz.
3. Update of the ending message
Message “VALID MEASUREMENT” only given if all criteria as specified in the criteria tab are fulfilled.
Remark: “Declaration mode” where only results are provided if measurement is valid and where criteria can not be changed by user to be provided later.
4. Important information how to handle day changes (measurements over midnight) in the data evaluation:
Time in [s since daystart] shall be continuously up-counted (from 86400.00 to 86400.01 at 00:00:00 a.m.) both in *.csdat and *.amb files
So the time unit shall be considered: [s since daystart (day1)]
Handling of input data where time changes from 86400.00 to 0.01 is not possible with reasonable efforts (only if additionally a date column would be added to both *.csdat and *.amb files, to be decided for later releases)

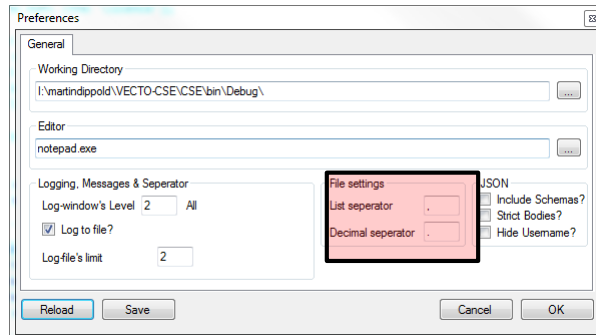
VECTO-CSE V2.0.4-beta6

Release Notes

2015-10-05

CSE Release updates

1. Free definition for list and decimal separator's in the used CSV-Files
 - The definition for **all** CSV-Files can be made under Tools/preferences. Exception are the Demo Files, these will be identified by the system and the old settings will be used only for this calculation.



CSE Release updates

2. User selection of the coordinate unit (Measurement section file *.csms)

- The used coordinate unit will be detected by the **name addition**. These additions are the following:

Coordinate	unit	Additional specification	Example
Decimal minutes	[mm.mm]	Standard choice. No addition needed	lat start
Decimal grad	[dd.dd]	Additional "(D)" needed in the header name	lat start (D)
Decimal seconds	[ss.ss]	Additional "(S)" needed in the header name	lat start (S)

- Because of the needed header names in the *.csms files the **header line must be UNcommented** while the units must commented (Error will be displayed if wrong).

Example:

trigger used (1=yes; 0=no)

0								optional: path and/or filename altitude file
meas. section ID	direction ID	length	heading	lat start	long start	lat end	long end	
# [id]	[id]	[m]	[°]	[mm.mm]	[mm.mm]	[mm.mm]	[mm.mm]	[-]
1	1	250	236	..P1..	..P1..	..P2..	..P2..	TrackDemo_1_1.csalt
2	1	250	236	..P2..	..P2..	..P3..	..P3..	TrackDemo_2_1.csalt
3	1	250	56	..P4..	..P4..	..P5..	..P5..	TrackDemo_3_1.csalt
4	1	250	56	..P5..	..P5..	..P6..	..P6..	TrackDemo_4_1.csalt
open nr. of rows ...								

CSE Release updates

3. User selection of the coordinate unit ([Data file *.csdat](#))

- The used coordinate unit will be detected by the **column identifier**. These are:

Signal	Unit	Column identifier
(D)GPS latitude	[mm.mm]	<lat>
	[dd.dd]	<lat_D>
	[ss.ss]	<lat_S>
(D)GPS longitude	[mm.mm]	<long>
	[dd.dd]	< long_D>
	[ss.ss]	< long_S>

4. Update of the Excel-Tool

- Adaption of the individual separator use
- Adaption of the new coordinate unit use
- Control of the specified heading in the *.csms files

VECTO-CSE V2.0.3-beta6

Release Notes

2015-07-23

CSE Release updates

1. Deletion of unused variables
 - <FC> from standard input data (can be added as additional signal)
 - T_amb_tamac from criteria file and GUI (not needed)
2. Added new variables
 - <t_ground> to standard input data as optional parameter
 - T_ground_max = 40°C as criteria parameter
 - At the moment the ground temperature is an optional parameter. If a signal is given CSE checks if the maximum ground temperature is exceeded.
3. Change of the standard criteria variable t_amb_max to 25°C (old 35°C)
4. Bugfix in the calculation of data without additional signals

VECTO-CSE V2.0.2-beta6

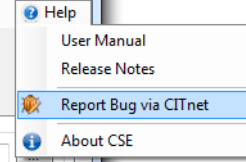
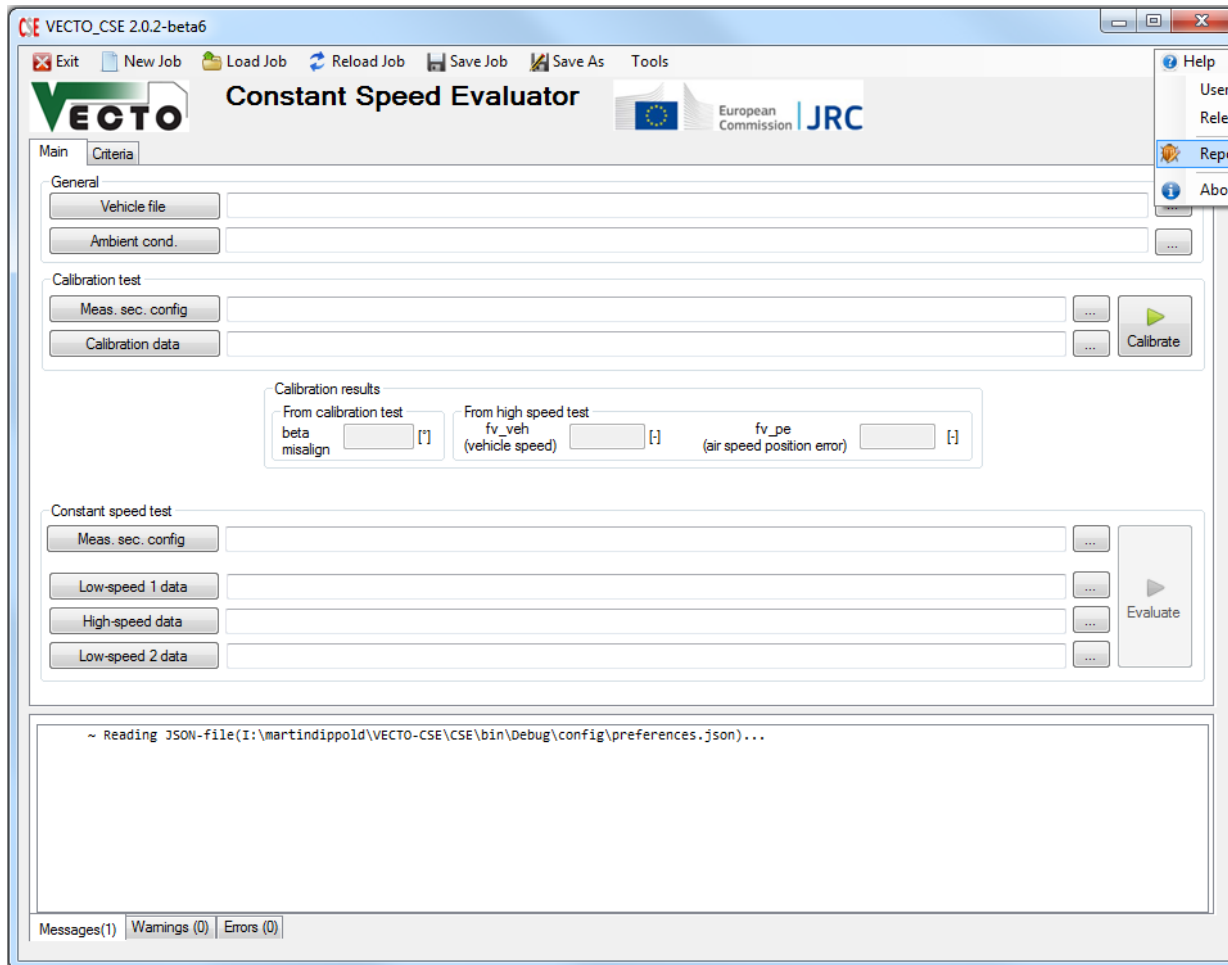
Release Notes

2015-07-20

CSE Release updates

1. Bug report is suggested to be performed via CITnet. Instructions for this process are given in the “Help” menu point (details see next slide)
2. Rho_air_ref deleted from GUI and source code (no longer needed)
3. According to the outcome of the IPW study the input signal on tire temperature („<t_tire>“ in the *.csdat file) is not required anymore, but can be processed in CSE as an optional signal (like p_tire).
 - If the t_tire signal is detected the following values are calculated for each MS/DS and reported in the *_CSE.csv file
 - t_tire_ave_LS_max
 - t_tire_ave_LS_min
 - t_tire_ave_HS_max
 - t_tire_ave_HS_min
 - The validity criteria valid_t_tire value is deleted
4. For the pilot phase the measurement of the “ground temperature” is recommended. This quantity shall be added to the *.csdat file as an additional signal „t_ground “. At the moment *.csdat applies no specific checks to this quantity.

Report Bug via CITnet



VECTO-CSE V2.0.2-beta5

Release Notes

2015-06-24

Overview updates compared to versions 2.0.1 (1/2)

ISSUE	Status	Comment
Update of calibration of vehicle speed and anemometer speed (high speed test instead of "calibration test")	Done	
Update of calculation of the CdxA value from measured drag forces	Done	some 1-2% different CdxA values calculated for test cases
Allow also non-continuous input data in *.csdat files	Done	
Update of generic data for cross wind dependency according to ACEA White book April 2015 (for tractor and semitrailer, new gen.shp file)	Done	
Update of criteria for stability of torque and vehicle speed according to ACEA White book April 2015	Done	
Update of definition of beta-signal in input data: old: 0° = air flow from front; new: 180° = air flow from front Output data: unchanged (0° = air flow from front)	Done	
Option in VECTO-CSE to read in cardan speed instead of engine speed and gear ratios for HS and LS Vehicle parameter "gear box type": MT_AMT --> n_eng is used; AT --> if n_eng is not specified n_card is used	Done	
Anemometer instrument calibration removed from CSE calculation quantities from csdat file read in to "_ic" values ("_ar" quantities deleted) f_aie etc. removed from GUI and from job-file	Done	
Default: Acceleration correction = on; averaging period = 1s	Done	Worse correlation of CdxA with beta in test cases
Introduction of stability / validity criteria for recorded engine speed (as a plausibility check for engine speed)	Done	Method to be discussed *

* See separate slides

Overview updates compared to versions 2.0.1 (2/2)

ISSUE	Status	Comment
Update of gradient correction: Handling of time steps where coordinates are constant over a certain time period (GPS accuracy issue) --> gradient set to 0 to avoid division by zero	Done	Not relevant for declaration
User-friendliness: set criteria to "standard" when CSE opens	Done	
User-friendliness: store information when switching between tabs	Done	
User-friendliness: non sensitivity to system regional settings (list separator etc.) (implemented via MS Excel tool)	Done	
User-friendliness: Add output for pass/fail criteria also for calibration run in the output file (MS_CAL) and in GUI	Done	
Direct start option implemented (VECTO-CSE now can be started from external scripts avoiding GUI operation)	Done	
Update of gradient correction: 2) Definition of altitude profile: suggestion Daimler: via Latitude and Longitude	open	Not relevant for declaration
Check / update of averaging of the beta angle within a dataset	waiting for ACEA decision	
Update of units for input of GPS data	waiting for ACEA decision	
Update of pass fail criteria based on tire temperature and tire pressure	waiting for IPW results	

Validity check for recorded engine speed

Criteria derived from stability criteria for vehicle speed

High speed test

Speed variation threshold [km/h]:

$$(v_{hms,avg} - 0.3) \leq v_{hm,avg} \leq (v_{hms,avg} + 0.3)$$

where:

$$\begin{aligned} v_{hms,avg} &= \text{average of vehicle speed per measurement section [km/h]} \\ v_{hm,avg} &= \text{1 s moving average of vehicle speed [km/h]} \end{aligned}$$

1) Calculation of $r_{dyn,ref,HS}$ for all high speed measurement sections:

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

2) Calculation of average $r_{dyn,ref,HS}$ from all valid high speed measurement sections

3) Check if 1s moving average of engine speed is within limits derived from vehicle speed criteria + tolerance (e.g. 1%)

$$\frac{30 \cdot i_{gear} \cdot i_{axle} \cdot \frac{(v_{hms,avg} - 0.3)}{3.6}}{r_{dyn,ref,HS} \cdot \pi} \cdot (1 - 2\%) \leq n_{eng,1s} \leq \frac{30 \cdot i_{gear} \cdot i_{axle} \cdot \frac{(v_{hms,avg} + 0.3)}{3.6}}{r_{dyn,ref,HS} \cdot \pi} \cdot (1 + 2\%)$$

New criteria: „delta_n_ec_HS“

Validity check for recorded engine speed

Criteria derived from stability criteria for vehicle speed

Low speed test

Speed variation threshold [km/h]:

$$(v_{lms,avg} - 0.5) \leq v_{lm,avg} \leq (v_{lms,avg} + 0.5)$$

where:

$v_{lms,avg}$ = average of vehicle speed per measurement section [km/h]

$v_{lm,avg}$ = moving average of vehicle speed over a time needed to drive 25m [km/h]

1) Calculation of $r_{dyn,ref,LS}$ for all low speed measurement sections:

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

2) Calculation of average $r_{dyn,ref,LS}$ from all valid low speed measurement sections

3) Check if „floating“ moving average of engine speed is within limits derived from vehicle speed criteria + tolerance (e.g. 1%)

$$\frac{30 \cdot i_{gear} \cdot i_{axle} \cdot \frac{(v_{lms,avg} - 0.5)}{3.6}}{r_{dyn,ref,LS} \cdot \pi} \cdot (1 - 2\%) \leq n_{eng,float} \leq \frac{30 \cdot i_{gear} \cdot i_{axle} \cdot \frac{(v_{lms,avg} + 0.5)}{3.6}}{r_{dyn,ref,LS} \cdot \pi} \cdot (1 + 2\%)$$

New criteria: „delta_n_ec_LS“

How to re-evaluate a data set from VECTO-CSE V2.0.1

1. Convert beta angle (column <beta> in *.csdat-files) to 180° = air flow from front
2. Amend vehicle file by gearbox_type „MT_AMT“ (see snapshot below)
3. Load all files into new VECTO-CSE Version and generate new job-file
(Remark: Old criteria files no longer provided due to additional parameters)

```
{
  "Header": {
    "Title": "vecto-cse VEHICLE",
    "FileVersion": "1.0.0",
    "AppVersion": "2.0.1-pre1",
    "ModifiedDate": "2014/05/28 00:33:50 +02:00",
    "Strict": true,
    "BodySchema": null,
  },
  "Body": {
    "classCode": 4,
    "configuration": "rigid",
    "vehWidth": 2.45,
    "vehHeight": 3.5,
    "anemometerHeight": 4.55,
    "testMass": 25000.0,
    "wheelsInertia": 90.0,
    "gearRatio_low": 2.5,
    "gearRatio_high": 1,
    "axleRatio": 3.6,
    "gearBox_type": "MT_AMT",
  }
}
```

Updated output in VECTO-CSE main result file (*CSE.csv)

Update of output results provided per combination of measurement section and driving directions

quantity	unit	description
SecID	[-]	measurement section ID as specified in the *.csms-file
DirID	[-]	driving direction ID as specified in the *.csms-file
F0_singleMS	[N]	result for F0 from linear regression
F0_singleMS_LS1	[N]	result for F0 from linear regression (low speed data only from first test)
F0_singleMS_LS2	[N]	result for F0 from linear regression (low speed data only from second test)
CdxA(β)	[m ²]	$CdxA(\beta) = 2 * (F_{res,ref} - F_0) / (v_{air}^2 * \rho_{air})$
CdxA0	[m ²]	CdxA converted to zero cross-wind
delta_CdxA	[m ²]	cross-wind correction
beta_abs_HS	[°]	average absolute beta from high speed dataset (0° refers to air flow from front!)
RRC_singleMS	[kg/t]	rolling resistance coefficient
RRC_singleMS_LS1	[kg/t]	rolling resistance coefficient (low speed data only from first test)
RRC_singleMS_LS2	[kg/t]	rolling resistance coefficient (low speed data only from second test)
Valid_RRC	[-]	Validity criteria for maximum difference of RRC from the two low speed runs passed (=1) or failed (=0)
t_tire_ave_LS_min	[°]	minimum tire temperature during low speed tests
t_tire_ave_LS_max	[°]	maximum tire temperature during low speed tests
t_tire_ave_HS_min	[°]	minimum tire temperature during high speed tests
t_tire_ave_HS_max	[°]	maximum tire temperature during high speed tests
F2_singleMS	[N/(m ² /s ²)]	result for F2 from linear regression
F2_singleMS_LS1	[N/(m ² /s ²)]	result for F2 from linear regression (low speed data only from first test)
F2_singleMS_LS2	[N/(m ² /s ²)]	result for F2 from linear regression (low speed data only from second test)

Overall output results (at the top of the *CSE.csv file) unchanged

Main issues to be analysed in beta testing

- 1. Change of CdxA result due to**
 - **Calibration of vehicle speed and air speed using the high speed test**
 - **Update of CdxA calculation**
- 2. Influence of the acceleration correction**
- 3. Is the validity check for engine speed passed**

Preview MS Excel preprocessing tool

MS Excel pre-processing tool

- **Handling of input data from different sources**
 - Vehicle specifications
 - Definition of measurement sections
 - Recorded data during calibration test and LS/HS tests
- **Performs consistency checks between files (completeness of data, coordinates vs. lengths of measurement sections etc.)**
- **Produces VECTO-CSE input files (independent from regional settings)**
- **Generates standard plots for basic checks**
- **User manual will be distributed beginning of July**
- **Use in later declaration not mandatory**

MS Excel pre-processing tool

Standard signal	Column identifier	Unit	Required	Calibration run	Low speed run 1	High speed run	Low speed run 2
time	<t>	[s] since day start	yes	available	available	available	available
(D)GPS latitude	<lat>	[mm.mm]	yes	available	available	available	available
(D)GPS longitude	<long>	[mm.mm]	yes	available	available	available	available
(D)GPS heading	<hdg>	[°]	yes	available	available	available	available
(D)GPS velocity	<v_veh_GPS>	[km/h]	yes	available	available	available	available
vehicle velocity	<v_veh_CAN>	[km/h]	yes	available	available	available	available
air speed	<v_air>	[m/s]	yes	available	available	available	available
inflow angle (beta)	<beta>	[°]	yes	available	available	available	available
engine speed	<n_eng>	[rpm]	yes	available	available	available	available
cardan speed	<n_card>	[rpm]	no				
torque meter (left wheel)	<tq_l>	[Nm]	yes	available	available	available	available
torque meter (right wheel)	<tq_r>	[Nm]	yes	available	available	available	available
ambient temperature on vehicle	<t_amb_veh>	[°C]	yes	available	available	available	available
trigger signal	<trigger>	[-]	no				
tyre temperature	<t_tire>	[°C]	yes	available	available	available	available
tyre pressure	<p_tire>	[bar]	no				
fuel mass flow	<fc>	[kg/h]	no				
validity	<valid>	[-]	no		available	available	available
Additional signals	Column identifier	Unit	Needed	Calibration run	Low speed run 1	High speed run	Low speed run 2
1 Satelites		[#]	no	available	available	available	available
2	<n_card1>	[rpm]	no	available	available	available	available

Check Data

Save Data

MS Excel pre-processing tool

