

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

VECTO Air Drag Release updates

2. 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)

3. 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

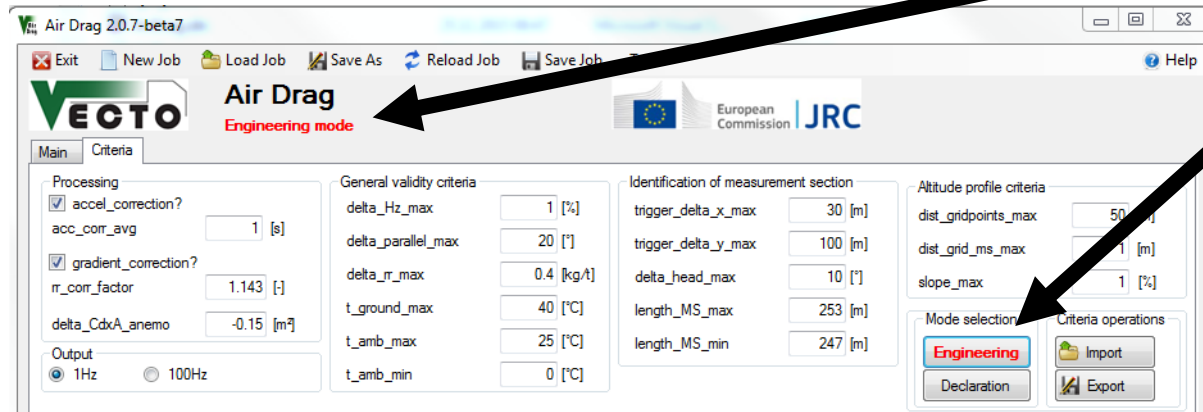
2016-10-20

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)

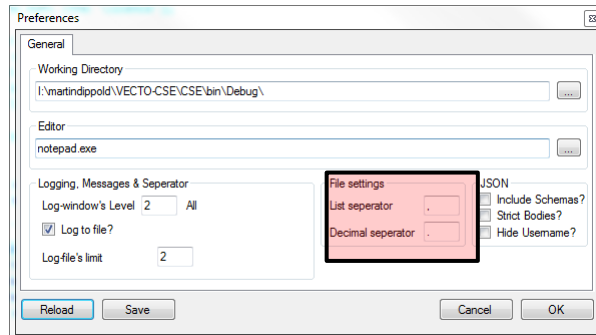
VECTO-CSE V2.0.4-beta6

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

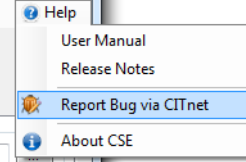
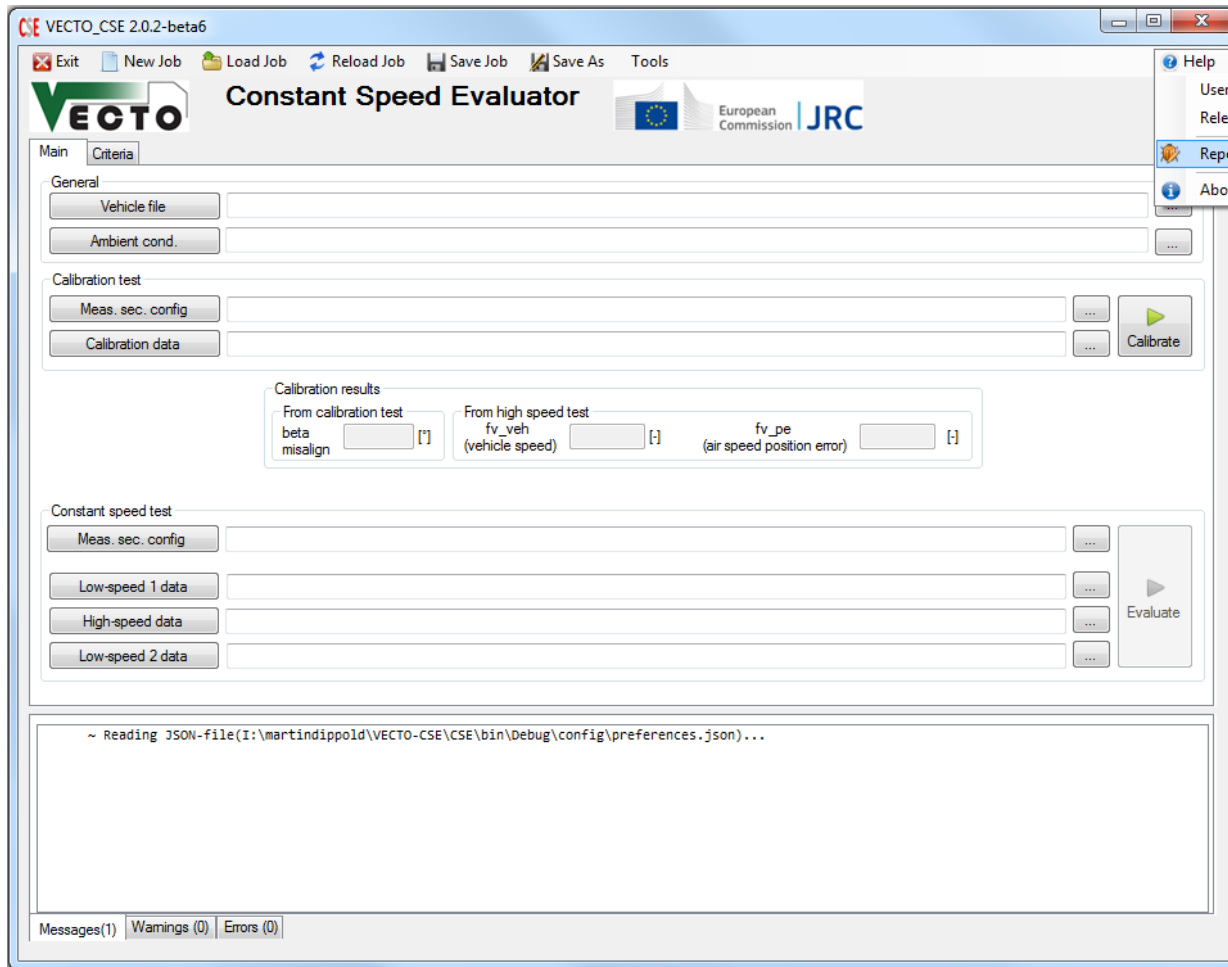
Release Notes

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:

| | | |
|---------------|---|---------------------------------------------------------|
| $v_{hms,avg}$ | = | average of vehicle speed per measurement section [km/h] |
| $v_{hm,avg}$ | = | 1 s moving average of vehicle speed [km/h] |

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) | [m2] | $CdxA(\beta) = 2 * (F_{res,ref} - F_0) / (v_{air}^2 * \rho_{air})$ |
| CdxA0 | [m2] | CdxA converted to zero cross-wind |
| delta_CdxA | [m2] | 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/(m2/s2)] | result for F2 from linear regression |
| F2_singleMS_LS1 | [N/(m2/s2)] | result for F2 from linear regression (low speed data only from first test) |
| F2_singleMS_LS2 | [N/(m2/s2)] | 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

