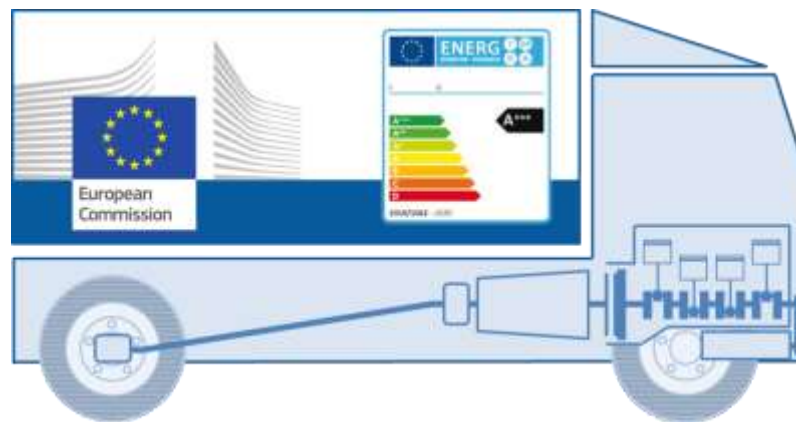


VECTO Engine

Short documentation and user manual

App Version 1.4

10.08.2017



VECTO Engine – GUI

The screenshot shows the VECTO-Engine 1.3 GUI with the following sections:

- Input:**
 - Component data: Manufacturer (TUG), Model (Best engine ever), Certification Number (123456789).
 - Idle speed of CO2-parent engine: 500 [1/min], Engine idle speed: 600 [1/min], Engine displacement: 12000 [ccm], Engine rated power: 130 [kW], Engine rated speed: 2200 [1/min].
 - Type of test fuel: Diesel / CI, HCV of test fuel: 42.500 [MJ/kg].
- Data files:**
 - Fuel consumption map of CO2-parent engine: J:\TE-Em\Projekte\I_2013_08_HDV_CO2_LOT_4_SR7\VECTO-Engine\Releases\VECTO-Engine 1.3\Demo input data\Demo_Map_...
 - Full-load curve of CO2-parent engine: J:\TE-Em\Projekte\I_2013_08_HDV_CO2_LOT_4_SR7\VECTO-Engine\Releases\VECTO-Engine 1.3\Demo input data\Demo_FullLo...
 - Full load curve: J:\TE-Em\Projekte\I_2013_08_HDV_CO2_LOT_4_SR7\VECTO-Engine\Releases\VECTO-Engine 1.3\Demo input data\Demo_FullLo...
 - Motoring curve curve of CO2-parent engine: J:\TE-Em\Projekte\I_2013_08_HDV_CO2_LOT_4_SR7\VECTO-Engine\Releases\VECTO-Engine 1.3\Demo input data\Demo_Motor...
- Specific fuel consumption measured:**
 - WHTC coldstart total: 200.00 [g/kWh], WHTC coldstart total: 200.00 [g/kWh], WHTC coldstart total: 200.00 [g/kWh], WHTC coldstart total: 200.00 [g/kWh].
 - WHTC Urban: 200.00 [g/kWh], WHTC Rural: 200.00 [g/kWh], WHTC Motorway: 200.00 [g/kWh].
 - Correction Factors: CF-RegPer: 1.00.
- Buttons:**
 - START FULL DATA EVALUATION (green button).
 - Precalculate characteristic engine speeds and grid for fuel map (grey button).
- Output:**
 - Output Directory: J:\TE-Em\Projekte\I_2013_08_HDV_CO2_LOT_4_SR7\VECTO-Engine\Releases\VECTO-Engine 1.3\Demo input data.
- Message:**
 - WHTC Simulation Results: Urban: 205.09 [g/kWh], Rural: 187.13 [g/kWh], Motorway: 178.05 [g/kWh], Total: 189.18 [g/kWh].
 - Writing XML output file Completed.
 - ATTENTION: 4 Warning(s) occurred. Please check detailed descriptions in "Message Window".

Step 1

Input all component data

Step 2

Load all required input files via separate open file buttons (for file format please see demo files)

Step 3

Input measured specific FC values and correction factor

Step 4

Define directory where output files are stored

Step 5

Press „Start“ button for full evaluation (OR press other button to precalculate grid for fuel map from CO2-parent full-load curve)

„Message“ window will display errors (red), warnings (orange), informations and results

VECTO Engine – Input files

- VECTO Engine needs 4 separate input files (determined according to the current version of the technical annex):
 - Fuel consumption map of CO₂-parent engine
 - Full-load curve of CO₂-parent engine
 - Full-load curve of engine to be certified
 - Motoring curve of CO₂-parent engine
- Input file formats
 - For file formats please refer to the technical annex or supplied demo files!
- Demo data supplied
 - Two different full-load curves for two power ratings of one engine CO₂-family supplied
 - Child: full-load of lower power rating
 - Parent: full-load of highest power rating

VECTO Engine – Output files

- VECTO Engine produces one XML output file:
 - File name is created based on GUI input data according to the following scheme:
“OutPath” + “Manufacturer” + “_” + Model + “_” + “Certification Number” + “.xml”

VECTO Engine – Operations performed (p1/4)

1. Reading of input files and automatic check of input data

1.1 Check of requirements for input data according to the definitions in paragraph 6.1 of the technical annex

1.2 Check of requirements for recorded FCMC data according to the definitions in paragraph 4.3.5.2 and subpoint (1) of paragraph 4.3.5.5 of the technical annex

2. Calculation of characteristic engine speeds from full load curves of parent engine and actual engine for certification according to the definitions in paragraph 4.3.5.2.1 of the technical annex

3. Processing of fuel consumption (FC) map

3.1 FC values at n_{idle} are copied to engine speed ($n_{idle} - 100 \text{ min}^{-1}$) in the map

3.2 FC values at n_{95h} are copied to engine speed ($n_{95h} + 500 \text{ min}^{-1}$) in the map

3.3 Extrapolation of FC values at all engine speed setpoints to a torque value of (1.1 times $T_{max_overall}$) by using least squares linear regression based on the 3 measured FC points with the highest torque values at each engine speed setpoint in the map

3.4 Adding of FC = 0 for interpolated motoring torque values at all engine speed setpoints in the map

3.5 Adding of FC = 0 for minimum of interpolated motoring torque values from subpoint (3.4) minus 100 Nm at all engine speed setpoints in the map

VECTO Engine – Operations performed (p2/4)

4. Simulation of FC and cycle work over WHTC and respective subparts for actual engine for certification
 - 4.1. WHTC reference points are denormalized using the full load curve input in originally recorded resolution
 - 4.2. FC is calculated for WHTC denormalized reference values for engine speed and torque from subpoint 4.1
 - 4.3. FC is calculated with engine inertia set to 0
 - 4.4. FC is calculated with standard PT1-function (as in main vehicle simulation) for engine torque response active
 - 4.5. FC for all motoring points is set to 0
 - 4.6. FC for all non-motoring engine operation points is calculated from FC map by Delaunay interpolation method (as in main vehicle simulation)
 - 4.7. Cycle work and FC are calculated according to equations defined in paragraphs 5.1 and 5.2 of the technical annex
 - 4.8. Simulated specific FC values are calculated analogous to equations defined in paragraphs 5.3.1 and 5.3.2 of the technical annex for measured values

VECTO Engine – Operations performed (p3/4)

5. Calculation of WHTC correction factors

5.1. Measured values from input to pre-processing tool and simulated values from point (4) are used in accordance with the equations in points (5.2) to (5.4)

$$5.2. CF_{Urban} = SFC_{meas,Urban} / SFC_{simu,Urban}$$

$$5.3. CF_{Rural} = SFC_{meas,Rural} / SFC_{simu,Rural}$$

$$5.4. CF_{MW} = SFC_{meas,MW} / SFC_{simu,MW}$$

5.5. In case that the calculated value for a correction factor is lower than 1, the respective correction factor is set to 1

6. Calculation of cold-hot emission balancing factor

6.1. This factor is calculated in accordance with the equation in point (6.2)

$$6.2. BF_{cold-hot} = 1 + 0.1 \times (SFC_{meas,cold} - SFC_{meas,hot}) / SFC_{meas,hot}$$

6.3. In case that the calculated value for this factor is lower than 1, the factor is set to 1

VECTO Engine – Operations performed (p4/4)

7. Correction of FC values in FC map to standard NCV

7.1. This correction is performed in accordance with the equation in point (7.2)

$$7.2. FC_{\text{corrected}} = FC_{\text{measured, map}} \times NCV_{\text{meas}} / NVC_{\text{std}}$$

7.3. $FC_{\text{measured, map}}$ shall be the FC value in the FC map input data processed in accordance with point (3)

7.4. NCV_{meas} and NVC_{std} shall be defined in accordance with paragraph 5.3.3.1 of the technical annex

7.5. In the case that reference fuel of the type B7 (Diesel / CI) in accordance with paragraph 3.2 of the technical annex was used during testing, the correction in accordance with points (7.1) to (7.4) is not performed.

8. Converting of engine full load and motoring torque values of the actual engine for certification to a logging frequency of the engine speed of 8 min⁻¹ if the average engine speed stepwidth is smaller than 6 min⁻¹

9.1. The conversion is performed by arithmetical averaging over intervals of $\pm 4 \text{ min}^{-1}$ of the given setpoint for the output data based on the full load curve input in originally recorded resolution

Contact data

- Please be aware that from now on all questions, user support and bug reports need to be handled via the CITnet service of the EU-COM.
- Also future updates of the tool will be released only via this platform (<https://webgate.ec.europa.eu/CITnet/confluence/display/VECTO/vecto-engine+releases>).
- If you do not already have an account for this service please contact jrc-vecto@ec.europa.eu.