INTAKE AIR AND EXHAUST GAS CONDITIONING

AVL ALTITUDE SIMULATOR

FOR STEADY STATE AND DYNAMIC ENGINE OPERATION

Application

The **AVL Altitude Simulator (C - EEU)** generates negative pressure conditions for intake air and exhaust gas to simulate different altitudes.
In combination with an **Intake Air Conditioning Unit AVL ConsysAir** (see related fact sheet), the whole system can be extended to positive pressure control and the control of combustion air temperature and humidity.

This variant of the AVL altitude simulation is the compact and mobile version of the well-known **AVL Altitude Simulator** which can provide a wider application range but only for a fixed installation (sharing option to several test beds possible) – see separate fact sheet.

Systems for specific requirements or for upgrades of existing systems are available on request.

Benefits at a glance

	• Compact and mobile design allows flexible use on several test beds • Compact and mobile design enables a quick execution/installation phase without any modifications on the building. • Precise adherence of pre-defined values for intake air and exhaust gas pressure • Precise adherence of pre-defined values for intake air temperature, humidity and pressure using proven AVL Intake Air Conditioning Units • High control stability using an air bypass technology • Huge performance map due to independent control of pressure, temperature and humidity • Possibility to perform an up-/down-hill drive from sea level up to 3500 m (nominal) or 4000 m (max.) without any control issues in between, independent from the test cell location. • Robust design offers maximum availability

Functional Description

An air bypass, by means of Y-pieces connected between the air inlet and exhaust outlet of the engine, guarantees almost constant total nominal flow rates, so that even dynamic speed and load changes of the engine can be coped without disturbing influences on the accuracy of conditioning (including pressure control). A well elaborated control algorithm ensures the optimal use of the implemented actuators for very stable conditions within the complete engine application range.

The Intake Air Conditioning Unit **(AVL ConsysAir)** can be used in addition for control of air temperature, humidity and positive pressure (up to +100mbar compared to ambient), whereas the **AVL Altitude Simulator** controls the pressure below ambient (nominal -350 mbar, max. -400 mbar). A range of +80 to -400 mbar (compared to ambient) can be simulated without any re-built in between.

The **AVL Altitude Simulator** is designed for the max. specified flow in combination with the nominal specified altitude (see specifications below) at the inlet and outlet of the engine at all operating conditions (even in dynamic operation). Heat exchangers cool the exhaust gas down to a temperature which is compatible with the blowers. Several shut off flaps allow to disable the **AVL Altitude Simulator** and its pipe work. With this operation the engine can be tested without altitude simulation.

Installation

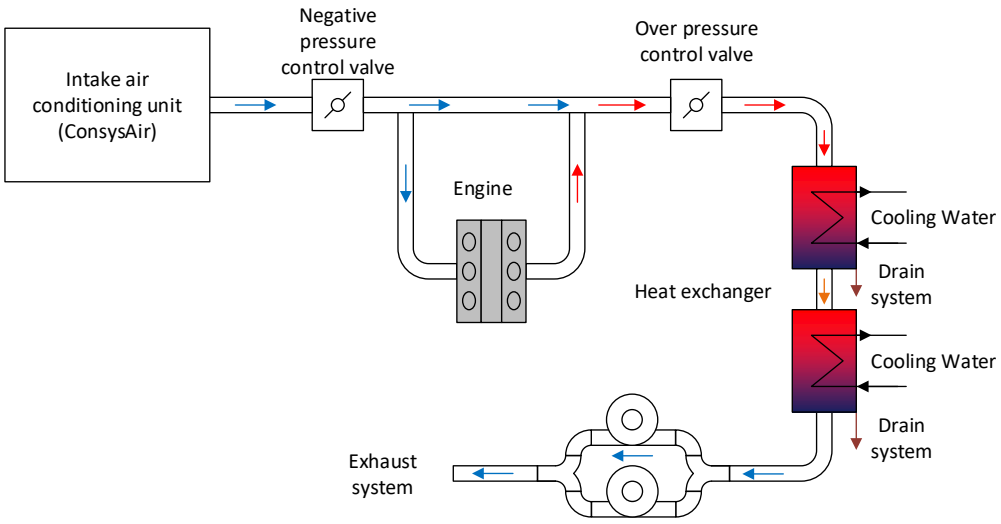
The AVL Compact Altitude Simulation can be installed on technical floor above, below or beside the test cell or even within the test cell.
The distance from the system to the engine should be between 4 and 12m.
The distance from the engine to the **AVL Altitude Simulator** should be between 7 and 14 m.

Control

The system can be connected to an external test bed automation system (e.g. AVL PUMA) for external set point setting and data exchange. The **AVL Altitude Simulator** is equipped with an internal PLC and HMI for Stand Alone operation.

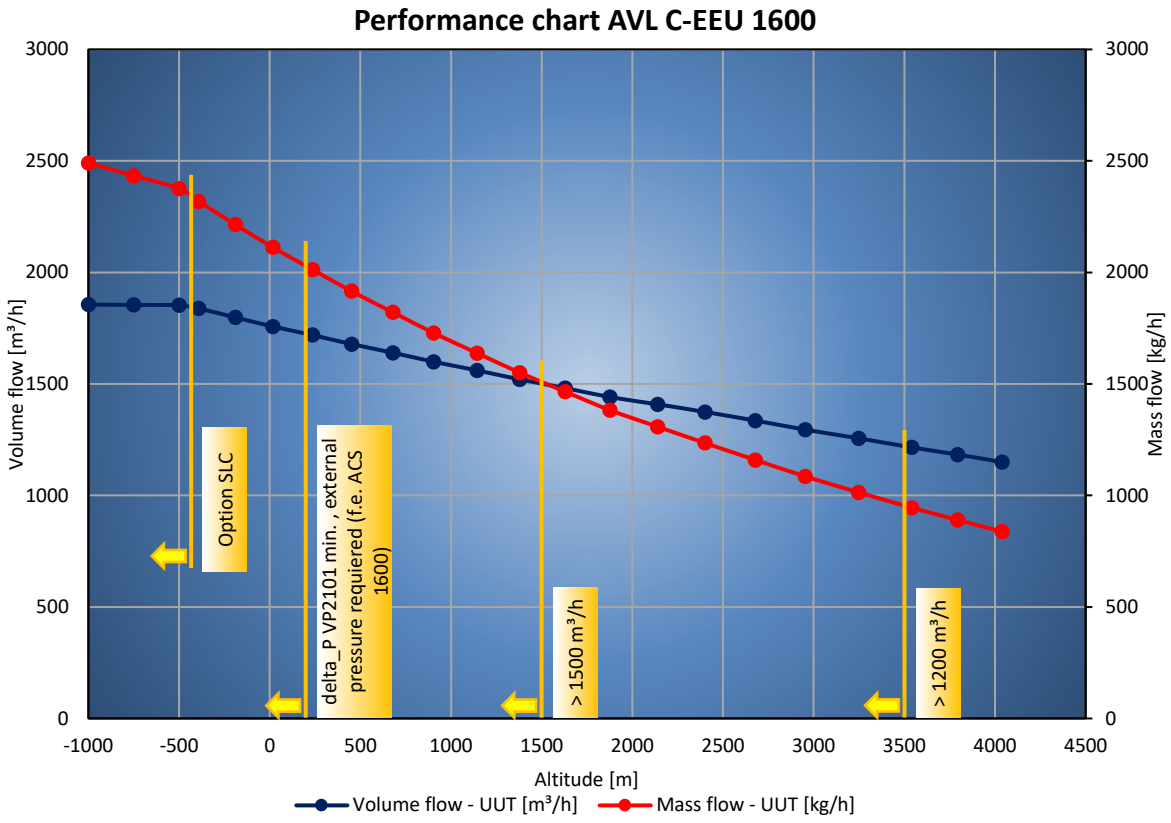
Illustrated installation for AVL Compact Exhaust Extraction Unit and ConsysAir

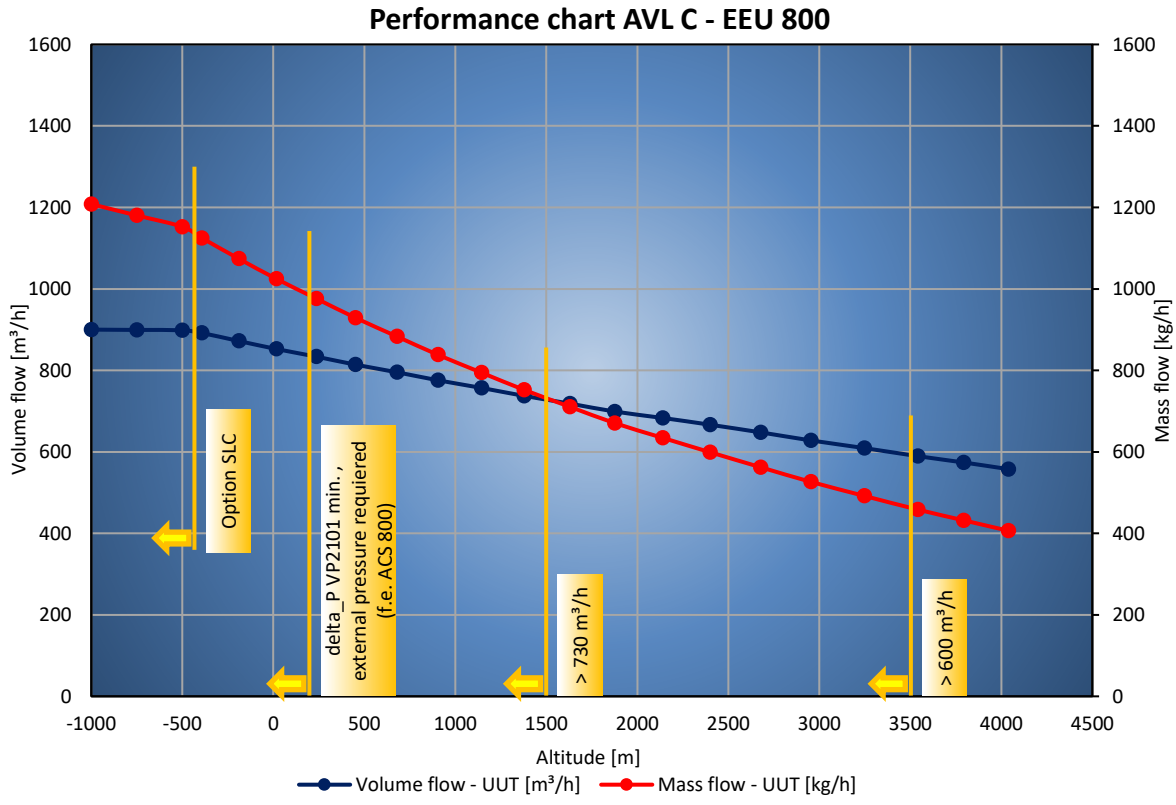
Schematic

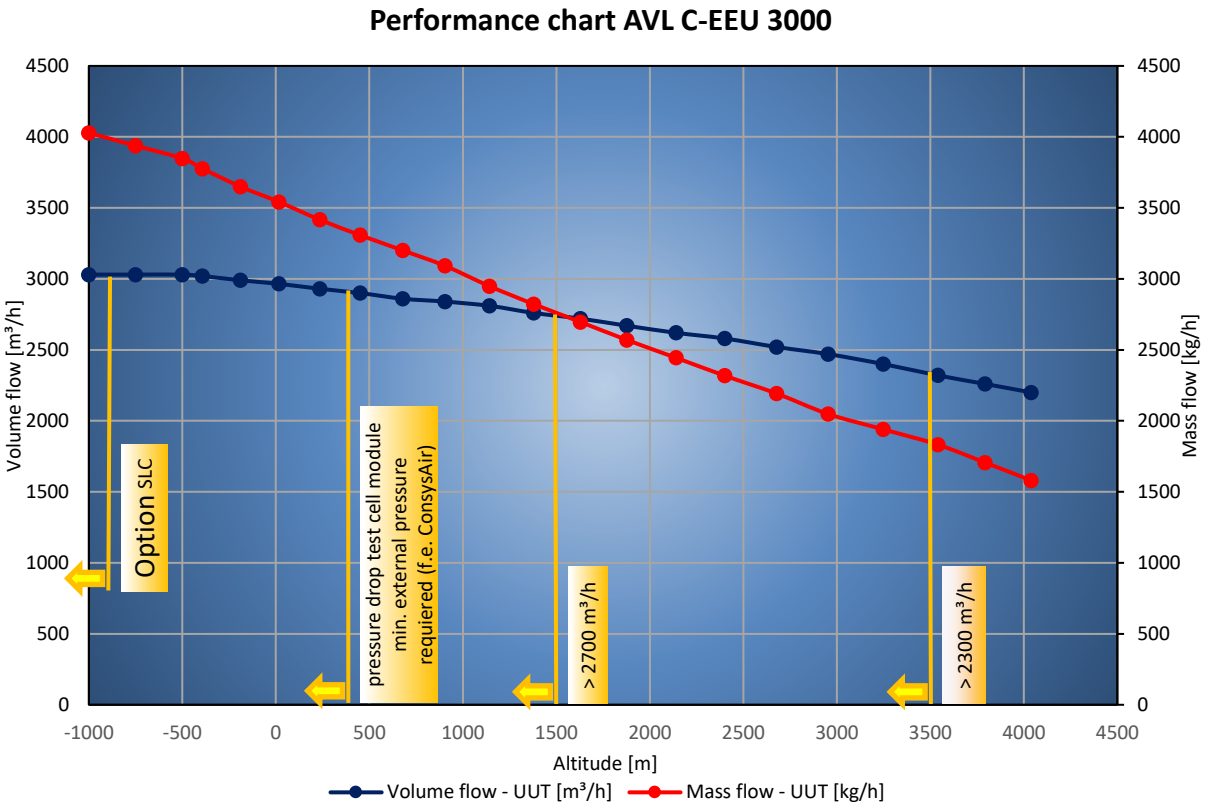


Technical data		C-EEU 800/3500	C-EEU 1600/3500	C-EEU 3000/3500	Unit
Basic data					
Air flow (blowers)	nominal	800 960	1600 1920	3000 3600	Nm³/h kg/h
Air flow (engine intake, considering the max. exhaust tail pipe temperatures)	nominal	600 720	1200 1440	2250 2700	Nm³/h kg/h
Adjustable air pressure in relation to ambient pressure and flow (see attached graphic) (max. value in relation with ConsysAir operation)	max.	+80 (with “Advanced Sea Level Compensation”) +100 (with ConsysAir Dynamic Package)			mbar
	nominal	-350			mbar
	min.	-400			mbar
	Accuracy in steady-state operation: +/- 1 mbar Accuracy in dynamic operation: +/- 3 mbar within 3 sec. (except temporary higher pressure peaks)				
Nominal operating conditions					
Pressure of the ambient air	p_{a_min}	960 - 1010			mbar
Temperature of the ambient air	T_{a_min}	5 - 40			°C
Intake gas temperature into heat exchanger	max.	650			°C
Exhaust temperature exit	max.	160			°C
Installed electric power					
Total installed power consumption	P_{ges}	27 (41)	51 (77)	83 (125)	kW (kVA)
Standard power supply		3 x 400VAC/50 Hz, N, PE			V, Hz
Facility					
Cooling water supply (water without glycol)	Supply temperature	25-30			°C
	Return temperature	25-42			°C
	Pressure	3 - 5			bar
	Mass flow	22	36	70	m³ H_2O/h
	capacity	225	450	860	kW
	pressure drop	approx. 1,5			bar
Condensate	Temperature	max. 90			°C
	Pressure	ambient			bar
	Mass flow	22,5	45	85	dm³ H_2O/h
Compressed air	Pressure	6 - 8			bar
Physical dimensions	Length	3050	3050	4100	mm
	Width	1890	1890	2000	mm
	Height	2050	2050	2100	mm
	weight	approx. 2500	approx. 3000	approx. 4000	kg
Machine noise to ambient	max.	87			dB(A)

Performance chart – useable air flow for combustion:


Performance chart AVL C-EEU 1600
Volume flow [m³/h]
Mass flow [kg/h]
Altitude [m]
Option SLC
delta_P VP2101 min. , external pressure requiered (f.e. ACS 1600)
> 1500 m³/h
> 1200 m³/h
Volume flow - UUT [m³/h]
Mass flow - UUT [kg/h]


Performance chart AVL C - EEU 800
Volume flow [m³/h]
Mass flow [kg/h]
Altitude [m]
Option SLC
delta_P VP2101 min. , external pressure requiered (f.e. ACS 800)
> 730 m³/h
> 600 m³/h
Volume flow - UUT [m³/h]
Mass flow - UUT [kg/h]


Performance chart AVL C-EEU 3000
Volume flow [m³/h]
Mass flow [kg/h]
Altitude [m]
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-1000
-500
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Option SLC
pressure drop test cell module
min. external pressure
requiered (f.e. ConsysAir)
> 2700 m³/h
> 2300 m³/h
Volume flow - UUT [m³/h]
Mass flow - UUT [kg/h]