

Test cell 2, Main specifications

AVL PUMA test system equipped with following measurement and control modules

Speed and torque control.

Load unit	Measurement range	Accuracy
AVL Alpha 500 eddy current dynamometer	0 – 500 kW from 2 400 – 8 000 RPM 0 – 2 000 Nm from 1 100 – 2 400 RPM	± 0.2 % of full scale for the total system

32 input channels for temperature, voltage, resistance and current measurements. (Number of channels can be increased)

Sensor / signal	Measurement range	Accuracy	Measurement rate Values / second
Pt100, Pt 1000	-50 to 650 °C	-50 to 200 °C ± 0,1 °C 200 to 650 °C ± 0,2 °C	1, 5, 10
Thermocouple Type K Other types;J,R,S,T,B,E	-200 to 1 370 °C	± 0,5°C	1, 5, 10
Voltage	± 11 V	1 mV	1, 5, 10, 100
Current	± 20 mA	10 µA	1, 5, 10, 100
Resistance	20 to 200 Ω	± 0,2 Ω	1, 5, 10
	200 to 2 000 Ω	± 2 Ω	1, 5, 10

Strain gage	Max. bridge Detuning	Accuracy	Supply voltage	Measurement rate Values / second
120 Ω	± 35 mV/V	± 5 µV/V	0.58 V	1, 5, 10
35 Ω	± 15 mV/V	± 2,5 µV/V	1.34 V	1, 5, 10
3,5 Ω	± 8 mV/V	± 1.25 µV/V	2.63 V	1, 5, 10

**16 input channels for pressure measurement.
(Number of channels can be increased)**

Sensor / signal	Number of sensors	Measurement range	Accuracy	Measurement rate Values / second
Pressure	3	-300 to 300 mbar	For ambient Temp. -20 to 80 °C ± 0.1 % FSO	0.1, 0.2, 0.5, 1, 2, 5, 10
	8	-1 to 2.5 bar		
	4	0 to 10 bar		
Barometric press.	1	800 to 1 200 mbar	± 0.5 mbar	

Air mass flow meter

Measuring principle	Measurement range	Accuracy
Hot film anemometer	0 – 2 400 kg/h (Different ranges are available)	± 1 %

**4 input channels for speed and frequency measurement.
(Number of channels can be increased)**

Sensor / signal	Measurement range	Accuracy	Measurement rate Values / second
Frequency	1 Hz to 300 kHz	25 ppm	1, 10, 100
	10 Hz to 300 kHz		
	100 Hz to 300 kHz		
Period	< 10 s	25 ppm	0.1, 1, 10, 100
	< 1 s		
	< 0.5 s		
	< 0.01 s		
Speed (e.g.: 100 pole pulse wheel standstill recognition 0.1 RPM recognition of direction of rotation)	1 to 15 000 RPM	< 0.1 RPM	1, 10, 100
Event	2 ³² Events Input freq. < 300 kHz	1	Measurement time 1 to 10000 s

16 digital inputs and 16 digital outputs for processing digital control signals.

Input voltage	5 – 24 VDC
Relays	5 A, 50V

12 analog outputs for demand value setting from the automation system.

Specification	Output signal type	
	Voltage	Current
Signal range	-11 to 11 V	± 25 mA
Resolution (16 bit)	336 µV	763 nA
Max. error at 25 °C	± 2 mV	± 10 µA
Max. error from 0 to 45 °C	± 4 mV	± 12 µA
Setting time	3.5 ms on 0.1 %	
Load	≥ 1 100 Ω	≤ 500 Ω

Dynamic fuel meter (AVL 733S)

Measuring principle	Measurement range	Accuracy
Gravimetric measuring principle	0 – 150 kg/h	± 0,1 %

Environmental sensor, Vaisala HMI 33.

	Measurement range	Accuracy
Relative humidity	φ %-rh 0 – 100 %	± 1 % rh
Temperature	°C -40 -- 160	± 0,5 °C

Diesel exhaust smoke measurement.

Measuring principle	Measurement range	Accuracy
AVL Opacimeter 439	Light absorption 0 – 10 / m	± 0.0025 / m
	Opacity range 0 – 100 %	± 0,1 %

Particulate sampling system Control Sistem PSS-20 mini dilute tunnel

Measuring principle
Partial flow dilution tunnel

BOO Instrument emission bench 1 for exhaust gas measurements.

Exhaust component	Measurement range	Accuracy
CO	0 – 250 ppm	Repeatability 1 % FS Linearity 1 % FS
	0 – 4 000 ppm	
THC	0 – 10 ppm	Repeatability 1 % FS Linearity 1 % FS
	0 – 100 ppm	
	0 – 1 000 ppm	
	0 – 10 000 ppm	
NO / NOx	0 – 10 ppm	Repeatability < 0.5% FS Linearity < 1 % FS
	0 – 100 ppm	
	0 – 1 000 ppm	
	0 – 10 000 ppm	
CO2	0 – 4 %	Repeatability 2 % FS Linearity 1 % FS
	0 – 16 %	
O2	0 – 3 %	Repeatability < 1 % FS Linearity < 1 % FS
	0 – 25 %	

BOO Instrument emission bench 2 for exhaust gas measurements.

Exhaust component	Measurement range	Accuracy
CO	0 – 250 ppm	Repeatability 1 % FS Linearity 1 % FS
	0 – 4 000 ppm	
THC	0 – 10 ppm	Repeatability 1 % FS Linearity 1 % FS
	0 – 100 ppm	
	0 – 1 000 ppm	
	0 – 10 000 ppm	
NO / NOx	0 – 10 ppm	Repeatability < 0.5% FS Linearity < 1 % FS
	0 – 100 ppm	
	0 – 1 000 ppm	
	0 – 10 000 ppm	
CO2	0 – 4 %	Repeatability 2 % FS Linearity 1 % FS
	0 – 16 %	
O2	0 – 3 %	Repeatability < 1 % FS Linearity < 1 % FS
	0 – 25 %	

Additional equipment available for any test cell

Equipment	Type
NH3 measurement	NEO laser for NH3 measurements
Particulate measurement	Control System Pss-20 Mini dilute tunnel
NOx analyser	Additional stand alone NOx analyser
Particulate weighing chamber	Temperature and humidity controlled
Micro soot sensor	AVL 483
Urea injection and control system	Air assisted atomization. PWM and frequency controlled dosing
HC injection and control system	Air assisted atomization. PWM and frequency controlled dosing
Exhaust cooler	Tubular heat exchanger