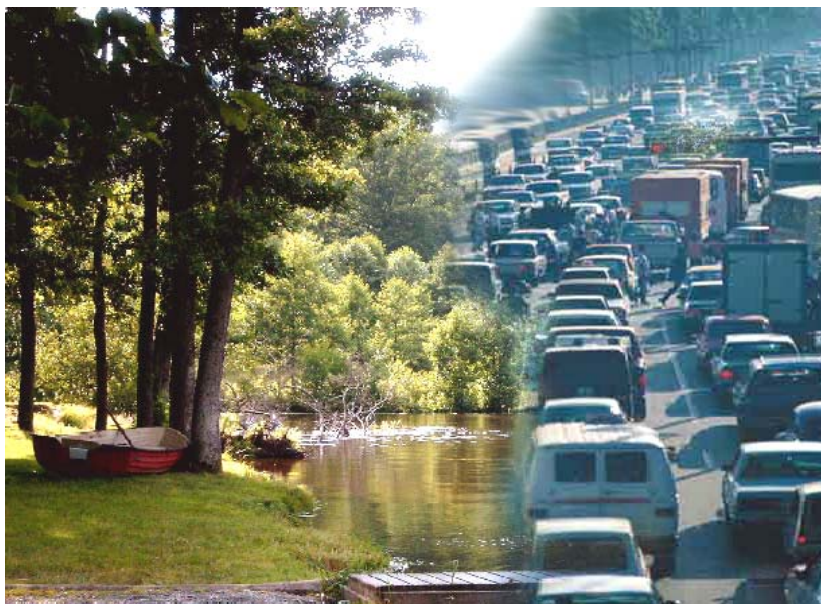


Measuring of nitrogen compounds in exhaust gases of engines

Measurements for the development of Otto-, Diesel engines, catalysts and DeNOx-SCR – catalyst monitoring by Diesel engines



New regulations for the automotive industries in Europe, Japan and USA demands reduction of Nitrogen Oxides in exhaust gases.

To achieve this, some developments are necessary:

- optimization of engines
- catalysts for Otto and Diesel engines
- DeNOx – SCR – catalysts with urea dosing for Diesel trucks.

For the optimized reduction of nitrogen oxides it is important to monitor the growths of NO and NO₂ continuously and simultaneously.

DeNOx – SCR – catalysts with urea dosing for diesel engines in trucks it is useful to optimize the urea dosing dependent of the NO concentration. As the measuring growth it is necessary to have NO and NO₂ also NH₃ for monitoring the NH₃-slip measuring behind the catalyst.

Demand on the measuring technology:

- Simultaneous measurement of NO, NO₂ as well as NO, NO₂ and NH₃
- measurement in moist combustion exhaust gases
- ppb – concentrations safety, precise and reproducibility
- fast measurement
- the technique must be prepared as well for engine test stands as for mobile measurements in automobiles

Demand on the Analyzer

- multi component analyzer
- no resources used such as converters or ozone
- no consumables
- contamination tolerant, corrosion resistant
- high stability
- no dependency of flow or pressure
- simple to operate
- simple to calibrate
- robust measuring device
- applicable in motor test stands as well as in mobile measurements in automobiles
- low operating costs

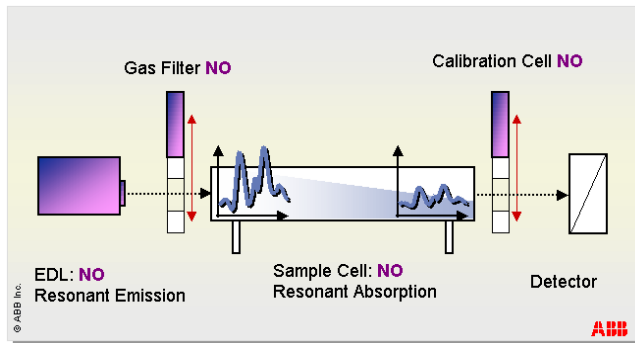
The solution from ABB

The heated extractive measuring unit for the simultaneous measurement of NO, NO₂ and NH₃ comprises the AO2000-Limas11HW multi component industrial photometer and the corresponding sample gas conditioning and feeding unit



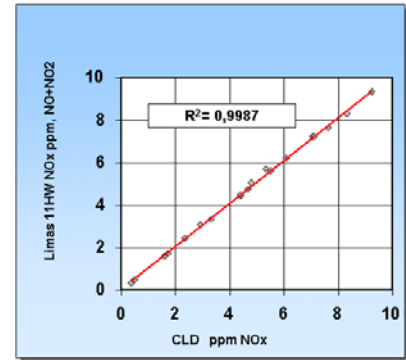
The Limas 11HW analyzer

The Limas 11HW is a continuous-operating industrial UV-photometer of the AO2000 product line. It measures up to 3 nitrogen oxides NO, NO₂ and NH₃, simultaneously in humid sample gas mixtures. The measuring component NO is measured in accordance with the UV – RAS – principle (Resonance Absorption Spectrometer). For the measuring component NO₂ and NH₃ is carried out accordance to the principle of wavelength comparison in UV radiation range 200-500 nm. Both these principles can be combined in the same Limas 11HW. As a result NO + NO₂ can be measured simultaneously for determining NO_x content without converter. This can be extended to include the measuring component NH₃ as an important component for the slip measurement of DeNO_x – SCR – catalysts. A quartz sample cell that can be heated to 80°C enables nitrogen oxides to be measured on almost sulfur-free exhaust gases up to a dew point of 65°C



Benefits

- with simultaneous measurement of NO and NO₂ for determination of NO_x it is not necessary to convert NO₂ to NO in a converter. This enables both measuring components to be displayed and evaluated.
- EPA- conform
- there are no resources used such as converters or ozone and therefore no consumption of converter materials, ozone disturber



Correspondence with other measuring principles is very good

- the additional measurement of NH₃ provides an overview of nitrogen oxides contained behind the catalyst and the ammonia dosing
- the quartz cell which is used as well as the design of the cell the way in which signals are processed makes the Limas tolerant of dirt, protects from corrosion and catalytic reactions in the sample cell.
- The heating of the sample gas feed paths permits the feed of humid sample gases at dew points up to 65°C. This prevents NH₃ and NO₂ being lost in solution due to cooling them below the dew point
- In this application the gas filled calibration cells make calibration easy, instead to calibrate with gas cylinders which is usually a consuming operation.
- the UV- radiation source used is an Electrodeless Discharge Lamp (EDL) with a long life time
- Further features are integrated into AO2000 series analyzers, such as
 - complete remote operation
 - integrated digital logbook
 - maintenance on request, required by Asset Management Software
 - network communication via Ethernet / Profibus / Modbus
- Limas 11HW is an ideal analyzer for the operation in motor test stands as well as in automotives for mobile operation

Measuring components and ranges for applications in exhaust gases of engines

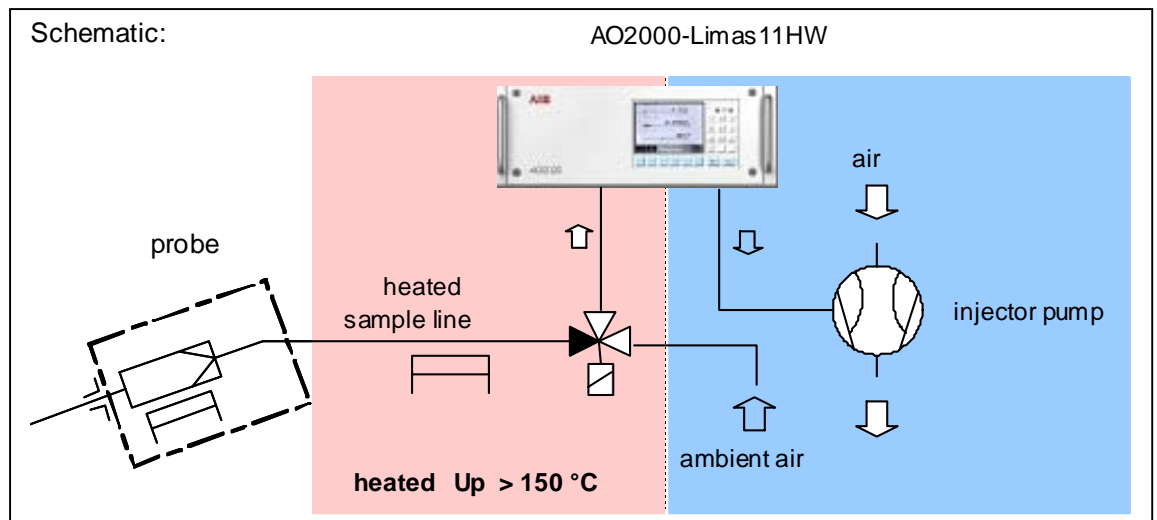
Application:	Measuring Component:	Measuring Ranges:
Raw exhaust gas (high)	NO	0... 100 / 5000 ppm
	NO ₂	0... 100 / 5000 ppm
Diluted exhaust gas (low)	NO	0... 10 / 500 ppm
	NO ₂	0....10 / 500 ppm
Bag test	NO	0.... 10 / 500 ppm
	NO ₂	0... 10 / 500 ppm
SCR / catalyst	NO	0.... 100 / 500 ppm
	NO ₂	0.... 100 / 500 ppm
	NH ₃	0... 100 / 500 ppm

The respective sample conditioning

For the extractive measurement the sample gas conditioning and sample gas delivery to the analyzer in the temperature of approx. 150°C is required. As this high temperature no condensate can form NH₃ and NO₂ do not condense into a solution. Materials such as PTFE, PVDF or Silicosteel are used for the gas-carrying components

The sample gas is taken to the analyzer via shortest possible heated sample gas line; a heated 3/2-way valve opens up the sample gas path when the required operation temperature has been

- optimized for measuring of NO/NO₂ / NH₃
- samples heated to > 150°C
- no condensate formation can take place
- guaranties high operational reliability
- Gas feed using the pressure or injector pump



The Limas 11HW is an UV process photometer which can be used in an application oriented way and operated for the measurement of humid nitrogen oxide measurements.

Limas 11HW measures the concentrations of NO, NO₂ as well as NH₃ in a precise, reproducible manner selective and simultaneous. It requires no chemical aids such as converter or ozone and is easy to calibrate and operate.

Compared with other analyzer systems the operating and maintenance costs are very low. As member of the AO2000 series gas analyzers it benefits from features such as remote control via Ethernet, integrated PLC-functions, alarm and messaging system, digital logbook and more.

Extract from the technical data

Measuring components	NO, NO + NO ₂ , NO + NO ₂ + NH ₃
measuring ranges	1 ...4 per measuring component
measuring range ratio	up to 1:50 accordance to EPA-specification
response time	> 2 s T90 el.
Stability	
zero point drift	< 100 ppb / 8h
span point drift	< 1% of the value per week
Detection limit	< 100 ppb
Reproducibility	< 25 ppb
Fluctuation of the signal	< 50 ppb
Sample gas dew point	< 65 °C
carrier gas	sulfur-free exhaust gas of Otto / Diesel engines diluted and undiluted
ambient temperature range	10 ... 35 °C



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