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This information is exclusively a technical description of the products. It is not meant or intends to be a special guarantee for a particular quality or durability with regard to section 443 BGB (German Civil Code).

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Version history

Document version	Previous version	Change description (including number)
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Version list

Version	Date	Author	Comment, Description, Changes
draft	20.04.06	HP Göttler	Specification NOx-Sensor "Uninox" (12V, Truck)
AA	31.08.06	HP Göttler	DF
AB	04.04.07	HP Göttler	2. Bank-Adressen, J1939-CAN-Matrix

Index

1 Related documents

653212.40.73	Siemens drawing NOx-Sensor
DIN EN 60068-2-2, Ba	Storage at continuous high temperature
DIN EN 60068-2-32 Ed	Drop to concrete floor
DIN EN 60068-2-64 Fh	Random vibration
DIN 50 017 KFW	Storage at ambient air and high humidity
DIN IEC 60068-2-11 Ka	Salt spray
DIN IEC 68 2-14, Na & Nb	Temperature cycle
DIN IEC 68245-2	Chemical resistance
DIN 40839 part 1 / ISO 7637-1	Electrical disturbance by conducting and coupling
DIN 40839 part 4 / ISO 11452-5	Electrical disturbance by narrow-band radiated electromagnetic energy
IEC CISPR 25, EN 55025	Electrical disturbance by electro magnetic interferences
ISO 10605, EN 61000-4-2	Electrical disturbance by electro static discharge

2 General

2.1 General description

This technical specification describes the smart NOx sensor (SNS) used for catalyst management in vehicles with gasoline or diesel engines. The smart NOx sensor consists of a ceramic sensor element and an electronic control unit.

The smart NOx sensor measures the NOx concentration, air/fuel ratio (A/F ratio) and equilibrum oxygen partial pressure in the exhaust gas of combustion engines (gasoline and diesel) and can be used for

- Lean burn engines (NOx trap)
- Diesel engines (SCR catalysts, NOx trap, closed-loop NOx control)
- On board diagnostics, OBD (gasoline and diesel engines)

Specified mounting position of the NOx Sensor is downstream of NOx trap or SCR catalyst.
(See also built-in-instruction - Chapter 7)

2.2 Function description

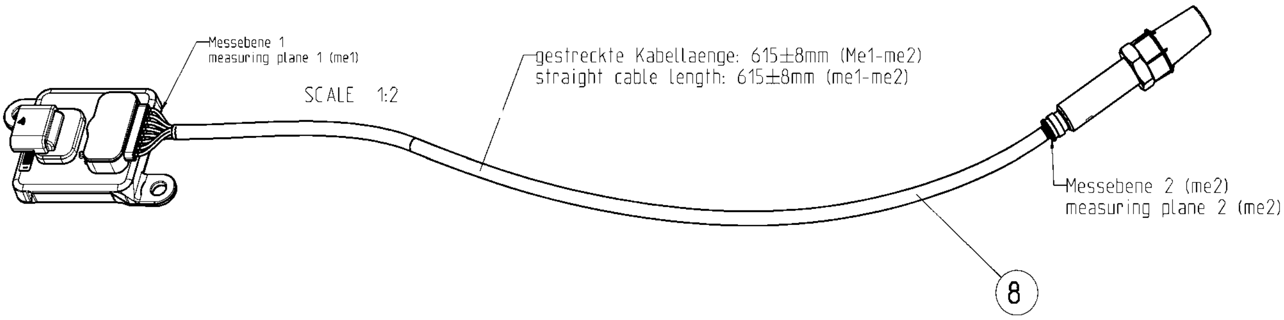
A ceramic sensor made of zirconia electrolyte measures in amperometric operation (chapter 6.1) the oxygen concentration entering from exhaust gas through a diffusion barrier into a first cavity. The oxygen concentration inside the cavity is controlled to the constant concentration of a few ppm NOx. Other components of the exhaust gas also entering the cavity as HC, CO and H_2 are oxidized at the pumping electrode made of Pt.

From the first cavity the test gas with a few ppm O_2 and NOx enters a second cavity, where gaseous oxygen is totally removed by an auxiliary pump. At the measuring electrode the equilibrium of $NO \leftrightarrow N_2 + O_2$ is changed by removing oxygen generated by the reduction of NO. The amperometric measurement IP2 of this generated oxygen represents the NOx concentration of the exhaust gas.

An electronic control unit (ECU) provides the power control for heating the sensor element to operating temperature. In an ASIC the regulation for the amperometric operation of all pumping cells to determinate NOx concentration, air/fuel ratio and binary λ signal is realized. The ECU provides the measured gas concentrations digitally via CAN bus.

The assembly of the entire NOx sensor system, consisting of sensor and electronic control unit connected by a wiring harness is shown in drawing 653212.40.73

3 Smart NOx Sensor assembly



3.1 Characteristic

Nr	Name	Symbol	Min.	Max.	Dim.	Remarks
1	NO_x concentration	NOx	0	1500	ppm	NO & NO_2 $1.0 \le \lambda \le \infty$ (without NH_3)
2	Linear Air/Fuel-ratio	λ_lin	0	1250	1000/ λ	
3	Lambda binary	λ_rich(λ≤0.9) λ_lean(λ≥1.1)	750	 200	mV mV	
4	Lambda binary (Static-λ)	λ_s	0.994	1.010	λ	
5	Response time NO_x	$\tau_{33<\text{—}>66\%}$ NOx		1300 1650	ms	fresh aged
6	Response time λ_lin	$\tau_{33<\text{—}>66\%}$ λ_lin		1000 1300	ms	fresh aged
7	R-to-L response ($T_{600\text{->}300\ mV}$)	TRL		500 600	ms	fresh aged
	L-to-R response ($T_{300\text{->}600\ mV}$)	TLR		500 600	ms	fresh aged

Allowed gas temperature range for validity of characteristic data: 200 – 800°C.

Measuring conditions: (chapter 6.3.3)

Items Nr. 1, Nr. 2 Synthetic gas equipment

Item Nr. 3, Nr. 4 Synthetic gas equipment; $T_{gas} = 350 \pm 20$°C

Items Nr. 5 Synthetic gas equipment, λ = 1 and 2, 0 < NOx < 250 ppm

Items Nr. 6, 7 Synthetic gas equipment, 0.97 < λ < 1.03

3.1.1 Light-off time

-	NOx	<	100 sec (fresh)
-	linear A/F-ratio	<	80 sec (fresh)
-	binary λ	<	80 sec (fresh)

Measuring condition: Air, T_{Gas} = 25 +/- 5°C, U_{bat} = 14,0V

Criteria: Status bit of function = 1

3.1.2 Measurement accuracy

NOx output:

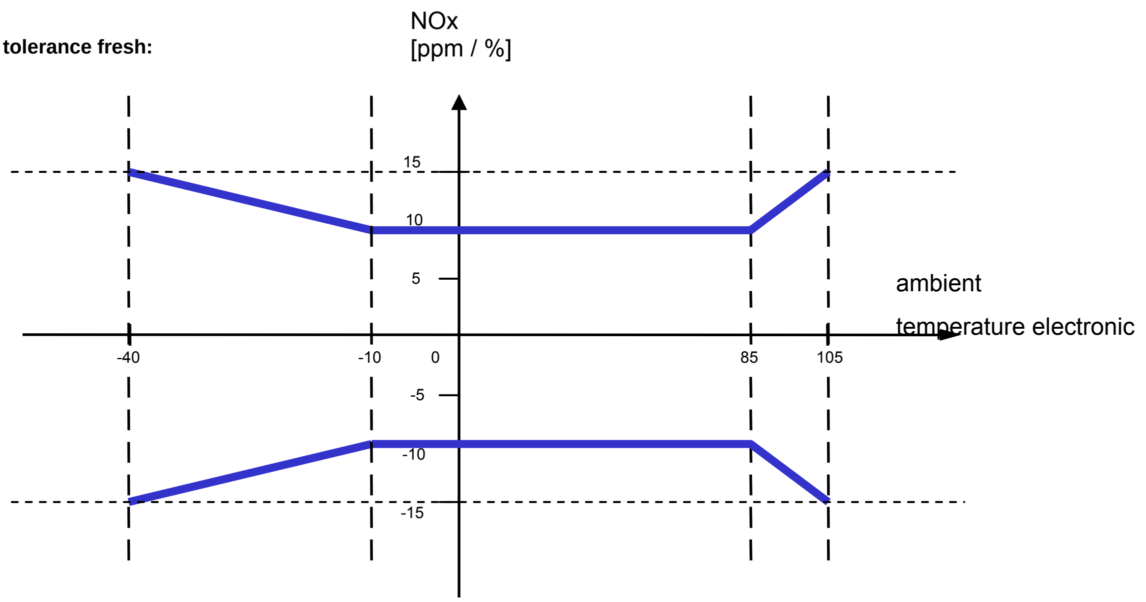
Depending on the temperature of the electronic sensor control unit, different accuracies for NOx are given:

Gas mixture: H_2O=3%
O_2=0%, 13%
N_2 balance

NOx fresh:

Limit values in “ppm” at 0 ppm and in “%” from 100 to 1500 ppm

NOx tolerance fresh:



NOx aged:

Limit values are 10 ppm / 10% higher than fresh limit values.

A/F output

- For 1000/λ at 1111 (≈ 0.9) ±15 (1000/λ) (fresh)
- For 1000/λ at 1000 (≈ 1.0) ±6 (1000/λ) (fresh) ±12 (aged)
- For 1000/λ at 378 (≈ 2.65) ±48 (1000/λ) (fresh)

Binary λ output

- Static λ: 1.002 ± 0.008 (fresh)

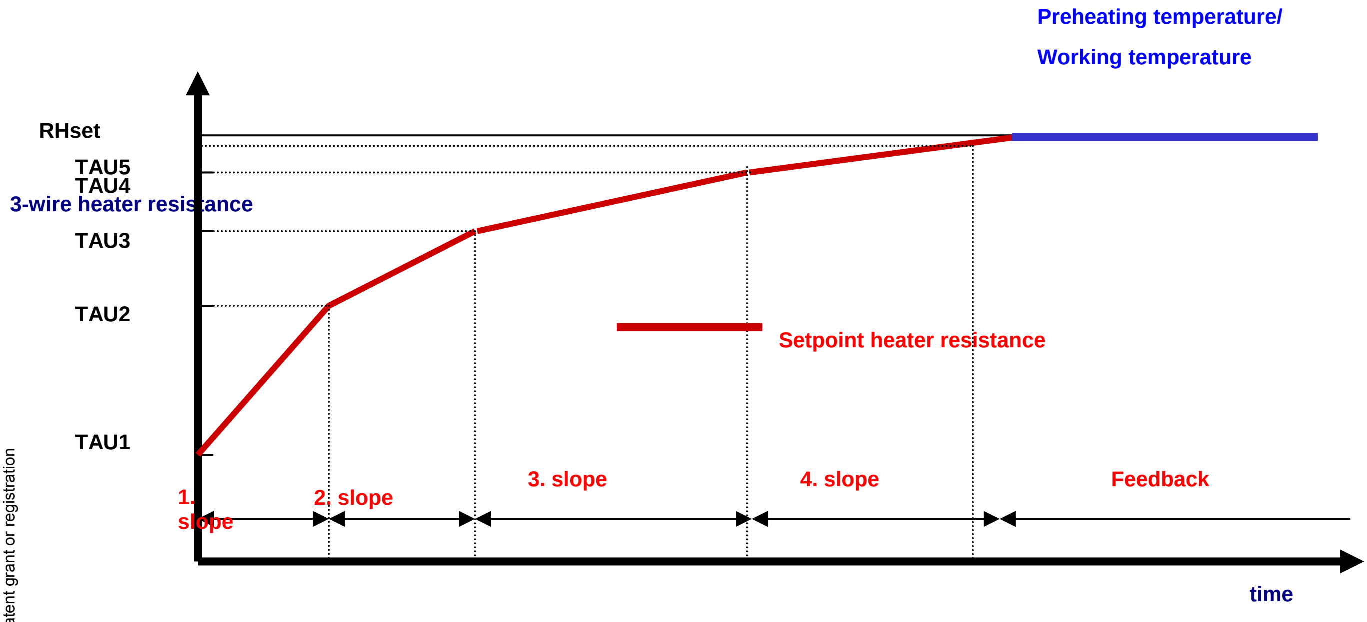
3.1.3 Preheating function:

If power supply is on, the sensor is in preheating function till dew point bit is sent via CAN. If dew point bit is taken away from CAN, the sensor is again in preheating mode.

Heating up to preheating temperature uses strategy as described in chapter 3.1.4. Preheating time is about 60sec after power on.

3.1.4 Heat up strategy

Schematic of heat up strategy



4 Requirements

4.1 Operating temperature ranges

Range of temperatures:

- Minimum ambient temperature electronics	T_{min}	=	- 40 °C
- Maximum ambient temperature electronics	T_{max}	=	+105 °C

Operating temperature 105°C -115°C allowed for up to10 min

- Minimum storage temperature without powering	T_{min}	=	-40°C
- Maximum storage temperature without powering	T_{max}	=	120°C
- Maximum storage time in spare part packaging			2 years
- Maximum exhaust gas temperature	T_{max}	=	800°C

Exhaust gas temperature of 950°C allowed for up to 100 h

- Maximum sensor hexagon screw temperature T_{max} = 620°C

Sensor hexagon screw temperature of 650°C allowed for up to 100 h

- Maximum sensor grommet temperature T_{max} = 200°C

Sensor grommet temperature of 230°C allowed for up to 100 h

- Minimum preheating sensor temperature	T_{min}	=	80°C
- Maximum preheating sensor temperature	T_{max}	=	120°C

Wire temperature of 230°C allowed for up to 100 h

Lifespan approved by life cycle pattern t = 2000h resp. 120 kmile

Within the operating temperature range, the functionality of the NOx Sensor is guaranteed within the specified tolerances.

4.2 Cable

Min. cable bending radius (each single wire) r = 3,5 mm

4.3 Acceleration

- maximum acceleration of NOx sensor γs = 490 m/sec²

- maximum acceleration of electronic interface γs = 3,81 gRMS
  (38 m/sec²) at 10Hz to 1000Hz (random)

4.4 Electrical characteristics

4.4.1 Supply voltage

- minimum supply voltage (ECU) $U_{bat\ min}$ = 9 V
- minimum supply voltage (Sensor Heater) $U_{bat\ min}$ = 12 V
- standard supply voltage U_{bat} = 13,5 V
- maximum supply voltage (Sensor Heater) $U_{bat\ max}$ = 16 V

The NOx sensor is protected against reverse battery voltage on the supply pins 1 and 4 (see 4.5.2)

4.4.2 Supply current

- typical supply current I < 1,5A
- peak supply current at switch on I_{max} = 16A

4.4.3 Supply power

- maximum supply power: P_{max} = 20W

4.4.4 CAN Lines

- minimum line voltage U_{min} = -3 V
- maximum line voltage U_{max} = 16 V

No line termination for CAN

4.4.5 Transfer Protocol

Aftertreatment Sensor Communication Protocol

Data format:

- Transfer rate 250 kBaud
- Repetition 50 msec
- Data format Intel
- Identifier extended

Transmit signals:

Standard transmit address (Pin5 open):

18F00F52h (PGN = 61455, in HEX: F00F; After Treatment outlet - position, bank 1)

Alternative transmit address (Pin5 to GND):

18F00E51h (PGN = 61454, in HEX: F00E; After Treatment intake - position, bank 1)

***** "Source address" not yet defined for sensors at exhaust bank 2 in "After treatment Sensors communications protocol"

Overview Transmit signals:

	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0 (L-Byte)	NOx	NOx	NOx	NOx	NOx	NOx	NOx	NOx ←
1 (H-Byte)	NOx ←	NOx	NOx	NOx	NOx	NOx	NOx	NOx
2 (L-Byte)	O_2	O_2	O_2	O_2	O_2	O_2	O_2	O_2 ←
3 (H-Byte)	O_2 ←	O_2	O_2	O_2	O_2	O_2	O_2	O_2
4	Status Byte	Status Byte	Status Byte	Status Byte	Status Byte	Status Byte	Status Byte	Status Byte
5	not used**	Status Heater Mode	Status Heater Mode	Error* Heater	Error* Heater	Error* Heater	Error* Heater	Error* Heater
6	not used**	not used**	not used**	Error* NOx	Error* NOx	Error* NOx	Error* NOx	Error* NOx
7	not used**	not used**	not used**	Error* O_2	Error* O_2	Error* O_2	Error* O_2	Error* O_2

* Error as FMI = **F**ailure **M**ode **I**ndicator

(see after treatment sensors communication protocol REV 0.1, Appendix A)

** not used bits = 0

	Range Coding	Definition
NOx	-200 ... 3012 [ppm] signal: unsigned integer	Transmitted is the NOx-concentration which is detected by the NOx-Sensor. The transmission is in 0.05 ppm NOx/bit +200 ppm. (f.e.: 7500 corresponds to 175ppm NOx → 7500 * 0,05 -200 = 175 ppm)
O_2	-12... 21 [%] signal: unsigned integer	Signal of the actual oxidation factor (%O_2): The transmission is in 0.000514%/bit +12%. (f.e.: 64202 corresponds to 21% O_2)

Status-Byte:

D7	D6	D5	D4	D3	D2	D1	D0
S3	S3	S2	S2	S1	S1	S0	S0

S0: Status **Supply in Range**

D1	D0	
0	0	Supply not in range
0	1	Supply in range
1	0	Not used => Error
1	1	Not available (=Initial value)

S1: Status **NOx-Sensor temperature heater element**

D3	D2	
0	0	Sensor not at temperature
0	1	Sensor at operating temperature
1	0	Not used => Error
1	1	Not available (=Initial value)

S2: Status **NOx-Signal**

D5	D4	
0	0	NOx-signal not valid
0	1	NOx-signal valid
1	0	Not used => Error
1	1	Not available (=Initial value)

S3: Status **Oxygen-Signal**

D7	D6	
0	0	O_2-signal not valid
0	1	O_2-signal valid
1	0	Not used => Error
1	1	Not available (=Initial value)

The status information will switch from “not available” to “signal not valid” after the dew point has been received.

Status Heater Mode:

D6	D5	
0	0	Automatic mode
0	1	Heatup slope 3 or 4
1	0	Heatup slope 1 or 2
1	1	Heater off / Preheating mode

Error Heater: D4 D3 D2 D1 D0

Error as FMI = **F**ailure **M**ode **I**ndicator

D4 … D0:	**31** (1Fh)	FMI not available / no error exists
	05	open wire
	03	short circuit

Error NOx: D4 D3 D2 D1 D0

Error as FMI = **F**ailure **M**ode **I**ndicator

D4 … D0:	**31** (1Fh)	FMI not available / no error exists
	05	open wire
	03	short circuit

Error O_2: D4 D3 D2 D1 D0

Error as FMI = **F**ailure **M**ode **I**ndicator

D4 … D0:	**31** (1Fh)	FMI not available / no error exists
	05	open wire
	03	short circuit

The error information will change from not available to a diagnosis result after the first diagnosis cycle was completely finished with an error result

Receive signals:

Receive ID: 18FEDF00h (PGN = 65247, in HEX: FEDF, Dewpoint-SPN = 3238)

Overview receive signals :

	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	tbd.	tbd.	tbd.	tbd.	Tbd.	tbd.	tbd.	tbd. ←
1	tbd.	tbd.	tbd.	tbd.	Tbd.	tbd.	tbd.	tbd. ←
2	tbd.	tbd.	tbd.	tbd.	Tbd.	tbd.	tbd.	tbd. ←
3	tbd.	tbd.	tbd.	tbd.	Tbd.	tbd.	tbd.	tbd. ←
4	tbd.	tbd.	tbd.	tbd.	Tbd.	tbd.	tbd.	tbd. ←
5	tbd.	tbd.	tbd.	tbd.	Tbd.	tbd.	tbd.	tbd. ←
6	tbd.	tbd.	tbd.	tbd.	Tbd.	tbd.	tbd.	tbd. ←
7	**Start-Code**	**Start-Code**	**Start-Code**	**Start-Code**	**Start-Code**	**Start-Code**	**Start-Code**	**Start-Code** ←

Start Code for sensor position "After Treatment Outlet Gas 1 (exh. Bank 1)"

	Range Coding	Definition
Start-code	**0000 0D00 (04h)**	**D=0: Dewpoint not reached** **D=1: Dewpoint reached, sensor heating up started**

The dew point byte (start code) must only be sent, if the exhaust gas contains no liquid water or other fluids.

Recommended repetition rate is >100msec

4.5 Mechanical characteristics

4.5.1 Physical dimensions

- Physical dimensions of sensing element and electronic control unit: see drawing No. 653212.40.73
- Straight cable length between sensor and electronic control unit: see drawing No. 653212.40.73
- Weight of whole NOx sensor: ~ 215 g.
- Weight of electronic control unit: ~ 100 g. (without sensor)

4.5.2 Connector

See built in instruction (chapter 7)

4.5.3 Thread Torque

See built in instruction (chapter 7)

4.5.4 Pull strength at sensor and electronics

The contacts inside the sensor assembly and wires, resp. inside the connector of the interface to the sensor shall maintain electrical continuity, when a pull force of 50 N is applied to each sensor wire.

5 Testing

After each environmental test the Smart NOx-Sensor must meet its specification

5.1 Sensor

5.1.1 Drop test

The sensor is dropped to a concrete floor once in perpendicular and twice in horizontal direction as indicated in 6.3.1.

EN 60068-2-32 Ed

Drop surface:	Concrete
Drop height:	1.0 m
Orientation in which the samples have to be dropped:	see enclosure

5.1.2 Stone impact test

- NOx-sensor assembly:

The NOx-sensor assembly is fixed horizontally and a stainless steel ball (approx. 100 g) drops from 1,5 m high on the sensor to produce approx. 1,5 Nm per impact.

One impact at each point as in described at enclosure

5.1.3 Humidity

The sensor is placed in a humidity chamber at air and uncontrolled humidity. Then the sensor is exposed to 4 cycles of the following temperature/humidity profile:

Temperature:	ambient air	71°C	28+/-10°C
Humidity:	ambient air	95% RH	85% RH
Time:	2hrs	20hrs	2hrs

The protection cover of the sensor is sealed not to expose the sensing element to the test profile. The connector is plugged with the mating counter connector during this test.

5.1.4 Salt spray test

Test according to DIN 50021-SS. Test time 72hours

5.1.5 Gasoline soak

A sensor is fixed on a test chamber and gasoline injected in it. The distance between surface of fuel and the *top* of the sensor protection cover is about 10.

Gasoline soak condition is as follows:

Pressure inside the test chamber : 1.3 bar

Duration of soaking: tbd. hours

After the gasoline soak, the gasoline is removed and the test chamber filled with air. The pressure inside the test chamber is retained at the same as during gasoline soak phase. The air soak time is 20 h.
After air soak, heater voltage is applied to the sensor in nitrogen gas at room temperature and the sensor outputs are monitored for a period of 2 h.

5.1.6 Temperature cycle

Expose the operating NOx-sensor to the temperature profile on propane burner stand with air injector for fast coolin down as follows:

Temperature	300°C < --- > 950°C		
Gas λ condition:	air	1.05 ± 0.05	(Burner OFF & Air injection)
Time	5 min < --- > 5 min.		
Test time	600 cycles		

The sensor is in operation if the burner is on, and is shut off when burner is off.

5.1.7 Water submergence test

The sensor is installed on the test device consisting of a propane burner and a water shower. Sensor is heated up to a temperature of 570°C at hexagon.

Then the sensor is submerged for 10 min in water with a room temperature.

The aforementioned heat-up and submergence is repeated 10 times.

The sensor is in operation during this test.

5.1.8 Water ingress

Position the sensor on a fixture with its protection tube pointing upwards. Insert a hypodermic needle through the protection tube to apply 5 ccm^3 of water towards the exhaust seal area of the sensor. Put a cap with a 3 mm diameter hole over the protection tube. Soak sensor for 1 h at room temperature (25°C+/-2°C). After soak, remove the cap and drain excess water. Apply heater voltage to the sensor in nitrogen gas and monitor sensor outputs for a period of 2 hours.

5.1.9 Chemical resistance

NOx-sensor :

The following liquids are put on the sensor grommet and lead wire, with grommet pointing upwards:

Gasoline, LLc, Engine oil, Brake oil

then exposure of the sensor at 100°C for 200 hours.

5.1.10 Continuous high temperature

NOx-Sensor assembly:

Expose the operating NOx-sensor to the temperature profile on propane burner stand as follows

Gas temperature:	850°C	950°C
Gas λ condition:	1.05 ± 0.05	1.05 ± 0.05
Test time:	400 h	100 h

5.1.11 Grommet high temperature

The grommet of the operating NOx-sensor is exposed to the temperature profile on propane burner stand as follows:

Temperature:	200°C	230°C
Test time:	400 h	100 h

5.1.12 High temperature vibration

Place the sensor on a high temperature vibration device consisting of a vibrator connecting with a propane gas burner. Expose the sensor to the temperature and vibration profile as follows:

Frequency:	50..100…150…250Hz
Acceleration:	30…40…50G
Vibration sweep cycle:	30 min/sweep cycle
Gas temperature:	850°C, λ at 1.05
Test time:	150 h

The sensor is in operation through the test.

5.1.13 Fuel additives / Poisoning test

The sensor is installed in the exhaust pipe of a gasoline engine and in operation through the following tests. The engine system operates during the test with the following conditions:

1) P poisoning :

ZnDTP content:	0.25cm³/Liter
Gas temperature:	400°C < -- > 700°C
Lambda:	1.0(2hrs) < -- > 1.0(0.5hr)
Test time::	70 hours

2) S poisoning :

S content:	0.1 wt%/Liter
Gas temperature:	400°C < -- > 850°C
Lambda:	1.0(2hrs) < -- > 1.0(1hr)
Test time:	102 hours

3) Si poisoning :

Si content:	Siloxane compounds 0.12cm³/Liter
Gas temperature:	400°C
Lambda:	1.0
Test time:	6 hours

Siloxane compounds consist of an equivalent volume amount of:
Hexamethyldisiloxane, tetramethyldisiloxane and tetramethyldivinyldisiloxane.

5.2 Electronic interface

The sensor ECU is validated according to the SV standard qualification program for the Smart NOx sensor.

Additional customer requirements regarding environmental or mechanical testing have to be tested application dependent.

5.3 Electromagnetic compatibility (EMC)

5.3.1 Definition of operation and functional states

U_{bat}: 13.5 V, dew point message 80h cyclic sent all 20 ms

Functional states:

A	in specification, NOx signal tolerance <= +/- 20 ppm resp. %
B	not in specification, NOx signal tolerance > +/- 20 ppm resp. %
C	Dew point necessary (reset of device)

5.3.2 Disturbance by transient conduction along supply lines

According to DIN ISO 40839 part 1: |Vs| < 75 V

5.3.3 Immunity against transient voltage on power and control lines

According to DIN 40839 part 1 / ISO 7637-1

Test pulse	Level		Requirement	Duration
1	IV	-100 V	C	5000 Pulses
2	IV	+100 V	C	5000 Pulses
3a	IV	-150 V	A	1 hour
3b	IV	+100 V	A	1 hour
4	IV	-6,5 V	C	5 Pulses
Jump start	IV	27 V	B	60 sec

5.3.4 Immunity against electromagnetic fields: Stripline Testing

U_{bat}=13,5V±0,5V, GND = 0V, 20°C<Ta<30°C, unless otherwise specified

According to DIN 40839 part 4 / ISO 11452-5 (Stripline)

Frequency range: 1 MHz … 1000 MHz

Amplitude modulation: 80 % (1 kHz sine wave)

Duration:	≥ 2sec.	
Frequency steps:	1 - 10 MHz	1 MHz
	10 - 200 MHz	2 MHz
	200 - 1000 MHz	10 MHz
Test condition	100 V/m	

Remark:

As deviation from ISO test conditions the device under test, which consists of sensor and interface, is according to the real environmental conditions exposed to the electrical field.

In all cases the interface must retain its functionality. The average deviation of outputs of the interface should not exceed ±10%. No distortions (error frames) on CAN-Bus may occur!

Measurements are done in air condition.

5.4 Immunity against Electrostatic Discharge (ESD)

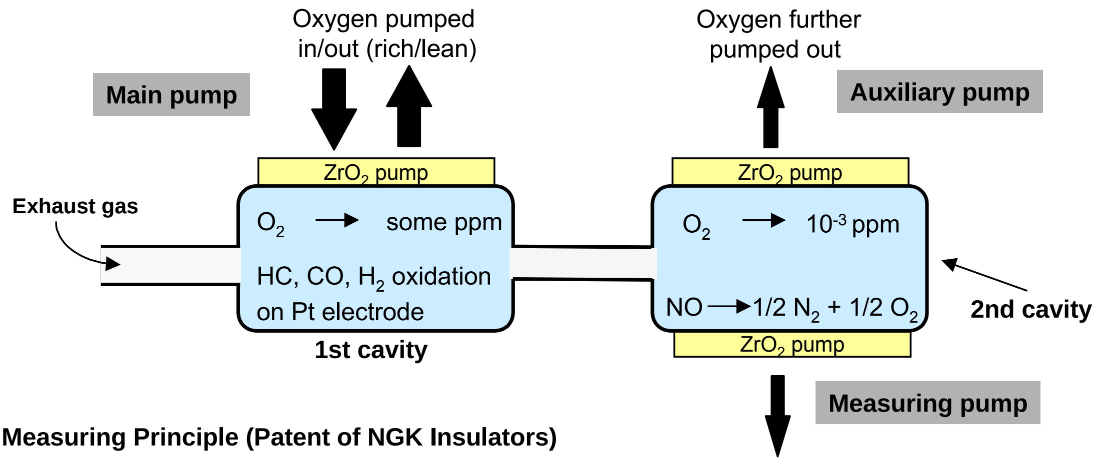
According to ISO 10605, EN 61000-4-2 (Human Body Model)

U_{ESD} < 6kV to all Pins U_{batt}, GND, CAN-high and Can-low (without external components).

After the test no damage is allowed.

6 Enclosure

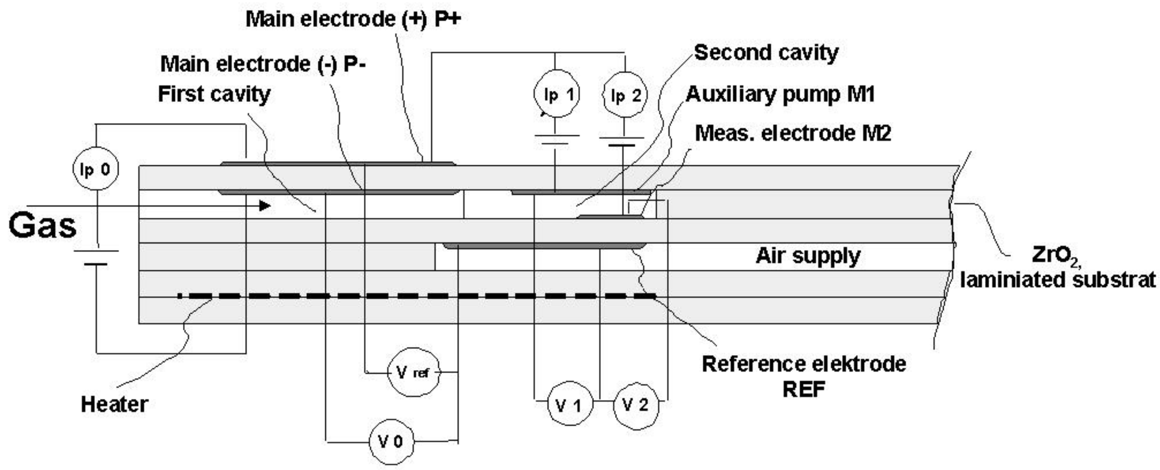
6.1 Schematic diagram of NOx-Sensor



Measuring Principle (Patent of NGK Insulators)

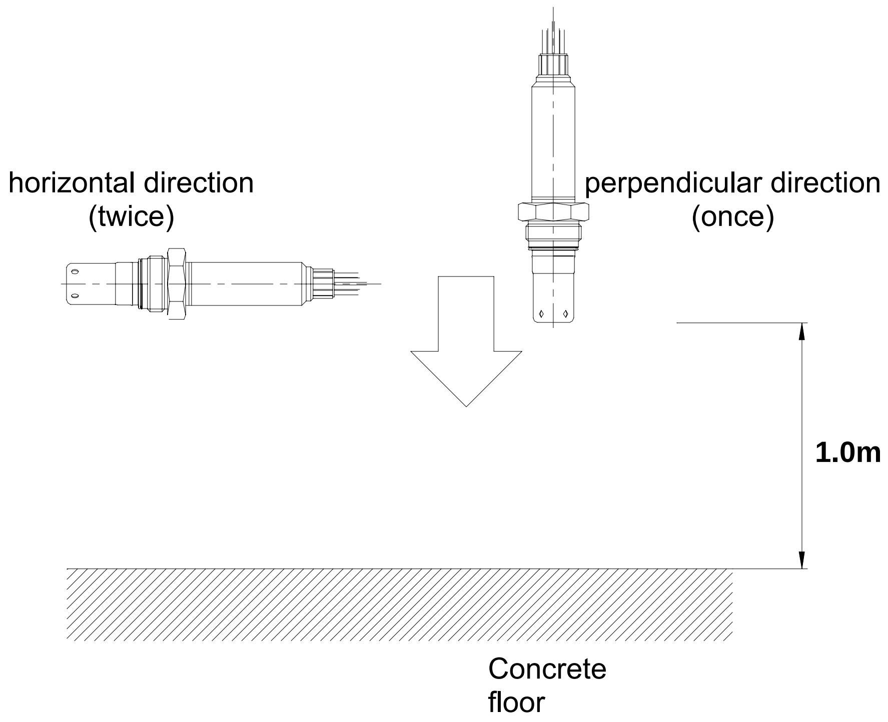
1. Chemical equilibrium, NOx $\longrightarrow N_2 + O_2$ is broken by removing O_2 in 1st cavity.
2. NOx is reduced by catalyst and O_2 is generated in the 2nd cavity.
3. Measure the generated oxygen, which represents the NOx concentration.

6.2 Definition of control signals



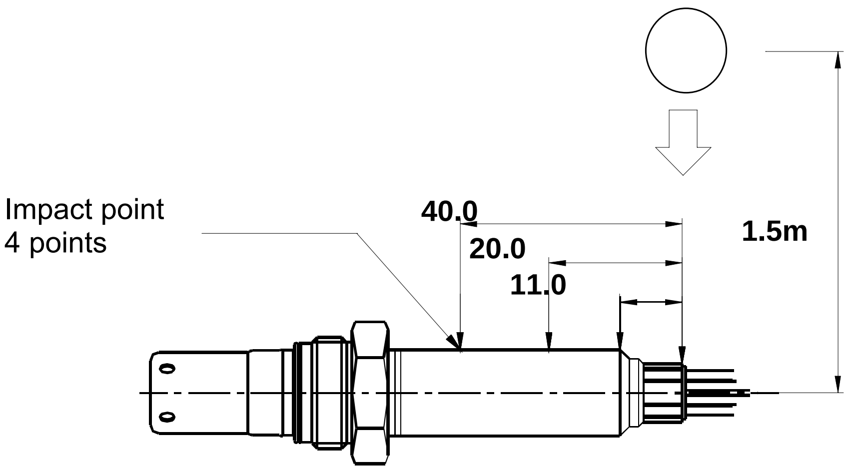
6.3 Test Procedures

6.3.1 Drop Test

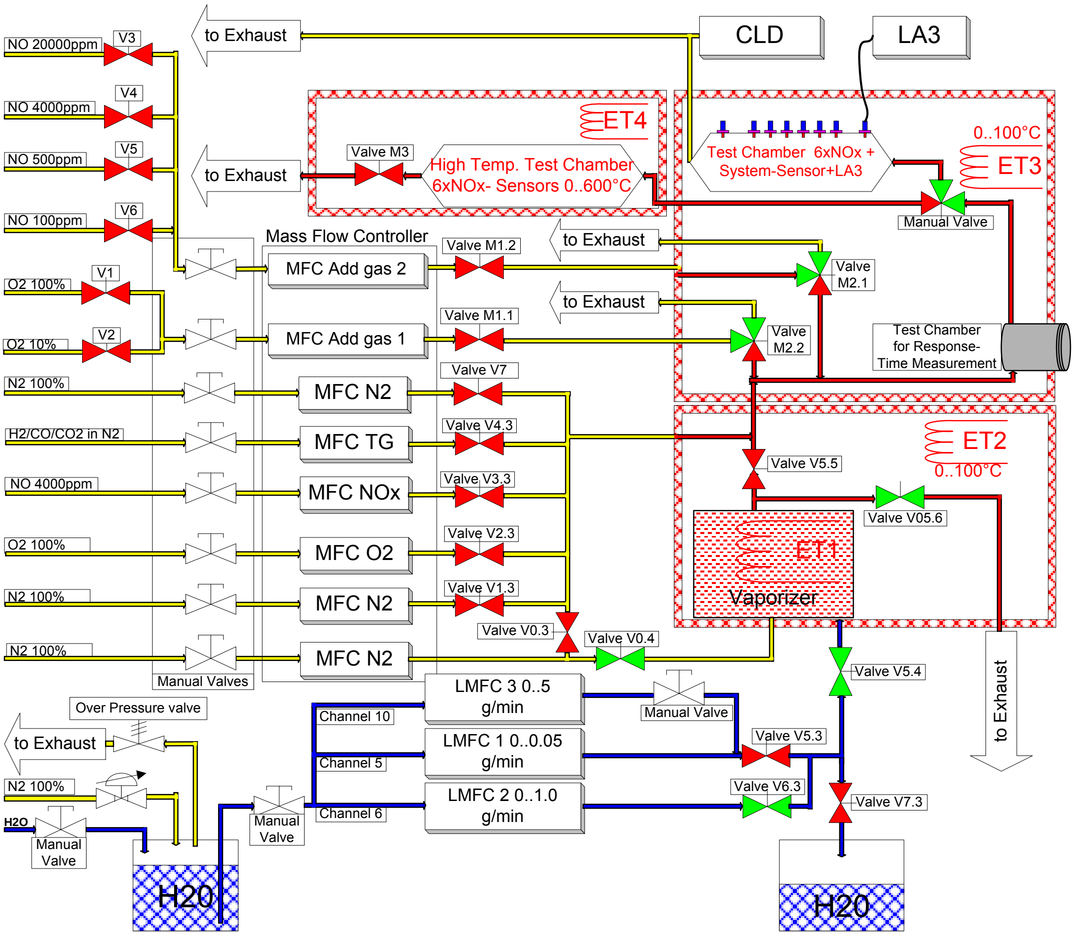


6.3.2 Stone Impact Test

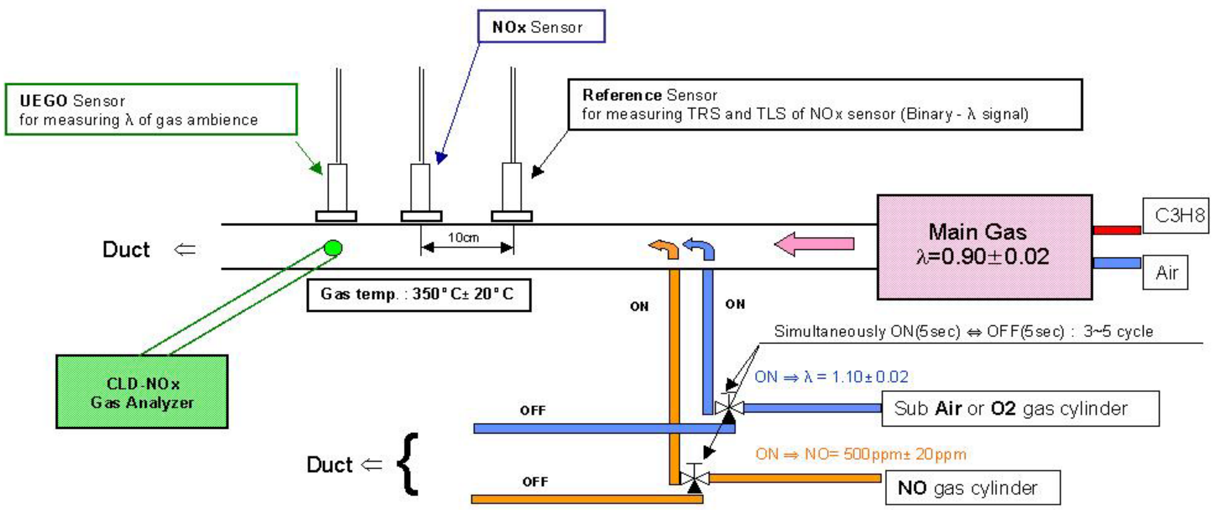
Stainless steel ball 100g



6.3.3 NOx synthetic gas equipment



6.3.4 Propane burner Stand Apparatus



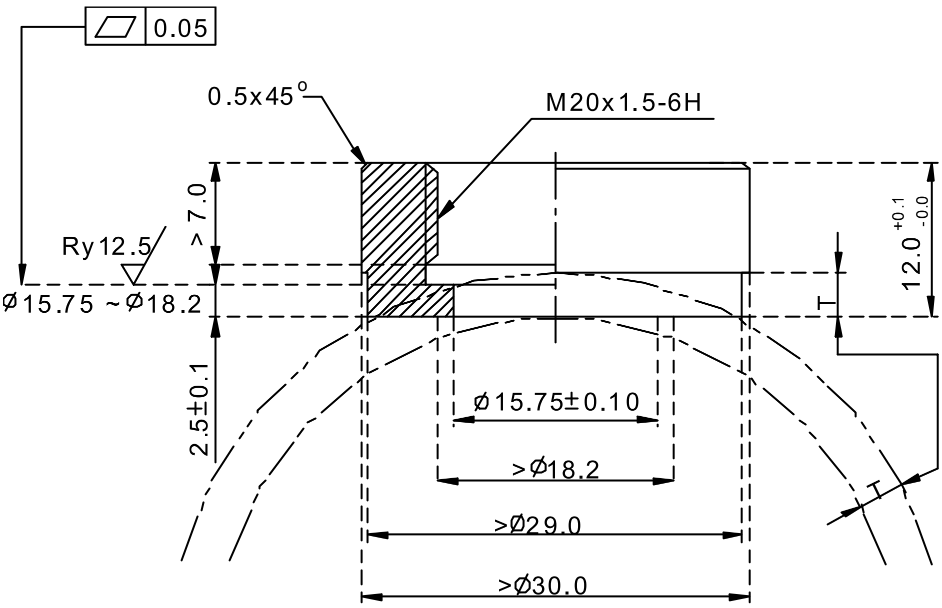
7 Built in instruction

7.1 Validity

This instruction is valid for the Smart NOx sensor (Uninox 12V)

7.2 Technical data

7.2.1 Boss



(*) After welding, the dimensions before welding have to be defined by the supplier of the boss.

The above shown boss drawing is a recommendation; other designs have to be released by SiemensVDO.

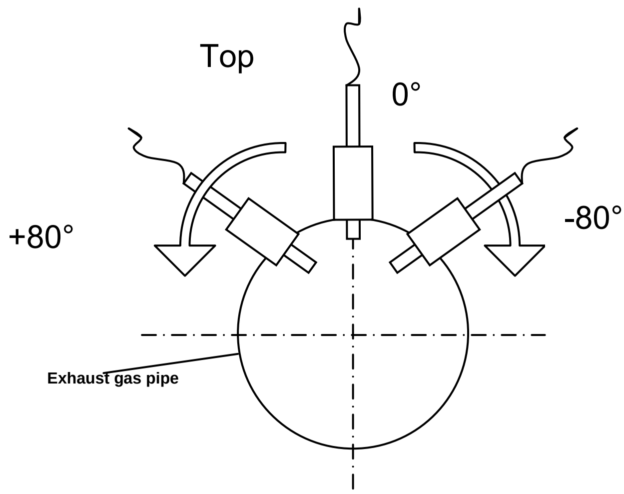
Recommended boss-material:	SUS304 or austenitic-ferritic stainless steel 1.4301
Boss characteristics:	HEX 22; M20x1,5-6e
Lubrication:	Anti Seize AS
Thread torque:	50 ± 10 Nm
Counter force:	tbd
Allowed twisting angle of the cable	180°
Allowed number of sensor montings	2

7.2.2 Cable outgoing at sensor grommet

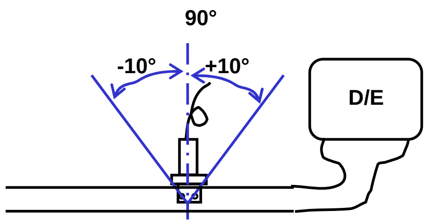
Angle between outgoing cable and longitudinal axes of the sensor: 0 +/-15°
Cable bent radius at grommet: > 20mm

7.2.3 Built in position

The NOx sensor has to be mounted in a way, that no condensed water is collected inside the protection tube of the sensing element.



7.2.4 Tilt angle in gas flow direction:



The recommended tilt angle is 90°±10°. Other angles are possible (as long as other specifications are fulfilled; e.g. maximum temperature hexagon, grommet) but may be linked with

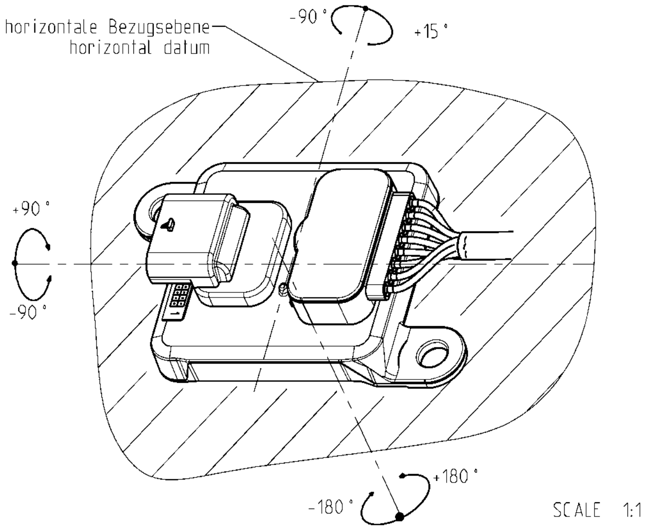
- a decrease in response time.

- a need of delayed dew point sending due to an increased amount of condensed humidity and less heating up of the sensor assembly by the exhaust gas in sloped bosses.
- a different gas sensitivity due to the changing gas concentration profiles versus the exhaust pipe diameter.

The evaluation of these items especially in terms of system needs has to be done by the customer.

7.2.5 Electronic control unit

The mounting positions of the sensor interface are restricted according to the air permeable membrane in the '8-wire' sensor connector. Allowed orientations of the ECU see drawing (view w/o 8pin ADR-protection):



7.2.6 Connector "MLK"

Amount of pins	5	
Type of counter connector	Hirschmann	
	MLK 872-860-501	
Connector assignment:	Pin1:	Ubatt
	Pin2:	Gnd
	Pin3:	CAN low
	Pin4:	CAN high
	Pin5:	Address switch

7.2.7 Cables/Varnish tube

Fixing positions:	at least 2
	10 cm from the ECU (other tbd. by customer)
Kind of fixing:	tbd. by customer
Isolation material cable:	PTFE
Wires:	Cu with Ni surface
Cross section:	0,6 mm²
Outer diameter:	1,68 ± 0,05 mm
Temperature range:	-40° to 200 °C
Resistance:	0,9 Ohm/km
Colours:	white, black, orange, blue, yellow, grey, red, green
Varnish tube:	flexible glasfiber silicon tube

7.2.8 CE-marking

The Smart NOx sensor is marked with "CE". This "CE" marking is related to the declaration of conformity with 94/9EG.

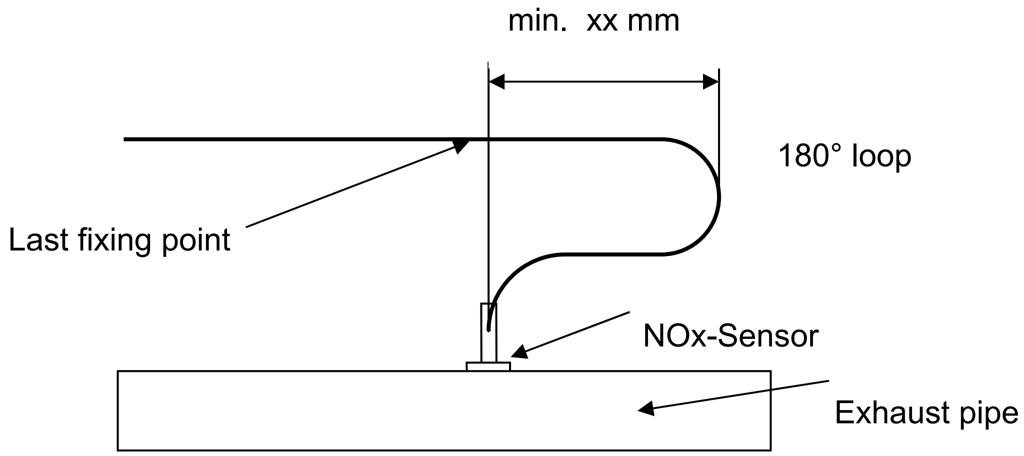
The Smart NOx sensor complies with the requirements of directive 94/9EG. It is classified according Annex1 as 'equipment group2, category 3' and fulfills the requirements according Annex2, 2.3

7.3 Comments for installation

The ECU of the smart NOx sensor should be mounted near the exhaust pipe so that the cable length of 608+/-8 mm can be installed with a security loop. The cable has to be fixed in a distance of 100 mm from the ECU or needs some other channeling. The security loop between the last fixing point and the sensor has to be kept. This guarantees that movement of the exhaust pipe during vehicle operation could not tighten and damage the cable.

Hint:

The length of the security loop has to be adapted by the customer to the amplitude of exhaust pipe movements.



Two lashes at the NOx sensor ECU are used for ECU fixing at the vehicle. The kind of mounting has to be defined by the customer. The used thread torque has to be agreed by the supplier.

If a complete mounting of sensor and ECU is not possible, the not mounted part of the smart NOx sensor has to be protected against mechanical damage. The installation positions of sensor and ECU have to be respected.

For mounting the sensor in the exhaust pipe turn the hex nut by hand. Last fixing has to be done with a thread torque tool. Respect the specified thread torque of 50 Nm. A slight counter torque by hand at the sensor is sufficient to avoid turning of the cables.

Any kind of painting of the Sensor or the sensor ECU has to be avoided.

The electrical connection of the smart NOx sensor with the vehicle ECU is done with the named connector system.