Motorsport and Industrial Applications

WARNING

Use of Bosch Products for Motorsport Applications - Important Information.

Technical Specifications are a Guide Only

The component specifications detailed within this information have been compiled by Bosch Australia as indicative operational and dimensional technical specifications only. The precise performance of a component during ordinary use will vary in accordance with a variety of enviromental factors.

Dimensional drawings and images shown within this information are representative only and are not to scale. No full scale engineering design for volume production should be undertaken without further consultation with Bosch Australia.

The provisions of these technical specifications in no way implies or otherwise, forms any application suggestion or recommendaton of suitability to the application for which the customer may have chosen a product.

Bosch is not Liable for Third Party Recommendations or Modifications
Bosch is not liable for damage arising from reliance on application recommendations and specification statements made by third parties regarding Bosch products.

Modification of fuel management systems should be carried out by suitably qualified personnel. It is the responsibilty of the purchaser / consumer to ensure the product is compatible with the fuel management system / vehicle used to avoid damage.
Subject to statutory warranties, Bosch is not liable for damage caused by third party recommendations or modifications.

Modification of fuel management systems may cause a vehicle to contravene state or federal emission laws and / or ADR's.
Bosch does not endorse or recommend the modification of standard vehicles and does not accept liability for damages or consequential loss related to any modification undertaken by the purchaser.

Bosch Does Not Warrant the Performance of it's Components When Used Outside their Specified or Normal Operating Range Purpose and / or Enviromental Conditions
Unless otherwise specified, Bosch components are designed, tested and produced for use with standard passenger vehicles only.Bosch does not warrant the peformance of components outside their specified or normal operating range , purpose and / or environmental conditions and, subject to statutory warranties, is not liable for any damage (consequential or otherwise) arising from their specified or normal operating range , purpose and / or environmental conditions.

A component should only be used in combination with other components which have compatible technical specifications and performance. Unless Bosch specifies otherwise, Bosch does not warrant that components will be compatible or appropriate for a particular application and it is the responsibility of the purchaser to ensure that a component is appropriate for the intended application.

Special Conditions Applicable When Ordering Some Specialised Products.
Due to the specialised nature of some of these products, they are often manufactured to order only. Certain parts listed within this information [generally parts with a "B" part number prefix] may therefore have a delivery lead time of up to ten (10) weeks from the date of order. Once orders have been placed and confirmed for these products they cannot be cancelled without penalty.

Subject to any applicable stautory warranties, Bosch warrants its components against **any manufacturing or material defects only.**

Oxygen Sensor Type Code LSM 11

"Lean" Sensor

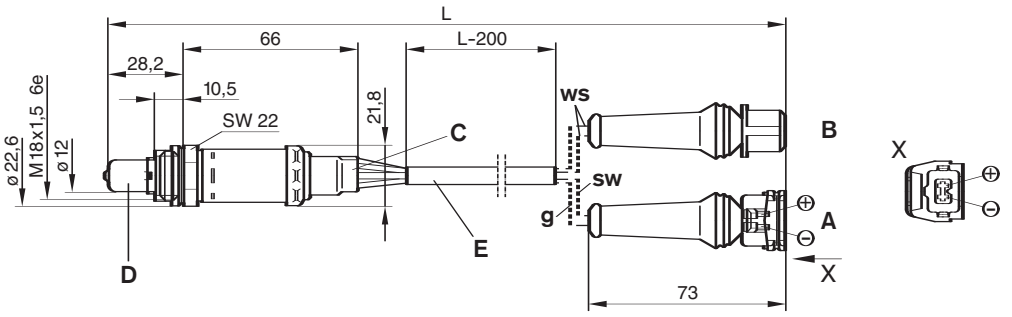
Overview
The oxygen sensor type LSM 11 is a thimble construction, zirconium dioxide sensor with integrated heater element. This sensor is a galvanic concentration cell with solid electrolyte permitting measurement of oxygen concentration in exhaust gas. These sensors have an output signal that is both stable and insensitive to interference, as well as being suitable for extreme operating conditions. Sensor output ranges from lambda = 1.00 < > 2.00, in certain applications. This sensor has various application possibilities including;

Combustion Processes
Oil burners
Gas burners
Coal-fired systems
Wood-fired systems
Industrial furnaces

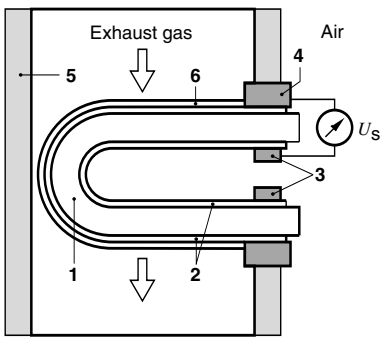
Engine Management Systems
Lean-burn engines
Gas engines

Measuring & Analysis Processes
Smoke measurement
Gas analysis (In conjunction with Air / Fuel ratio meter)

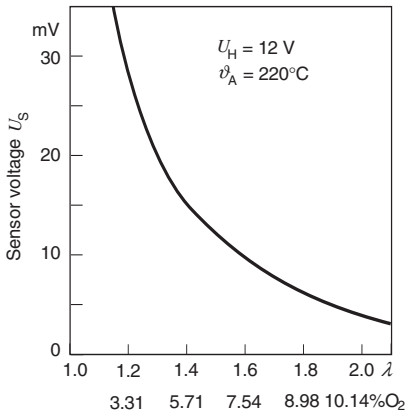
Dimension drawing.
A Signal voltage, **B** Heater voltage, **C** Cable sleeve and seals, **D** Protective tube, **E** Protective sleeve, **L** Overall length. **ws** White, **sw** Black, **g** Grey.



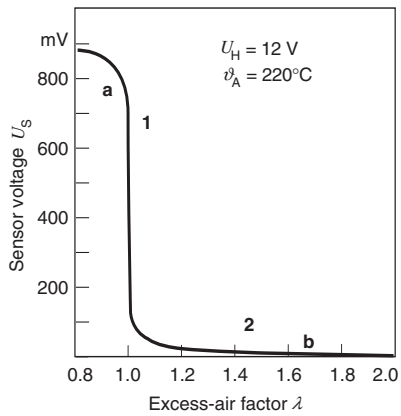
Lambda sensor in exhaust pipe (principle).
1 Sensor ceramic, **2** Electrodes, **3** Contact, **4** Housing contact, **5** Exhaust pipe, **6** Ceramic protective coating (porous).



Characteristic curve: Propane gas (lean range).

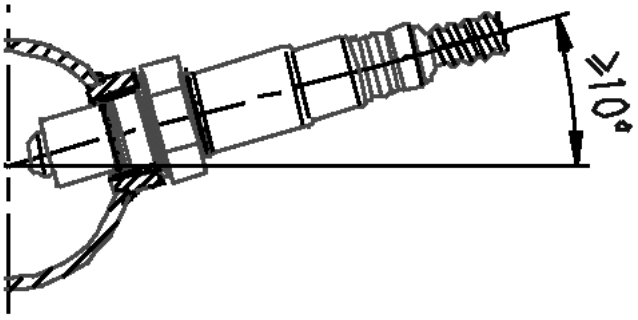


Characteristic curve: Complete range.
1 Closed-loop control λ = 1; **2** Lean control
a Rich A/F mixture, **b** Lean A/F mixture

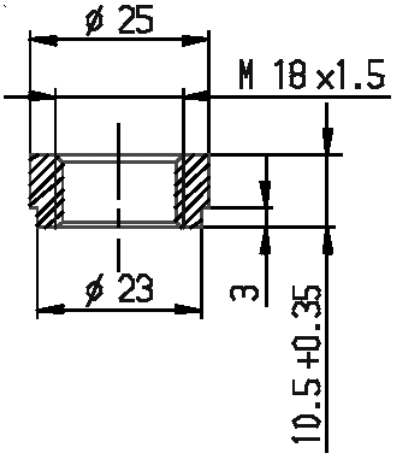


General Installation Instructions & Requirements
In general, the sensor installation point must be tested sufficiently by the customer for function and durability.

- Installation in the exhaust line must be at a point guaranteeing representative exhaust gas composition whilst also satisfying the specified temperature limits
- The sensor installation location must be selected to minimise exhaust side stressing with condensation water in order to prevent ceramic element cracking.
- Locate the sensor as close to the engine as possible, respecting maximum allowed temperature range.
- The exhaust pipe in front of the sensor should not contain any pockets, projections, protrusions, edges, flex-tubes etc. to avoid accumulation of condensation water. A downside slope of the pipe is recommended.
- Make sure, that the front hole of the double protection tube does not point against exhaust gas stream.
- Never switch on the sensor heater before engine start.
- Installation angle should be inclined at least 10 degrees towards horizontal (electrical connection upwards). Thus preventing the collection of liquids between sensor housing and sensor element during the cold start phase. Other installation angles must be in spected and tested individually.



- As the sensor receives reference air through the connection cable, the use of cleaning/greasing fluids at the sensor plug connection is not permitted.
- Assembly with special high temperature resistant grease on the screw-in thread is recommended
- Tightening torque = 40 – 60 Nm, material characteristics and strength must be appropriate.
- Recommended material for the thread boss in the exhaust pipe: Temperature resistant stainless steel to following standards; DIN 17440 1.4301 or 1.4303, SAE 30304 or 30305 (US). Thread boss dimensions should be as in sketch, note that sensor thread must be covered completel
- The sensor must be covered when underseal (wax, tar etc.) or spray oil is applied to the vehicle.
- The sensor must not be exposed to strong mechanical shocks (e.g. while the sensor is installed). Otherwise the sensor element may crack without visible damage at the sensor housing.



- Underfloor installation of the sensor remote from the engine re quires an additional check of the following points; positioning of the sensor with respect to stone impact hazard; positioning and fixing of cable and connector with respect to mechanical damage, cable bending stress and thermal stress.
- The sensor should not be exposed to continuous, one-sided drip ping of water, e.g. by the air-conditioning condensation water outlet. The thermal stress could lead to mechanical damage of the sensor.
- The sensor cable must not be soldered. It must only be crimped, clamped or secured by screws.

LSM 11 Technical Data & Specifications

General	
Sensor Part Number	
with 2500mm cable length	**0 258 104 002**
with 650mm cable length	**0 258 104 004**
Electrical connection	2 x 2 pole connectors
Connector part numbers	
for heater element	1 287 013 003
for sensor output	1 287 013 002
Mounting thread size	M18 x 1.5mm
Sensor hexagon size	SW 22
Application Conditions	
Temperature range, passive (storage temperature)	-40…+ 100° C
Sustained exhaust gas temperature with heating switched on	+ 150…+ 600° C
Permissible maximum exhaust gas temperature at sensor element with heating switched on	+ 800° C
Operating temperature	
of the sensor housing hexagon	< + 500° C
at the cable gland	< + 200° C
at the connection cable	< + 150° C
at the connector	< + 120° C
Temperature gradient at the sensor-ceramic front end	< + 100 K/s
Temperature gradient at the sensor-housing hexagon	< + 150 K/s
Load current, maximum	+/- 1 uA
Heater Element	
Nominal supply voltage (preferably AC)	12 V
Operating voltage	12…13 V
Nominal heating power for exhaust gas = 350° C & exhaust gas flow speed of ~ 0.7 m/sec at 12 V heater voltage in steady state	~16 W
Heater current at 12 V steady state	~ 1.25 A
Insulation resistance between heater and sensor connection	> 30m ohms
Data for Heater Applications	
Lambda control range	1.00…2.00
Sensor output voltage for lambda = 1.025…2.00 at exhaust gas temperature of 220° C and a flow rate of 0.4…0.9 m/sec	68…3.5 mV (2)
Sensor internal resistance in air at 20 ° C at 12 V heater voltage	< 250 ohms
Sensor voltage in air at 20° C in as-new state and at 13 V heater voltage	-9…-15 mV

Data for Heater Applications cont.

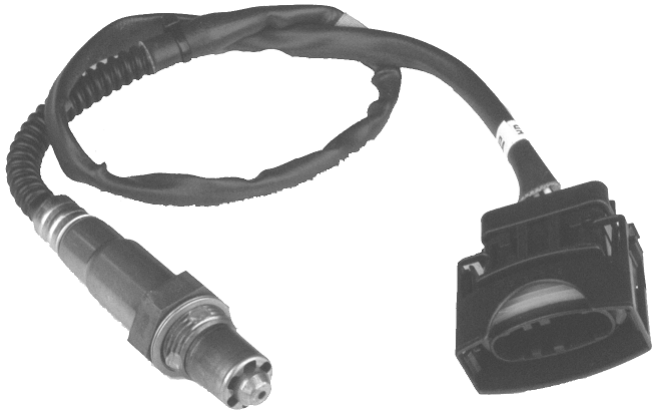
Manufacturing lambda tolerance in as-new state (standard deviation 1 s) at exhaust gas temperature of 220° C and at flow rate of ~ 0.7 m/sec	
at lambda = 1.30	< 0.013
at lambda = 1.80	< 0.050
Relative sensitivity - sensor voltage/lambda value delta at lambda = 1.30	0.65 mV/0.01
Influence of the exhaust-gas temperature on sensor signal for a temperature increase 130 to 230° C, at a flow rate < 0.7 m/sec, and lambda = 1.30 (delta lambda)	< 0.01
Influence of heater-voltage change +/- 10% of 12 V at exhaust gas temperature of 220° C	
at lambda = 1.30; lambda delta change	< +/- 0.009
at lambda = 1.80; lambda delta change	< +/- 0.035
Response time at exhaust gas temperature = 220° C and ~ 0.7 m/sec flow rate. As-new values for the 66% switching point; lambda jump = 1.10 < > 1.30	
for the jump in the "lean" direction	2.0 sec
for the jump in the "rich" direction	1.5 sec
Guideline value for sensor's "readiness for control" point to be reached after switching on oil burner and sensor heater; exhaust gas temperature ~ 220° C; flow rate ~ 1.8 m/sec; lambda = 1.45; sensor in exhaust pipe dia. 170mm	70 sec
Sensor ageing (lambda value drift) in heating-oil exhaust gas after 1,000 continuous burner operation with EL heating oil; measured at exhaust gas temperature of 220° C	
at lambda = 1.30; lambda delta change	< +/- 0.012
at lambda = 1.80; lambda delta change	< +/- 0.052
Sensor useful life at exhaust temperature of < 300° C	In individual cases to be checked by customer; guideline value ~ 10,000 hours

(2) = See characteristic curves on page D4

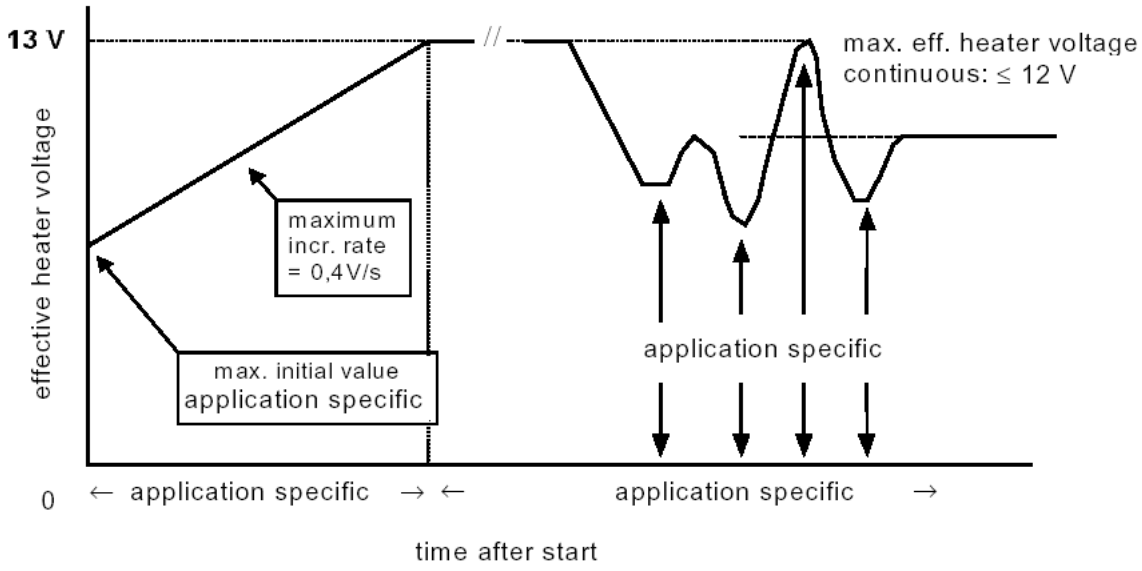
Oxygen Sensor Type Code LSU 4

“Broadband” Sensor

Overview
The Broadband oxygen sensor type LSU 4 is a Planar construction zirconium dioxide, dual cell current limiting sensor with integrated heater. Sensor output can range from l = 0.7 up to l= • (atmospheric) hence the LSU is capable of being used as a universal sensor for l = 1 application as well as various other l ranges. These sensors have been applied to petrol and diesel engines for lambda control.
The sensor connector module carries a calibration-trimming resistor that defines the characteristics of each individual sensor. This resistor is critical for the correct operation of the sensor and must not be removed, hence removal and/or exchange of the connector module is prohibited.
Due to the unique operational nature of the LSU 4 broadband oxygen sensor, they can only be operated in conjunction with a special control unit designed to support the dual measuring cells, ion pump and the complex heater management requirements.
Important Note: It is common practice for these sensors to be used in conjunction with various aftermarket air/fuel ratio measurement devices, not of Bosch design or manufacture. It should be noted that these sensors are more susceptible to damage from thermal shock than the older “Thimble” design sensors, this is mainly due to their much higher operational temperatures. As detailed below, the heater management strategy used for the LSU 4 sensor is quite complex and generally vehicle specific. Whilst these sensors are “Universal” in their measurement capabilities, they are not designed to be “Universal” in their installation position. Installation position is critical to prevent moisture settling into the sensor element during shut down; hence the sensor should never be allowed to become inverted during storage. Therefore when using these sensors for temporary air/fuel ratio measurements, i.e. chassis/engine dynamometer testing, the operator should take care to protect the sensor from moisture ingress and physical damage that may create the potential of thermal shock to the sensor element resulting in premature sensor failure.

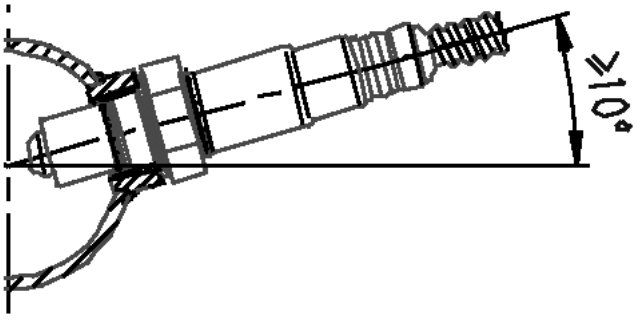


Sensor Heater Management
Due to the high operational temperature of the sensing element of the LSU sensor, complex application specific heater element control strategies are used to control sensor temperature across various operating conditions. These strategies are used to avoid sensor damage caused by thermal shock resulting in premature sensor failure. The heater supply voltage must be controlled, so that the temperature of the sensor is kept at a nominal temperature of approximately 750°C.
The heater circuit of the LSU is a pulse width modulated (PWM) control circuit allowing infinite control of the heater supply voltage to compensate for various engine, vehicle and climatic operating conditions. The table below shows some of the factors involved in mapping the control requirements of the sensor heater element.
Important Note: The sensor heating element should never be connected directly to battery voltage.

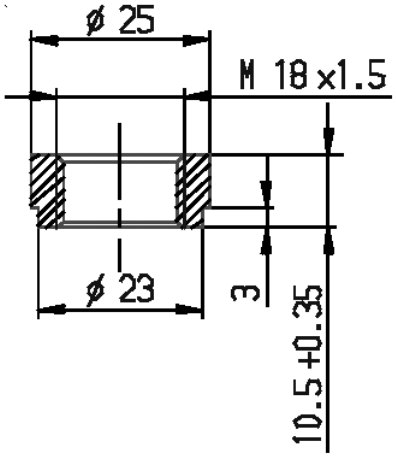


General Installation Instructions & Requirements
In general, the sensor installation point must be tested sufficiently by the customer for function and durability.

- Installation in the exhaust line must be at a point guaranteeing representative exhaust gas composition whilst also satisfying the specified temperature limits
- The heater power must always be switched on power controlled, starting with a maximum ramp up nominal voltage as described in the sensor specifications. This is to reduce thermal stress of the sensor element at cold start due to high peak power in the first seconds.
- The sensor installation location must be selected to minimise exhaust side stressing with condensation water in order to prevent ceramic element cracking.
- Locate the sensor as close to the engine as possible, respecting maximum allowed temperature range.
- The exhaust pipe in front of the sensor should not contain any pockets, projections, protrusions, edges, flex-tubes etc. to avoid accumulation of condensation water. A downside slope of the pipe is recommended.
- Make sure, that the front hole of the double protection tube does not point against exhaust gas stream.
- Never switch on the sensor heating control unit before engine start.
- Delay of sensor heater start or power control of the sensor heater as a function of engine and ambient temperature.
- Installation angle should be inclined at least 10 degrees towards horizontal (electrical connection upwards). Thus preventing the collection of liquids between sensor housing and sensor element during the cold start phase. Other installation angles must be inspected and tested individually.



- As the sensor receives reference air through the connection cable, the use of cleaning/greasing fluids at the sensor plug connection is not permitted.
- Assembly with special high temperature resistant grease on the screw-in thread is recommended
  Tightening torque = 40 – 60 Nm, material characteristics and strength must be appropriate.
- Recommended material for the thread boss in the exhaust pipe: Temperature resistant stainless steel to following standards; DIN 17440 1.4301 or 1.4303, SAE 30304 or 30305 (US). Thread boss dimensions should be as in sketch, note that sensor thread must be covered completely.
  The sensor must be covered when underseal (wax, tar etc.) or spray oil is applied to the vehicle.
- The sensor must not be exposed to strong mechanical shocks (e.g. while the sensor is installed). Otherwise the sensor element may crack without visible damage at the sensor housing.
- Underfloor installation of the sensor remote from the engine requires an additional check of the following points; positioning of the sensor with respect to stone impact hazard; positioning and fixing of cable and connector with respect to mechanical damage, cable bending stress and thermal stress.
- The sensor should not be exposed to continuous, one-sided drip ping of water, e.g. by the air-conditioning condensation water out let. The thermal stress could lead to mechanical damage of the sensor.



LSU 4 Technical Data & Specifications

General	
Sensor Part Number (as example)	
with 650mm cable length	**0 258 006 065**
with 460mm cable length	**0 258 006 066**
Electrical connection	6 pole connector module (with integrated trim resistor)
Connector part number	D 261 205 138
Mounting thread size	M18 x 1.5mm
Sensor hexagon size	SW 22
Application Conditions	
Temperature range, passive (storage temperature)	-40…+ 100° C
Permissible maximum exhaust gas temperature at sensor element with heating switched on. Note: If the exhaust gas temperature of 850° C is exceeded, the heater power must be switched off. In this case the accuracy of the sensor signal is limited.	< + 980° C (max 250 h in 10 min intervals)
Operating temperature	
of the sensor housing hexagon	< + 570° C
at the cable gland	< + 200° C
at the connection cable	< + 150° C
at the connector	< + 120° C
Maximum current load of lambda = 1 Nernst cell	< 10 uA
Maximum pumping current into pump cell	
for rich gas signal	> - 9 mA
for lean gas signal	< 18 mA
Heater Element	
Nominal supply voltage, test voltage	9 V
Maximum permissible effective heater voltage at sensor element temperature of < 900° C	
short time < 200 hours	< 13 V
continuous	< 12 V
Minimum frequency of heater voltage control	
at supply voltage (peak) < 16 V	> 2 Hz
at supply voltage (peak) < 28 V	> 10 Hz
Nominal heating power for exhaust gas = 350° C & exhaust gas flow speed of ~ 0.7 m/sec at 9 V heater voltage	~10 W
Insulation resistance between heater and sensor connection	> 30m ohms
Initial heater voltage is dependent on start temperature of sensor; nominal values at	
- 40° C	7.4 V
- 10° C	7.8 V
+ 20° C	8.2 V
+ 50° C	8.6 V
Maximum heater voltage increase during warm-up phase	< 0.4 V/sec
Nominal heater cold resistance at ambient temperature for new sensor, including cable and connector	
at 20° C	3.2 ohms
at - 40° C	2.1 ohms

Data for Measurement Applications

Lambda control range	0.70…infinity
Sensor internal resistance at 750° C	~ 80 ohms
Guideline value for sensor "light-off time" to be reached after switching on sensor heater; exhaust gas temperature ~ 20° C	< 20 sec
Sensor ageing (lambda value drift) in calibration gas; measured at exhaust gas temperature of 20° C	
at lambda = 1.70; lambda delta change	+/- 0.20
at lambda = 0.80; lambda delta change	+/- 0.04
Sensor useful life at exhaust temperature of < 300° C	> 160,000 km dependent on installation compliance