FUNCTIONAL SAFETY ASSESSMENT

This certifies, that the company

Sensitron S.r.l.
Via della Repubblica, 48
20010 Cornaredo (MI) - ITALY

.

Manufacturing plant: **Sensitron S.r.l.**
Via della Repubblica, 48
20010 Cornaredo (MI) - ITALY

Is authorized to provide the product mentioned below with the mark as illustrated

Description of product: (Details see Annex 1)

Detector SMART3G with Electrochemical Sensor
Detector SMART3G with intelligent Infrared Sensor
Detector SMART3G with Pellistor Sensor
Detector SMART3G-Gr1
Detector SMART3G-D2
Detector SMART3G-C2
Detector SMART3G-D3
Detector SMART3G-C3

Detector SMART3-R with Electrochemical Sensor
Detector SMART3-R with intelligent Infrared Sensor
Detector SMART3-R with Pellistor Sensor

Tested in accordance with: **EN 61508: 2010 Parts 1, 2, 3, 4, 5, 6, 7**
EN 50402: 2017

Inspection & Certification Services TÜV NORD Italia S.r.l.

Registration No. 23 23874 01 rev.2
Test Report No. PS-23874-23-M rev. 2
File reference 23874-01

Validity
from 2023-10-10
until 2026-08-25

TÜV NORD Italia S.r.l. (TÜV NORD Group)
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Cerro Maggiore, 2023-10-10
prodotto@tuev-nord.it

Please also pay attention to the information stated overleaf

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Product description

Detector SMART3G with Electrochemical Sensor

The SMART3G detector is consisting of an EC sensing element operated in diffusion mode and protected by a membrane against dust. The signal of the sensing element will be amplified, processed and normalized in relation to the measuring range of 0 – 25(30) %Vol. oxygen or 0 – 300(500) ppm CO. The measuring range and the target gas are depending on the type of sensing element. The signal output is linear and will be realised alternatively by an analogue 4 – 20 mA signal or a digital output.

Detector SMART3G with intelligent Infrared Sensor

The SMART3G detector is consisting of an intelligent IR sensor (with microprocessor) operated in diffusion mode. The signal of the sensing element will be amplified and linearized in the intelligent sensor, processed and normalized in relation to the measuring range of 0 – 100 % of the LEL. The signal output is linear and will be made alternatively by an analogue 4 – 20 mA signal or a digital output.

Detector SMART3G with Pellistor Sensor

The SMART3G detector is consisting of a Pellistor sensing element operated in diffusion mode and protected by a sintered metal. The signal of the sensing element will be amplified, processed and normalized in relation to the measuring range of 0 – 100 % of the LEL. The signal output is linear and will be made alternatively by an analogue 4 – 20 mA signal or a digital output.

Detector SMART3G-Gr1

SMART3G detector fitted into Group I Mines and Tunnels suitable housings.

Detector SMART3G-D2

SMART3G detector fitted into Zone 1 Category 2 areas suitable housings. The detector comes with a display

Detector SMART3G-C2

SMART3G detector fitted into Zone 1 Category 2 areas suitable housings. Without display

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Detector SMART3G-D3

SMART3G detector fitted into Zone 2 Category 3 areas suitable housings. The detector comes with a display

Detector SMART3G-C3

SMART3G detector fitted into Zone 2 Category 3 areas suitable housings. Without display

Detector SMART3-R with Electrochemical Sensor

The SMART3-R detector is consisting of an EC sensing element operated in diffusion mode and protected by a membrane against dust. The signal of the sensing element will be amplified, processed and normalized in relation to the measuring range of 0 – 25(30) %Vol. oxygen or 0 – 300(500) ppm CO. The measuring range and the target gas are depending on the type of sensing element. The signal output is linear and will be realized alternatively by an analogue 4 – 20 mA signal or a digital output.

Detector SMART3-R with intelligent Infrared Sensor

The SMART3-R detector is consisting of an intelligent IR sensor (with microprocessor) operated in diffusion mode. The signal of the sensing element will be amplified and linearized in the intelligent sensor, processed and normalized in relation to the measuring range of 0 – 100 % of the LEL. The signal output is linear and will be realised alternatively by an analogue 4 – 20 mA signal or a digital output.

Detector SMART3-R with Pellistor Sensor

The SMART3-R detector is consisting of a Pellistor sensing element operated in diffusion mode and protected by a sintered metal. The signal of the sensing element will be amplified, processed and normalized in relation to the measuring range of 0 – 100 % of the LEL. The signal output is linear and will be realised alternatively by an analogue 4 – 20 mA signal or a digital output.

Operating temperature range
-40 to +60 °C with IR sensor and Pellistors
-40 to +50 °C with cells

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Storage temperature range
-20 to +60 °C

Operating humidity range
5-95% non-condensing

Type designation:

Detector SMART3G with Electrochemical Sensor

FW Version: 04.01.01
HW Version: 2

Detector SMART3G with intelligent Infrared Sensor

FW Version: 04.01.01
HW Version: 2

Detector SMART3G with Pellistor Sensor

FW Version: 04.01.01
HW Version: 2

Detector SMART3-R with Electrochemical Sensor

FW Version: 04.01.01
HW Version: 2

Detector SMART3-R with intelligent Infrared Sensor

FW Version: 04.01.01
HW Version: 2

Detector SMART3-R with Pellistor Sensor

FW Version: 04.01.01
HW Version: 2

Refer to the internal document DN 1.8

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Safety related data:

Single channel use of SMART3G detector with EC sensor

For the calculation of PFD the proof test interval T1 is specified with 1 year and the average time for repair (MTTR) is specified with 24 hours. Implementing the assumed values for the sensing element to the PFD calculation leads to the following results:

Safety Function	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}	SFF	PFD	% of SIL 2
4 – 20 mA output	1,12E-09	1,53E-06	7,80E-08	1,23E-07	92,89%	5,44E-04	15,54%
Digital output RS 485	1,00E-09	1,53E-06	7,80E-08	1,20E-07	93,06%	5,29E-04	15,11%

Failure rates for **λ** are given per hour.

The column "% of SIL 2" considers the percentage of that rate ($3,5 \times 10^{-3}$) which is commonly accepted as maxim subsystem (= detector). The values achieved for the two different safety functions are 15,37% and 14,97% of the sensor subsystem of a SIL 2 overall safety system. In both cases the SFF is well above the required 90%.

Redundant use of SMART3G detector with EC sensor

For redundant use the probability of common failures which would occur in both channels at the same time has to be considered. The formulas for the PFD calculation for a 1 out of 2 (1oo2) are specifying a "β-factor" for the rate of common failures within the total rate of dangerous undetected failures. For the complete detector including sensing element a β-factor of 10 % will be assumed as conservative approach. This leads to the following results:

Safety Function	PFD	% of SIL 3
4 – 20 mA output	2,75E-05	7,86%
Digital output RS 485	2,68E-05	7,66%

The column "% of SIL 3" considers the percentage of that rate ($3,5 \times 10^{-4}$) which is commonly accepted as maxim subsystem (= detector). The values achieved for the two different safety functions are 15,45% and 15,06% of the sensor subsystem of a SIL 3 overall safety system.

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Because the software of the detector is compliant with SIL 3 the redundant use of two detectors in a 1oo2 a full compliance with SIL 3 in combination with a Galileo central unit.

Single channel use of SMART3G detector with intelligent IR sensor

For the calculation of PFD the proof test interval T1 is specified with 1 year and the average time for repair (MTTR) with 24 hours. Implementing the assumed values for the sensing element to the PFD calculation leads to

Safety Function	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}	SFF	PFD	% of SIL 2
4 – 20 mA	1,60E-08	5,01E-07	4,14E-07	3,21E-08	96,66%	1,51E-04	5,29%
Digital output	1,59E-08	4,89E-07	4,14E-07	2,88E-08	96,97%	1,37E-04	3,91%

Failure rates for **λ** are given per hour.

The column "% of SIL 2" considers the percentage of that rate ($3,5 \times 10^{-3}$) which is commonly accepted as maxim subsystem (= detector). The values achieved for the two different safety functions are 15,2% and 4,37% of this m sensor subsystem of a SIL 2 overall safety system. In both cases the SFF is well above the required 90%.

Redundant use of SMART3G detector with intelligent IR sensor

For redundant use the probability of common failures which would occur in both channels at the same time has to be considered. The formulas for the PFD calculation for a 1 out of 2 (1oo2) are specifying a "β-factor" for the rate of common failures within the total rate of dangerous undetected failures. For the complete detector including sensing element a β-factor of 10 % will be assumed as conservative approach. This leads to the following results:

Safety Function	PFD	% of SIL 3
4 – 20 mA output	7,60E-06	2,17%
Digital output RS 485	6,85E-06	1,96%

The column "% of SIL 3" considers the percentage of that rate ($3,5 \times 10^{-4}$) which is commonly accepted as maxim subsystem (= detector). The values achieved for the two different safety functions are 15,2% and 2,2% of this m

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sensor subsystem of a SIL 3 overall safety system.

Because the software of the detector is compliant with SIL 3 the redundant use of two detectors in a 1oo2 a full compliance with SIL 3 in combination with a Galileo central unit.

Single channel use of SMART3G detector with Pellistor sensor

For the calculation of PFD the proof test interval T1 is specified with 1 year and the average time for repair (MTTR) is specified with 24 hours. Implementing the assumed values for the sensing element to the PFD calculation leads to the following results:

Safety Function	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}	SFF	PFD	% of SIL 2
4 – 20 mA output	1,60E-08	1,32E-06	9,29E-08	1,10E-07	92,84%	4,88E-04	13,94%
Digital output RS 485	1,59E-08	1,31E-06	9,29E-08	1,07E-07	92,99%	4,73E-04	13,51%

Failure rates for **λ** are given per hour.

The column "% of SIL 2" considers the percentage of that rate ($3,5 \times 10^{-3}$) which is commonly accepted as maxim subsystem (= detector). The values achieved for the two different safety functions are 13,68% and 13,37% of the sensor subsystem of a SIL 2 overall safety system.

In both cases the SFF is well above the required 90%.

Redundant use of SMART3G detector with Pellistor sensor

For redundant use the probability of common failures which would occur in both channels at the same time has to be considered. The formulas for the PFD calculation for a 1 out of 2 (1oo2) are specifying a "β-factor" for the rate of common failures within the total rate of dangerous undetected failures. For the complete detector including sensing element a β-factor of 10 % will be assumed as conservative approach. This leads to the following results:

Safety Function	PFD	% of SIL 3

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4 – 20 mA output	2,47E-05	7,06%
Digital output RS 485	2,39E-05	6,83%

The column "% of SIL 3" considers the percentage of that rate ($3,5 \times 10^{-4}$) which is commonly accepted as maxim subsystem (= detector). The values achieved for the two different safety functions are 13,77% and 13,46% of the sensor subsystem of a SIL 3 overall safety system.

Because the software of the detector is compliant with SIL 3 the redundant use of two detectors in a 1oo2 combination leads to a full compliance with SIL 3 in combination with a Galileo central unit.

Single channel use of SMART3-R detector with EC sensor

For the calculation of PFD the proof test interval T1 is specified with 1 year and the average time for repair (MTTR) is specified with 24 hours. Implementing the assumed values for the sensing element to the PFD calculation leads to the following results:

Safety Function	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}	SFF	PFD	% of SIL 2
4 – 20 mA, RS485 and 3-relays outputs	1,20E-10	1,84E-06	7,20E-08	1,37E-07	93,31%	6,06E-04	17,31%

Failure rates for **λ** are given per hour.

The column "% of SIL 2" considers the percentage of that rate ($3,5 \times 10^{-3}$) which is commonly accepted as maxim subsystem (= detector). The values achieved for the two different safety functions are 14,60% and 14,74% of the sensor subsystem of a SIL 2 overall safety system. In both cases the SFF is well above the required 90%.

Redundant use of SMART3-R detector with EC sensor

For redundant use the probability of common failures which would occur in both channels at the same time has to be considered. The formulas for the PFD calculation for a 1 out of 2 (1oo2) are specifying a "β-factor" for the rate of common failures within the total rate of dangerous undetected failures. For the complete detector including sensing element a β-factor of 10 % will be assumed as conservative approach. This leads to the following results:

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Safety Function	PFD	% of SIL 3
4 – 20 mA, RS485 and 3-relays outputs	3,08E-05	8,8%

The column "% of SIL 3" considers the percentage of that rate ($3,5 \times 10^{-4}$) which is commonly accepted as maxim subsystem (= detector). The values achieved for the two different safety functions are 14,69% and 14,83% of the sensor subsystem of a SIL 3 overall safety system.

Because the software of the detector is compliant with SIL 3 the redundant use of two detectors in a 1oo2 a full compliance with SIL 3 in combination with a Galileo central unit.

Single channel use of SMART3-R detector with intelligent IR sensor

For the calculation of PFD the proof test interval T1 is specified with 1 year and the average time for repair (MTTR) is specified with 24 hours. Implementing the assumed values for the sensing element to the PFD calculation leads to the following results:

Safety Function	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}	SFF	PFD	% of SIL 2
4 – 20 mA, RS485 and 3-relays outputs	1,50E-08	7,92E-07	4,33E-07	4,56E-08	92,45%	2,11E-04	6,03%

Failure rates for λ are given per hour.

The column "% of SIL 2" considers the percentage of that rate ($3,5 \times 10^{-3}$) which is commonly accepted as maxim subsystem (= detector). The values achieved for the two different safety functions are 14,6% and 4,20% of this sensor subsystem of a SIL 2 overall safety system. In both cases the SFF is well above the required 90%.

Redundant use of SMART3-R detector with intelligent IR sensor

For redundant use the probability of common failures which would occur in both channels at the same time has to be considered. The formulas for the PFD calculation for a 1 out of 2 (1oo2) are specifying a "β-factor" for the rate of common failures within the total rate of dangerous undetected failures.

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For the complete detector including sensing element a β-factor of 10 % will be assumed as conservative approach. This leads to the following results:

Safety Function	PFD	% of SIL 3
4 – 20 mA, RS485 and 3-relays outputs	1,06E-05	3,03%

The column "% of SIL 3" considers the percentage of that rate ($3,5 \times 10^{-4}$) which is commonly accepted as maxim subsystem (= detector). The values achieved for the two different safety functions are 14,65% and 2,11% of this m sensor subsystem of a SIL 3 overall safety system.

Because the software of the detector is compliant with SIL 3 the redundant use of two detectors in a 1oo2 a full compliance with SIL 3 in combination with a Galileo central unit.

Single channel use of SMART3-R detector with Pellistor sensor

For the calculation of PFD the proof test interval T1 is specified with 1 year and the average time for repair (MTTR) is specified with 24 hours. Implementing the assumed values for the sensing element to the PFD calculation leads to the following results:

Safety Function	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}	SFF	PFD	% of SIL 2
4 – 20 mA, RS485 and 3-relays outputs	1,50E-08	1,63E-06	8,69E-08	1,25E-07	93,28%	5,51E-04	15,74%

Failure rates for **λ** are given per hour.

The column "% of SIL 2" considers the percentage of that rate ($3,5 \times 10^{-3}$) which is commonly accepted as maxim subsystem (= detector). The values achieved for the two different safety functions are 12,97% and 13,03% of the sensor subsystem of a SIL 2 overall safety system.

In both cases the SFF is well above the required 90%.

Redundant use of SMART3-R detector with Pellistor sensor

For redundant use the probability of common failures which would occur in both channels at the same time has to be considered. The formulas for the

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PFD calculation for a 1 out of 2 (1oo2) are specifying a “β-factor” for the rate of common failures within the total rate of dangerous undetected failures. For the complete detector including sensing element a β-factor of 10 % will be assumed as conservative approach. This leads to the following results:

Safety Function	PFD	% of SIL 3
4 – 20 mA, RS485 and 3-relays outputs	2,79E-05	7,97%

The column “% of SIL 3” considers the percentage of that rate ($3,5 \times 10^{-4}$) which is commonly accepted as maxim subsystem (= detector). The values achieved for the two different safety functions are 13,02% and 13,08% of the sensor subsystem of a SIL 3 overall safety system.

Because the software of the detector is compliant with SIL 3 the redundant use of two detectors in a 1oo2 combination leads to a full compliance with SIL 3 in combination with a Galileo central unit

Conditions for safe use:

Detector SMART3G with Electrochemical Sensor

The values for the SIL-Capability of the SMART3G detector and the determined failure rates are valid only if the following conditions for use will be obeyed (responsibility of the user).
The detector has to be placed at a position suitable for the measuring application, to be connected correctly to the central unit and to be put into operation by Sensitron or an authorized installer company.
Analogue output: A signal of 3mA is under scale condition; from 20 to 21.6 will be indicated as concentration above 100% LEL. Signals < 2 mA (fail low) and > 22 mA (fail high) have to be recognized by the central unit as detector fault. If a central unit from Sensitron is used this is ensured automatically.
Digital output: The detector has to be connected to a central unit from Sensitron, which will send and receive the high safety data protocol for the communication with the detector.
The environmental parameters (e.g. the ranges for temperature, humidity and pressure) specified in the user manual have to be observed and followed.
The SMART3G detector has to be maintained regularly following the instructions and to be calibrated using a certified calibration gas mixture.
The proof test has to be carried out minimum once per year. As proof test a regular calibration using a certified calibration gas mixture has to be carried out without additional requirements.

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Detector SMART3G with Intelligent Infrared Sensor

The values for the SIL-Capability of the SMART3G detector and the determined failure rates are valid only if the following conditions for use will be obeyed (responsibility of the user).
The detector has to be placed at a position suitable for the measuring application, to be connected correctly to the central unit and to be put into operation by Sensitron or an authorized installer company.
Analogue output: A signal of 3mA is under scale condition; from 20 to 21.6 will be indicated as concentration above 100% LEL. Signals < 2 mA (fail low) and > 22 mA (fail high) have to be recognized by the central unit as detector fault. If a central unit from Sensitron is used this is ensured automatically.
Digital output: The detector has to be connected to a central unit from Sensitron, which will send and receive the high safety data protocol for the communication with the detector.
The environmental parameters (e.g. the ranges for temperature, humidity and pressure) specified in the user manual have to be observed and followed.
The SMART3G detector has to be maintained regularly following the instructions and to be calibrated using a certified calibration gas mixture.
The proof test has to be carried out minimum once per year. As proof test a regular calibration using a certified calibration gas mixture has to be carried out without additional requirements.

Detector SMART3G with Pellistor Sensor

The values for the SIL-Capability of the SMART3G detector and the determined failure rates are valid only if the following conditions for use will be obeyed (responsibility of the user).
The detector has to be placed at a position suitable for the measuring application, to be connected correctly to the central unit and to be put into operation by Sensitron or an authorized installer company.
Analogue output: A signal of 3mA is under scale condition; from 20 to 21.6 will be indicated as concentration above 100% LEL. Signals < 2 mA (fail low) and > 22 mA (fail high) have to be recognized by the central unit as detector fault. If a central unit from Sensitron is used this is ensured automatically.
Digital output: The detector has to be connected to a central unit from Sensitron, which will send and receive the high safety data protocol for the communication with the detector.
The environmental parameters (e.g. the ranges for temperature, humidity

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and pressure) specified in the user manual have to be observed and followed.
The SMART3G detector has to be maintained regularly following the instructions and to be calibrated using a certified calibration gas mixture.
It has to be ensured that the SMART3G detector with Pellistor sensor has no contact with traces of one of the following poisoning agents which may destroy the catalyst of the sensing element:

- Silicone vapours (e.g. in polishes, waterproof agents, silicone grease or plasticizer)
- Organic phosphorous compounds (e.g. herbicide or insecticide)
- Halogen compounds (e.g. inorganic or organic chlorine or fluorine compounds)
- Sulphur compounds (e.g. hydrogen sulphide or sulphur organic compounds)

If the presence of one of the mentioned poisons for the catalytic sensor will be expected an IR sensor e.g. SMART3G IR or should be used instead of the Pellistor sensor.
If none of the mentioned poisons is expected but the presence cannot be excluded short calibration intervals are recommended which may be enlarged if no negative effect will be recognized during normal operation.
The proof test has to be carried out minimum once per year. As proof test a regular calibration using a certified calibration gas mixture has to be carried out without additional requirements.

Detector SMART3-R with Electrochemical Sensor

The values for the SIL-Capability of the SMART3G detector and the determined failure rates are valid only if the following conditions for use will be obeyed (responsibility of the user).
The detector has to be placed at a position suitable for the measuring application, to be connected correctly to the central unit and to be put into operation by Sensitron or an authorized installer company.
Analogue output: A signal of 3mA is under scale condition; from 20 to 21.6 will be indicated as concentration above 100% LEL. Signals < 2 mA (fail low) and > 22 mA (fail high) have to be recognized by the central unit as detector fault. If a central unit from Sensitron is used this is ensured automatically.
Digital output: The detector has to be connected to a central unit from Sensitron, which will send and receive the high safety data protocol for the communication with the detector.
The environmental parameters (e.g. the ranges for temperature, humidity and pressure) specified in the user manual have to be observed and

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followed.
The SMART3G detector has to be maintained regularly following the instructions and to be calibrated using a certified calibration gas mixture.
The proof test has to be carried out minimum once per year. As proof test a regular calibration using a certified calibration gas mixture has to be carried out without additional requirements.

Detector SMART3-R with Intelligent Infrared Sensor

The values for the SIL-Capability of the SMART3-R detector and the determined failure rates are valid only if the following conditions for use will be obeyed (responsibility of the user).
The detector has to be placed at a position suitable for the measuring application, to be connected correctly to the central unit and to be put into operation by Sensitron or an authorized installer company.
Analogue output: A signal of 3mA is under scale condition; from 20 to 21.6 will be indicated as concentration above 100% LEL. Signals < 2 mA (fail low) and > 22 mA (fail high) have to be recognized by the central unit as detector fault. If a central unit from Sensitron is used this is ensured automatically.
Digital output: The detector has to be connected to a central unit from Sensitron, which will send and receive the high safety data protocol for the communication with the detector.
The environmental parameters (e.g. the ranges for temperature, humidity and pressure) specified in the user manual have to be observed and followed.
The SMART3-R detector has to be maintained regularly following the instructions and to be calibrated using a certified calibration gas mixture.
The proof test has to be carried out minimum once per year. As proof test a regular calibration using a certified calibration gas mixture has to be carried out without additional requirements.

Detector SMART3-R with Pellistor Sensor

The values for the SIL-Capability of the SMART3G detector and the determined failure rates are valid only if the following conditions for use will be obeyed (responsibility of the user).
The detector has to be placed at a position suitable for the measuring application, to be connected correctly to the central unit and to be put into operation by Sensitron or an authorized installer company.
Analogue output: A signal of 3mA is under scale condition; from 20 to 21.6 will be indicated as concentration above 100% LEL. Signals < 2 mA (fail low) and > 22 mA (fail high) have to be recognized by the central unit as

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detector fault. If a central unit from Sensitron is used this is ensured automatically.
Digital output: The detector has to be connected to a central unit from Sensitron, which will send and receive the high safety data protocol for the communication with the detector.
The environmental parameters (e.g. the ranges for temperature, humidity and pressure) specified in the user manual have to be observed and followed.
The SMART3G detector has to be maintained regularly following the instructions and to be calibrated using a certified calibration gas mixture.
It has to be ensured that the SMART3G detector with Pellistor sensor has no contact with traces of one of the following poisoning agents which may destroy the catalyst of the sensing element:

- Silicone vapours (e.g. in polishes, waterproof agents, silicone grease or plasticizer)
- Organic phosphorous compounds (e.g. herbicide or insecticide)
- Halogen compounds (e.g. inorganic or organic chlorine or fluorine compounds)
- Sulphur compounds (e.g. hydrogen sulphide or sulphur organic compounds)

If the presence of one of the mentioned poisons for the catalytic sensor will be expected an IR sensor e.g. SMART3G IR or should be used instead of the Pellistor sensor.
If none of the mentioned poisons is expected but the presence cannot be excluded short calibration intervals are recommended which may be enlarged if no negative effect will be recognized during normal operation.
The proof test has to be carried out minimum once per year. As proof test a regular calibration using a certified calibration gas mixture has to be carried out without additional requirements.