



User Manual



Gas Detector

Teta EcoWent / Teta EcoN

Product code: PW-105-CO / PW-111-NO2



We design, manufacture, implement and support:
Systems for Monitoring, Detection and Reduction of gas hazards








For more details please visit our website www.atestgaz.pl

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Remarks and reservations

-  Read and understand this manual prior to connection and operation of the device. Keep the User Manual with the device for future reference.
-  The manufacturer shall not be held responsible for any errors, damage or defects caused by improper selection of suitable devices or cables, errors in installation of equipment or any misuse due to failure to understand the document content.
-  Unauthorised repairs and modifications of the device are not allowed. The manufacturer shall discard any responsibility for consequences of such actions.
-  Exposure of the device to the impact of excessive mechanical, electric or environmental factors may lead to damage of the device.
-  Operation of damaged or incomplete devices is not allowed.
-  Engineering of a gas detection system for any specific facilities to be safeguarded may need consideration of other requirements during the entire lifetime of the product.
-  Use of unauthorized spare parts different from the ones listed in Table 6 is strictly forbidden.

How to use this manual?

-  Important fragments of the text are highlighted in the following way:



Pay extreme attention to information provided in such framed boxes.


-  This User Manual consists of a main text and attached appendices. The appendices are independent documents and can be used separately from this Manual. Page numbering of appendices starts anew with no relationship to page numbering of the main document and appendices may have their own tables of contents. In the right bottom corner of each page you can find the name (symbol) of any document included into the User Manual package with its revision (issue) number.

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1 General information










1.1 Application field

Gas detectors Teta EcoWent and Teta EcoN are designed as crucial components of the Teta Gas system for monitoring of hazardous gas concentrations and are dedicated to detect excessive (hazardous) concentrations of carbon oxide and nitrogen dioxide in public access facilities, in particular in underground garages and car parks.



Teta EcoWent and Teta EcoN gas detector are not designed for operation in areas with potentially explosive atmospheres.

Key features of gas detectors:

-  Power supply and data transmission via a single two-core cable.
-  Safe installation with low power supply voltage of any polarization.
-  Easy assembling and networking.
-  Possibility to couple with the Teta MiniDet gas detector and to set up a pair of collaborating devices for combined detection of CO and LPG concentrations.
-  Simple and clear procedure to assign and verify addresses of individual detectors within a gas monitoring network.
-  Possibility to verify status of individual detectors by means of the supervising control unit.
-  Optional calibration of the detector parameters by replacement of the detector PCB (electronics board) – very short time of calibration.
-  Three alarm thresholds.
-  Indication of detector faults.

1.2 Operation principle

Gas detectors are crucial components of any system for gas detection. They are designed for periodical measurements of gas concentration in ambient air. Information that the settings for concentration thresholds are exceeded is shown by means of dedicated light indicators (LEDs) provided on the side wall of the detector housing (see Figure 1) and transmitted via a digital output line.


Presence of hazardous gases is detected by means of electrochemical sensors. Such a solution enables high insensitivity to variations of ambient conditions, such as temperature, humidity or pressure. The sensor also distinguishes with high immunity to presence of disturbing chemical compounds (e.g. methane, isobutene or carbon dioxide), which eliminates occurrence of faked alarms.

The sensor applied in our detectors demonstrates slight sensitivity to hydrogen and fumes vapours of ethanol, but for typical applications such gases occur only sporadically and in small amounts. Please refer to Appendix [2] for more details about electrochemical sensors.

Teta EcoWent detectors can directly collaborate with Teta MiniDet devices (by direct coupling by means of X2 terminal) and make up a paired unit that enables simultaneous detection of carbon monoxide (CO) and LPG (C₃H₈ and C₄H₁₀)¹.

¹ Sensors are calibrated with the use of gaseous propane C₃H₈.

Operation of gas detector consists in periodical measurements of hazardous gases in their vicinity with continuous averaging of measurement results. Momentary concentration of gases are measured with the time period of 1 second and average concentrations are calculated. These measurements enable reporting of warnings or alarms.

 for CO/NO₂:

- Alarm 1 or Alarm 2 is raised against the average concentrations of hazardous gases during the most recent 5 minutes,
- Alarm 3 is reported when the momentary concentration exceeds the threshold limit during the time period of 1 minute,

 for LPG:



- Conditions for Alarm 1 and Alarm 2 are established against average concentration for the most recent one minute,
- Alarm 3 is generated when any momentary concentration exceeds the threshold limit.

Depending on results of the foregoing actions the system may adopt various statuses that are described in subsequent paragraphs

1.2.1 Operation

It is the status when the gas detector is in sound working conditions and takes regular measurements.


Measurement results for the monitored gas still remain below threshold limits and no irregularities in operation of the equipment are detected. The detector needs no particular attention of personnel beside:

-  regular and frequent verification of indications, preferably under daily basis,
-  periodical inspection and calibration (see Section 7.7.1).

1.2.2 Alarm 1 (threshold 1) / Alarm 2 (threshold 2)



It is the device status when only slight concentrations of hazardous gases are detected and advising the personnel is needed.

Under such circumstances the operator should undertake the following actions:

-  check possible reasons that may include:
 - appearing of gas in facilities monitored by the system,
 - interference of the detector operation by foreign substances (e.g. solvents of high concentration or fuel fumes) – such substances must be expelled from monitored facilities,
 - offset of the characteristic curve – as the times goes by the detector tend to drift with an offset of the null point. Therefore detectors must be regularly calibrated, otherwise the alarm thresholds (for Alarm 1 or Alarm 2) may offset to the area of pure air, i.e. the situation when competent inspectors have checked by means of appropriate instruments that no gas or interfering substances are present at the facilities.

1.2.3 Alarm 3 (threshold 3)





This status is adopted when concentration of hazardous gases exceeds the third threshold during the time period longer than one minute. If so, the necessary actions shall include:

-  evacuation of third persons from the endangered area,
-  if possible, enable ventilation of endangered confined spaces, e.g. open windows and doors (unless the control unit automatically switched the ventilation system on).

1.2.4 Failure

In parallel to measurements of gas concentration the detector carries out a series of self-test measurements to verify fault-free operation of the sensor and the gas monitoring system as a whole.

The defects indicated by the gas detectors may include:

-  problems with built-in gas sensors,
-  error of communication with the control unit,
-  incorrect configuration,
-  interrupted /broken connection with the Teta MiniDet detector.

1.2.5 Warm – up

After power on the detector need some time to stabilize operation parameters of sensors. It is the time period when no measurements are taken. Such a warm-up procedure takes about two minutes and the detector starts normal operation.

2 Safety



Do never install gas detectors at locations exposed to direct effect of water (moisture) or direct sunlight.



When defects are revealed switch the detector off, secure connection cables and contact maintenance staff or a service team.



All activities related to connecting detectors must be carried out while Control Unit's power supply is off.



Despite the power supply voltage for the Gas Safety System is off, dangerous voltage may persist across terminals of the Control Unit. Such a voltage may come from another system controlled by the same unit, for instance ventilation, that use one output pin of the Control Unit.



The gas detector must be reliably secured during any repair, installation or maintenance works.



Before painting the facility walls make sure that the device is properly secured against unintentional painting or paint splashing.



Before painting the facility floor make sure that the device is properly secured against unintentional painting or paint splashing.



Before use of silicon or silicon-based materials (paints, adhesives, sealant, etc.), make sure that the device is properly secured against unintentional coating.

3 Device design

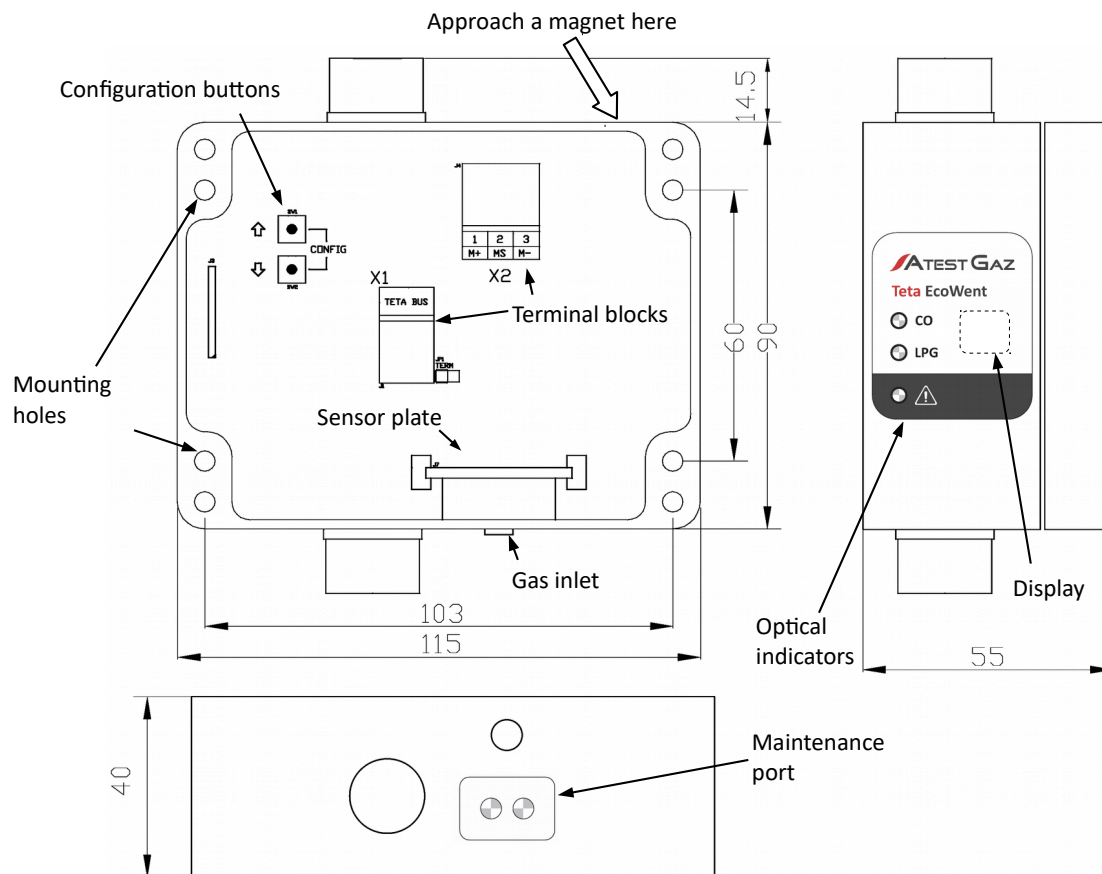


Figure 1: Layout of device components and its dimensions

4 Input-output interfaces

4.1 Electric interface

Locations and arrangement of terminal blocks is shown on Figure 1.

Port designation	Name	Terminal	Description
X1	TETA BUS		Teta Bus port. Parameters – see section 8
			Supply / data transmission line
X2			Port for connection of the Teta MiniDet Gas Detector
	M+	1	Positive
	MS	2	Signal line
	M-	3	Negative

Table 1: Electric connections

5 User interface

5.1 Indication of the device status

Gas detectors are provided with three LED indicators to show status of the device. These LEDs are located on the side wall of the device housing (see Figures 1 and 2).

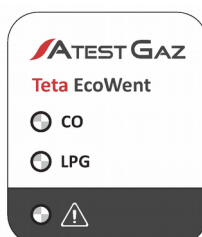
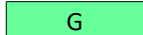









Figure 2: User interface

Table 2 summarizes how status of the gas detector is indicated by means of individual LEDs. Detailed description of possible operation status is provided in Section 1.2.

LED indicator	LED indication	Operation mode
CO / NO ₂		Regular operation of the detector, gas concentration below the established thresholds
		Alarm 1
		Alarm 2
		Alarm 3
		Failure of the measuring path for CO or NO ₂ , incorrect connection
		Warm-up of the measuring path for CO or NO ₂
LPG		Regular operation of the detector, gas concentration below the established thresholds
		Alarm 1

² G – green, Y – yellow, R – red.








LED indicator	LED indication	Operation mode
		Alarm 2
		Alarm 3
		Failure of the measuring path for LPG, incorrect connection, configuration error or defect of the coupled Teta MiniDet detector
		Warm-up of the measuring path for LPG
		No requests from the Control Unit
		Internal defect of the gas detector (no relation to the measuring paths)



Table 2: Indication of the gas detector operation modes

5.2 Display

The side wall of the device housing comprises also a display module (see Figure 1). The display panel is designed to show information that is explained in subsequent sections.

5.2.1 Detector address

The detector address can be displayed with no need to open the device housing, it is just enough to approach a permanent magnet to a specific location on the housing (this location is shown in Figure 1). Depending on the operation mode of the detector the following details are displayed:

-  regular operation of the detector – the display presents sequentially the detector address (Ad), its setting and tE,
-  failure or warm-up – the sequence of address (Ad) and setting.

The device address can be also displayed by means of configuration buttons.

5.2.2 Information about operation details

The configuration buttons can be also used to display details related to operation modes of the detector (HE) - see more in Section 7.5.2.

5.2.3 Information about tests /simulations

The configuration buttons can be also used to display details related to completed tests/simulations of the detector – see more in Section 7.7.3.

6 System architectures

The gas monitoring systems can be made up of independent gas detector Teta EcoWent or Teta EcoN or coupled and collaborating pairs of detectors (Teta EcoWent with Teta MiniDet).

6.1 Data bus architecture

In this system gas detectors are connected to the bus via T-connectors S2.

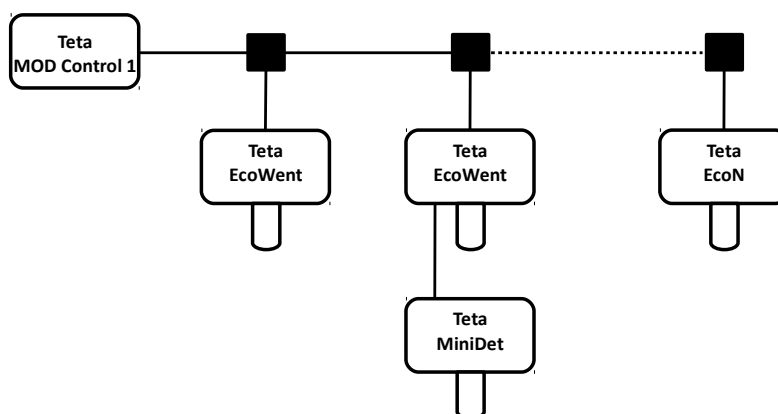


Figure 3: Arrangement of gas detectors according to the data bus architecture

Detailed schematic diagrams in an editable format can be found on our website tetagas.atestgaz.pl.



7 Lifetime cycle

7.1 Transportation



The device can be shipped in the same way as new equipment of that type. If the original package or another protecting means (e.g. corks) is unavailable the conveyed equipment must be secured against shocks, vibrations or moisture by means of adequate methods and material at the own responsibility of the sender.




The device can be conveyed under environmental conditions as described in Table 5.

7.2 Installation

7.2.1 Deployment of gas detectors

Deployment of gas detectors must be determined by the system designed with consideration to the following rules:



-  installation of CO detectors is recommended at the height of upper respiratory airways, i.e. circa 1.2 to 1.7 above the floor level,
-  NO₂ detectors should be installed at about 30 cm above the floor,

-  detectors must not be exposed to direct effect of water (moisture) or other chemicals (e.g. cleaning chemicals when the facilities are being cleaned), as well as to direct effect of sunlight, rain or wind,
-  detectors must be secured against damaging mechanical impacts,
-  locations of detectors must enable easy checks and adjustments as well as replacement or disconnection of each detector.

7.3 Mechanical mounting of detectors



Mounting of gas detector is allowed only after full completion of all civil engineering works.

-  Spring clamps of terminal blocks are released by depression of the button with a screwdriver.
-  Detectors must be fixed by means of mounting holes that are visible after opening of the housing. Make sure that the gas inlet looks downwards. Dimensions of the housing, arrangement of mounting holes and layout of internal components is shown in Figure 1. Drilling of mounting holes in walls or other permanent structures is easier with use of a drilling pattern attached to the device package.

7.3.1 Electric network



The electric network must be deployed according to the engineering documentation.



The electric system must be designed in conformity to general rules for engineering of A&C³ systems.



Electric cables and conductors shall be routed in a safe manner to have then protected against possible damage.

If stranded cables are used for deployment of electric lines, ends of cable cores in such cables must be secured by means of clamping bushings (lug).

When two conductors are to be connected to a single terminal clamp of the device they must be encapsulated first within a common clamping bushing (lug) – see details in Table 5.



Do never leave spare lengths of cables inside the device. Bare wires or wires surplus may lead to a hazard of electric shock or equipment damage.



Do never leave redundant cable cores not terminated inside the device.



Incorrect routing of cables may result in impairment of the equipment immunity to electromagnetic interferences.

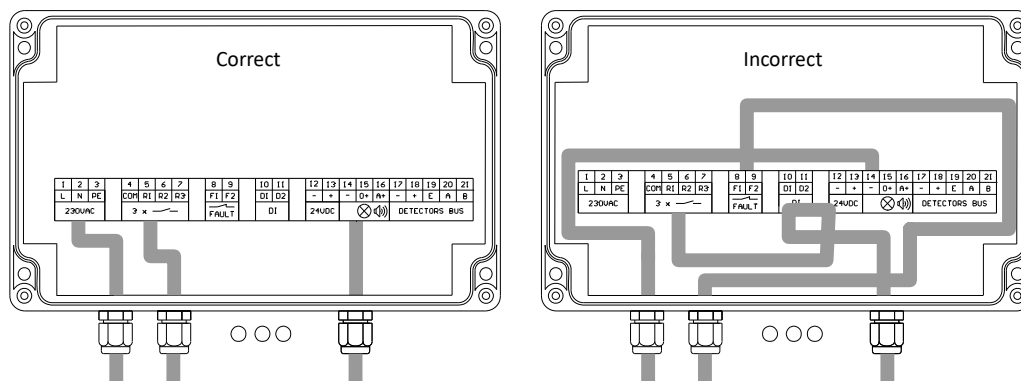


Figure 4: An example of cable termination inside a gas detector

7.3.2 Types of suitable cables and conductors

Connection type	Recommended cable type	Example of a suitable cable designation
Connections between T-connectors and gas detectors	Two-core cable	YDY 2 x 1 mm ²
Connections between Teta EcoWent /EcoN detectors and Teta MiniDet detectors	Three-core cable	YDY 3 x 1 mm ²

Table 3: Types of suitable cables

7.4 Commissioning of the gas monitoring system

After having the electric network complete and power voltage supplied to all devices carry out the following operations:

- ✂ assign addresses to all detectors (see details in section 7.5.1),
- ✂ select the operation mode(s) (see details in section 7.5.2),
- ✂ configure the control unit (see User Manual for the Teta MOD Control 1 Unit),
- ✂ simulate generation of alarms signals S1 (if coupled pairs of gas detectors are included into the system – also the S2 alarm signals) – see details in sections 7.7.3.2 and 7.7.3.3,
- ✂ make sure that the system works according to the underlying logic flow chart – execute a test of safety functions – see details in section 7.7.3.4.



If any civil engineering or building (finishing) jobs could have been performed yet after installation of the Gas Detection System a test of all detectors is mandatory to make sure that detectors correctly respond to presence of hazardous gases.



In case of improper operation of the system recheck all wiring and connections or contact the system provider /equipment manufacturer.



The gas monitoring system can be approved for operation only after passing results of all aforementioned checks and verifications.

7.5 Configuration of gas detectors

Reliable operation of gas detector needs preliminary configuration of the device parameters. The configuration is performed with the use of two buttons $\downarrow\uparrow$ (CONFIG) that are available after opening of the device housing (see Figure 1). These buttons enable also displaying of the detector settings.

Information about the detector settings is displayed on side wall of the device housing (see Figure 1).

7.5.1 Assigning addresses to gas detectors



Depress the arrow buttons $\downarrow\uparrow$ (see Figure 1) and hold them about one second to enter the mode of address assignment (the 'Ad' message appears on the device display). Release the buttons with the 'Ad' message active and the message starts blinking slowly – the desired address can now be set by means of the arrow buttons $\downarrow\uparrow$. Finally, depress the both arrow buttons $\downarrow\uparrow$ simultaneously to confirm the address and store it into the device (the setting continues blinking for about two seconds). Finally, the device quits the procedure of address assignment.

Should the selected address is not confirmed and stored, the old address remains intact and after 15 seconds the detector quits the mode of address assignment.



The default address is 99.

7.5.2 Operation modes of gas detectors

The two possible operation modes can be pre-set:

-  the detector is operates as an independent device,
-  the detector is coupled with the Teta MiniDet device (default setting).

Depress the arrow buttons $\downarrow\uparrow$ (see figure 1) and hold them about two seconds to enter the procedure that enables selection of the operation mode (the 'HE' message appears on the device display). Release the buttons with the 'HE' message active and the message starts blinking slowly – the desired operation mode can now be set by means of the arrow buttons $\downarrow\uparrow$. There are two possible options where:

-  '0' means independent operation of the detector,
-  '1' stands for collaboration with the Teta MiniDet device.

Simultaneous depressing of the both buttons confirms the selection and the operation mode is stored in the detector memory (the setting continues blinking for about two seconds). Finally, the device quits the procedure of the operation mode selection.

Omission to confirm the selected operation mode leaves the previous selection intact in the device memory after 15 seconds the detector quits the procedure of operation mode selection.



When the gas detector is configured for independent operation but the Teta MiniDet device is connected anyway, an error message appears (indicated by the LPG LED).

7.6 Troubleshooting

When a detector reports problems with its operation (see Table 2) the reason for such a behaviour of the device can be identified following guidelines summarized in Table 4.



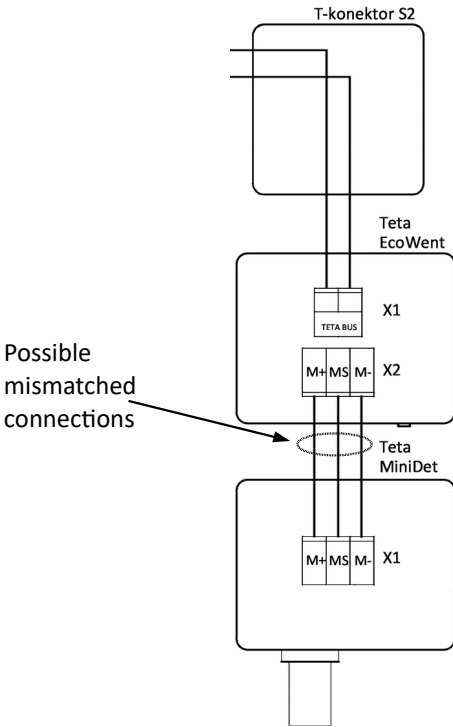






LED indicator	LED indication	Configuration option	Possible reason for the problem
CO / NO ₂		-	<ul style="list-style-type: none"> Defect in the measuring path for CO or NO₂ Defective gas sensor
LPG		Independent operation of the gas detector	<ul style="list-style-type: none"> Improper setting for the operation mode – see Section 7.5.2
		Gas detector is coupled with the Teta MiniDet device	<ul style="list-style-type: none"> Defect of Teta MiniDet Gas Detector Improper setting for the operation mode – see Section 7.5.2 Improper connection at the location pointed on the schematic below 
		-	<ul style="list-style-type: none"> No requests from the Control Unit – the control unit is configured with insufficient number of gas detectors, Poor quality of electric connection (high level of interferences) Improper power voltage for the detector
		-	<ul style="list-style-type: none"> Internal defect of the detector

Table 4: Possible reasons for error signals

7.7 Maintenance schedule

Each user must be aware of the fact that operation of any gas monitoring system leads to inevitable ageing of equipment, in particular gas sensors, due to detrimental impact of environmental factors. Therefore the systems must undergo regular and scheduled maintenance.




Maintenance operations shall include:

-  calibration of gas detectors,
-  replacements of fast-wearing parts,
-  scheduled inspections.

7.7.1 Calibration

Gas sensor incorporated into the device is a component that subject to ageing due to environmental factors, which inevitably leads to deterioration of its sensitivity.

To compensate the deterioration effect the gas detectors must be calibrated on the regular basis (calibration frequency is specified in the Calibration Certificate – see Table 5) by authorized personnel of the equipment manufacturer. The calibration procedure can be carried out in several manners:

-  dismantling of the gas detector to send it to the manufacturer for calibration,
-  removing only sensor plates to send them to the manufacturer for calibration (see Section 7.7.2.1),
-  sending a request to authorized service team of the manufacturer to come and calibrate the detectors on site.

7.7.2 Replacement of fast wearing parts






Please refer to Table 6 for the recommended lifetime and replacement schedule of fast wearing parts.

7.7.2.1 Replacement of a sensor plate

Operation of gas detector leads to natural deterioration of metrological parameters of gas sensors. That effect can be compensated by regular and scheduled adjustment of the detector indication up to the moment when the sensor is completely exhausted and must be replaced. It is assumed that replacement of a gas sensor should take place when its sensitivity drops below 50% of the initial one.

Replacement of a sole sensor is infeasible since it sits on a base plate (sensor plate) and must be replaced together with its plate – see Table 6.





To replace the sensor plate proceed in the following way:

-  switch off the power voltage for the gas detector,
-  open the device housing,
-  replace the sensor plate (see Figure 1),
-  close the housing,
-  switch on the power voltage for the gas detector.

7.7.3 Test / simulation

Tests of the gas monitoring systems are necessary to make sure that the gas monitoring system is in sound operating condition. Please contact the equipment manufacturer in case of any irregular response of gas detectors.

The following tests can be distinguished:

-  tests with the use of a standardized gas – test gas is supplied to inlet of the gas detector (or a pair of coupled detectors), the message 'tE' should appear on the device display,
-  simulation of alarms for CO concentration (for Teta EcoWent detectors) or NO₂ (Teta EcoN detectors), the message 'S1' should appear on the display,
-  simulation of alarms for LPG concentration (for Teta MiniDet detectors), the 'S2' message should appear on the device display,
-  test of safety functions.

7.7.3.1 Test with standardized gas

Upon making sure that the detectors is operable it is possible to carry out a test of its parameters to confirm its performance.

Test mode is initiated by approaching a permanent magnet to the detector, the display shows the 'Ad' message, the detector address stored in its memory and the 'tE' message. Test mode is quitted upon removing of the magnet or within five minutes after test initiation. The location where the magnet is to be approached is shown in Figure 1.

Test of gas detector with the use of standardized gas is initiated after supplying test gas with specific concentration to the detector inlet with observation of the detector response (correct indication that alarm thresholds for CO or NO₂ are exceeded).

Tests assume that momentary concentration of the test gas are measured and alarms are generated without any delay.

When the detector under test is coupled with the Teta MiniDet detectors the test gas (LPG) must be also supplied to the second device.



Correct execution of the test needs application of a calibration kit with the standardized reference gas – carbon monoxide (CO) with concentration of 150 to 300 ppm or nitrogen dioxide NO₂ with concentration from 5 to 30 ppm (see Table 7).



Unauthorized tests of gas detectors when gas with unknown composition and concentration is supplied to the detectors is prohibited. Under such circumstances the gas sensor can be damaged, which leads to loss of the detector calibration.

7.7.3.2 Simulation of alarms for CO /NO₂ gases (S1 alarms)

Simultaneous depressing the arrow buttons ↓↑ (see Figure 1) and holding them depressed for about three seconds switches the detector over to the simulation mode for CO /NO₂ gases (S1 alarm). Releasing of these buttons in the simulation mode initiates consecutive simulation of alarms for CO concentration (Teta EcoWent detectors) or NO₂ concentration (Teta EcoN detectors).

The simulation makes it possible to check response of input relays at the Control Unit. In case of no response or improper operation of the Control Unit it must be inspected with correction of erroneous connections, if any. Contact the equipment manufacturer if the subsequent simulation, after making corrections, is also unsuccessful.

The simulation mode (S1) is quitted automatically after the simulation is completed or upon depressing any of the arrow buttons ↓↑.

7.7.3.3 Simulation of alarms for LPG gas (S2 alarms)

Simultaneous depressing the arrow buttons ↓↑(see Figure 1) and holding them depressed for about four seconds switches the detector over to the simulation mode for LPG gas (S2 alarm). Please remember that that simulation mode is available only for detectors where collaboration with Teta MiniDet detectors is enables (HE parameter is set to 1). The simulation procedure is carried out in the same way as for S1 alarms, but alarms are generated for the Teta MiniDet detector.

The simulation mode (S2) is quitted automatically after the simulation is completed or upon simultaneous depressing the both arrow buttons ↓↑.

7.7.3.4 Test of safety functions

Execution of the test for safety functions is recommended once a year. Test gas is supplied to one unit of each detector type and response of all components within the Gas Safety System is checked together with all collaborating systems (e.g. ventilation).



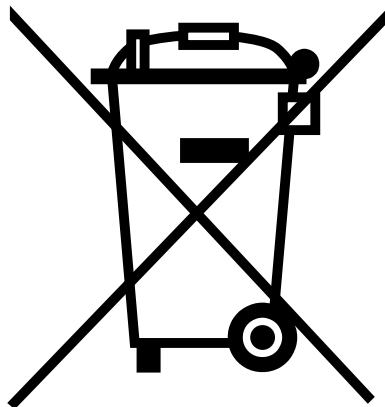
Test of safety function must be executed without approaching of a magnet to gas detector or initiation of alarm simulations.

7.7.4 Maintenance

Gas detectors should be cleaned only by wiping its housing with a soft damp cloth. Cleaning agents containing solvents, white spirit, extraction naphtha or alcohols are not allowed.

The device needs no other maintenance beside cleaning external surface of the housing. These surfaces should be wiped with a soft cloth moistened with water and slight amount of a mild detergent.

7.8 Disposal



This symbol on a product or on its packaging indicates that the product must not be disposed of with other household waste. Instead, it is the user's responsibility to ensure disposal of waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. The proper recycling of your waste equipment at the time of disposal will help to conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. Information about relevant designated collection points can be obtained from the Local Authority, waste disposal companies and in the place of purchase. The equipment can also be returned to the manufacturer.

8 Technical specification

Power voltage	12 – 50 V ~	
<ul style="list-style-type: none"> V_{CC} Power consumption <ul style="list-style-type: none"> CO / NO₂ CO + LPG 	0.5 W 1.5 W	
Ambient conditions	Operation	Storage
<ul style="list-style-type: none"> Temperature Humidity Pressure 	-20 – 40°C 10 – 90% long term 0 – 99% short term 1013 ± 10% hPa	0 – 40°C 30 – 90% long term
Monitored gases	Carbon monoxide (CO)	Nitrogen dioxide (NO ₂)
Measurement ranges	0 – 300 ppm	0 – 10 ppm
Index of protection	IP 43	
Parameters of digital communication	Teta BUS	
<ul style="list-style-type: none"> Communication protocol 		
Integrated signalling equipment (visual)	LED controls 7-segment LED display	
Protection class	III	
Dimensions	See figure 1	
Cable glands (cable diameter range)	Gland pressed into the installation pipe – diameter of the pipe 16 mm. Glands multiband – diameter of wire 3.5 – 12 mm	
Acceptable cable cores	0.2 – 2.5 mm ² – wire cores 0.2 – 2.5 mm ² – stranded cores	
Enclosure material	ABS	
Weight	0.3 kg	
Lifetime	-	
Schedule of mandatory inspections	Every 12 months (Calibration Certificate validity)	
Lifetime of fast wearing parts (gas sensors)	See Table 6	
Mounting	4 holes for screws with the diameters of 4 mm, hole layout – see Figure 1	

Table 5: Technical specification

9 List of fast wearing parts

No.	Part name	Lifetime	Manufacturer	Product code
{1}	Sensor plate CO	Up to 5 years ⁴	Atest Gaz	PWS-017-CO
{2}	Sensor plate NO ₂		Atest Gaz	PWS-017-NO2-10

Table 6: List of fast wearing parts

⁴ In case of installation in dwelling houses, public access buildings, car parks or garages

10 List of accessories

Product code	Description
PW-114-A	Mounting kit for Teta EcoWent gas detector
PW-114-C	Mounting kit for the set of gas detectors Teta EcoWent + Teta MiniDet
PW-064-WM1	Mounting bracket WM1 (for wall-mounted installation)
PW-092-A	Calibration kit
-	Standardized reference gas – carbon monoxide CO with concentration of 300 ppm
-	Standardized reference gas – nitrogen dioxide NO ₂ with concentration of 10 ppm

Table 7: List of accessories

11 Marking codes of products

Product code	Device name
PW-105-CO	Gas Detector Teta EcoWent
PW-111-NO2	Gas Detector Teta EcoN

Table 8: Specification of marking codes for gas detectors

12 Appendices


- [1] DEZG121-ENG– EC Declaration of Conformity – Teta EcoDet, Teta EcoN, Teta EcoTerm, Teta EcoWent, Teta MiniDet
- [2] PU-Z-032-ENG – Parameters of gas detectors with electrochemical sensor
- [3] PU-Z-039-ENG – Classification of chemicals used at Atest Gaz

EU Declaration of Conformity

Atest Gaz A. M. Pachole sp. j. declares with full responsibility, that the product:

(Product description)	(Trade name)	(Type identifier or Product code)
Gas Detector	Teta EcoDet	PW-106
	Teta EcoN	PW-111
	Teta EcoTerm	PW-113
	Teta EcoWent	PW-105
	Teta MiniDet	PW-107

complies with the following Directives and Standards:

-  in relation to Directive 2014/30/EU – on the harmonisation of the laws of the Member States relating to electromagnetic compatibility:
 - EN 50270:2006

This declaration of conformity is issued under the sole responsibility of the manufacturer.

Purpose and scope of use: product is intended for use in gas detection systems for residential, commercial and industrial environment.

This EU Declaration of Conformity becomes not valid in case of product change or rebuild without manufacturer's permission.

Gliwice, 14.07.2017


(Name and Signature)
Managing Director
Aleksander Pachole

Parameters of gas detectors with electrochemical sensor

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1 Detected substances

Detectors equipped with electrochemical sensors are used for measuring and detecting the presence of specific substances in gaseous atmospheres in concentrations generally above single "ppm," but in some cases (e.g. oxygen, hydrogen), the concentration may be tens or hundreds of thousands "ppm".

These gases have characteristic measurement ranges. Most of the detected substances are primarily volatile inorganic compounds. Some organic compounds, such as ethylene, ethylene oxide, may also be detected.

Table 1 presents an example list of substances detected by electrochemical sensors.

Name of the substance	IUPAC name	Molecular formula	CAS
Oxygen	Oxygen	O ₂	7782-44-7
Ozon	Trioxxygen	O ₃	10028-15-6
Hydrogen	Hydrgen	H ₂	1333-74-0
Ammonia	Azane	NH ₃	7664-41-7
Arsine	Arsenic trihydride, Arsane	AsH ₃	7784-42-1
Carbon monoxide	Carbon monoxide	CO	630-08-0
Chlorine	Chlorine	Cl ₂	7782-50-5
Chlorine dioxide	Chlorine dioxide	ClO ₂	10049-04-4
Ethylene oxide, epoxyethane	Oxirane	C ₂ H ₄ O	75-21-8
Formaldehyde	Methanal	HCHO	50-00-0
Hydrazine, diamine, diazane	Hydrazine	N ₂ H ₄	302-01-2
Hydrogen chloride	Hydrogen chloride	HCl	7647-01-0
Hydrogen cyanide, Prussic acid	Formonitrile, Hydridonitridocarbon	HCN	74-90-8
Hydrogen sulfide, Sulfane	Hydrogen sulfide	H ₂ S	7783-06-4
Nitric oxide	Oxidonitrogen	NO	10102-43-9
Nitrogen dioxide	Nitrogen dioxide	NO ₂	10102-44-0
Phosgene	Carbonyl dichloride	COCl ₂	75-44-5
Silane	Silane	SiH ₄	7803-62-5
Sulphur dioxide	Sulphur dioxide	SO ₂	7446-09-5
Ethylene	Ethene	C ₂ H ₄	74-85-1
Tetrahydrothiophene (THT)	Thiolane	C ₄ H ₈ S	110-01-0

Table 1: Substances detected by the electrochemical sensors

2 Principle of operation

Electrochemical sensors are micro fuel cells. Figure 1 shows a simplified structure of an electrochemical sensor.

The sensor inlet (1) is protected with anti-condensation membrane (6) which serves also as a protection against dust. The simplest electrochemical sensor consists of two electrodes: sensing (2) and counter (3), separated by a thin layer of electrolyte (4). Depending on the detected gas, the reduction or oxidation reaction occurs on the first electrode, which is balanced by a counter electrode by water oxidation or oxygen reduction respectively. In order to improve the performance of the sensor, a third electrode – the reference electrode – is used (5). It has a constant potential that is not dependent on the concentration of the measured gas. Owing to electrode reactions, electrons are generated, whose orderly flow – electric current, is proportional to the concentration of the detected gas.

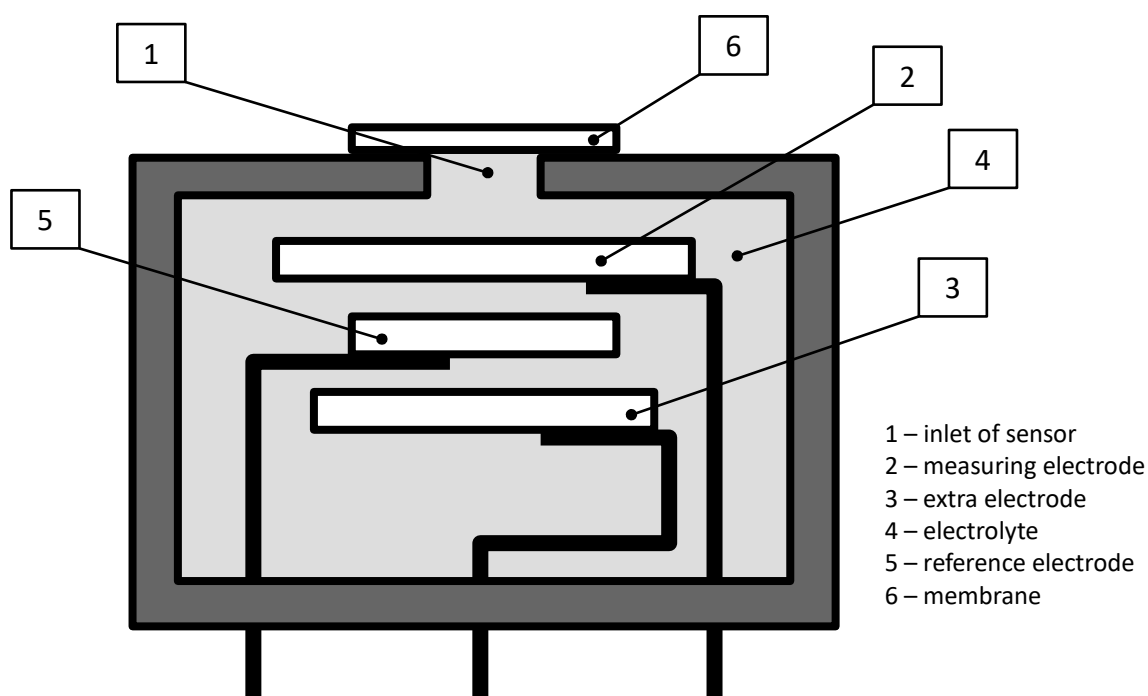


Figure 1: Construction of an electrochemical sensor

Example response to a carbon monoxide sensor:

Sensing electrode: $\text{CO} + \text{H}_2\text{O} \rightarrow \text{CO}_2 + 2\text{H}^+ + 2\text{e}^-$

Counter electrode: $\frac{1}{2}\text{O}_2 + 2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2\text{O}$

Overall reaction: $\text{CO} + \frac{1}{2}\text{O}_2 \rightarrow \text{CO}_2$

3 Impact of environmental conditions



Never exceed the rated operating parameters of the detector. These parameters can be found in the "detector calibration certificate".



The detector must be used in accordance with the provisions in the User's Manual.

3.1 Composition of the controlled atmosphere

It is assumed that the standard composition of the atmosphere is a mixture of gases with the proportions indicated in table 2.

Ingredient	C [% vol]	C [ppm]
Nitrogen	78.084	780 840
Oxygen	20.946	209 460
Argon	0.934	9 340
Carbon dioxide	0.0360	360
Neon	0.00181	18.18
Helium	0.00052	5.24
Methane	0.00017	1.70
Krypton	0.00011	1.14
Hydrogen	0.00005	0.50
Xenon	0.000008	0.087

Table 2: Typical composition of atmospheric air

When gas concentrations in the atmosphere differ significantly from those indicated in the table 2, it is necessary to conduct the analysis of the impact of such a situation on the detector operation. This publication assumes that the detector is operated under a standard formulation.

3.1.1 Impact of the presence of a substance in a controlled atmosphere

The electrochemical sensor is relatively selective. This means that in addition to the "working gas," that is the one which the detector responds to, these sensors also respond to a relatively small number of other substances in comparison to other measurement techniques.

Because of the indication, a set of substances exists or can exist:

- ✂ to which the sensor responds *in plus* giving a positive signal proportional to the concentration of a substance (e.g. carbon monoxide on a carbon monoxide sensor, being its "working gas", hydrogen on a carbon monoxide sensor),
- ✂ to which the sensor responds *in minus* giving a negative signal proportional to the concentration of a substance (for example, nitrogen dioxide for a sulphur dioxide sensor),
- ✂ to which sensor does not respond (the output signal does not change – e.g., nitrogen at a carbon monoxide sensor).

A set of substances exists or may exist for every detector:

- ✂ the ones that are inert to the sensor – do not react chemically with the sensor detector element (e.g. nitrogen on a carbon monoxide sensor),
- ✂ the ones that react chemically with the detector element of the sensor and do not cause a supernormal degradation of its properties (e.g. sensor working gas),
- ✂ the ones that affect the sensor elements and cause temporary or permanent degradation of its characteristics or properties.

Due to the physio-chemical phenomena, for each sensor there may be a collection of substances which interact with the working substance leaving no possibility of reaching the detector elements of the sensor by the working gas (e.g. ammonia dissolves in water vapour). In the case of some substances (e.g. chlorine, phosgene, hydrogen chloride, sulphur dioxide) the operating range of the sensor is low enough so that the gas at these concentrations can be absorbed by water vapour from the atmosphere, or condensed on the elements of the sensor. Thus, it will not be the same one, visible for the detector, as long as its concentration does not reach a sufficiently high value and does not saturate water vapour being on the way to the sensor.

3.1.2 Impact of the presence of a working gas or other reaction gas

The reaction of gas from the detector element of the sensor causes its wear, therefore, detectors equipped

with electrochemical sensors are designed to measure and detect the short-term presence of certain gases in the atmosphere. Both the more sustained concentration with values falling within the range of measurement, and even instantaneous concentrations outside the measuring range lead to a rapid wear of the sensor.

3.1.3 Effect of oxygen concentration value

Depending on the sensor, oxygen is required in most cases for the electrochemical reaction. For a short period of time, oxygen dissolved in the electrolyte is sufficient, however, constant operation in an oxygen-free atmospheres is generally impossible.

3.2 Influence of temperature

The temperature of the measured atmosphere affects the characteristics of the sensor. Its influence in the work of the sensor is compensated electronically.

Very rapid changes in air temperature in the rated temperature range of the detector can cause the sensor responses to this phenomenon.

Rapid reduction of temperature can cause a rapid increase in relative humidity, and thus the reaction of the sensor.

3.3 Influence of moisture

- ✍ Depending on the sensor, water is necessary for the electrochemical reaction because the sensors cannot operate in an atmosphere with a low relative humidity. Working in such conditions may lead to the excessive concentration of the electrolyte, which is corrosive and can cause damage to the sensor.
- ✍ When the humidity of the measured atmosphere is within the rated range of the detector operation, it does not affect the reading. However, sudden, abrupt changes of humidity in the measured atmosphere can cause momentary appearance of the signal despite the lack of working gas in the vicinity of the sensor.
- ✍ It is necessary to consider phenomena making the working gas react with moisture in the atmosphere, not allowing it to reach the sensor (vapours of ammonia, chlorine, hydrogen chloride, phosgene, etc.).
- ✍ Condensation may block the flow of working gas to the sensor.

3.4 Influence of pressure

Sudden change of pressure in the presence of working gas can cause an incorrect indication of the detector proportional to the speed and volume change of pressure.

3.5 Influence of vibrations, impacts

It should be ensured that the detector is not exposed to shock and vibration in excess of the amplitude of vibrations amounting to 0.15 mm of the frequencies of over 10 Hz.

4 Factors shortening the lifetime of the sensor

The lifetime of the sensor is limited due to the gradual wear of the electrolyte and electrodes.

This time can be significantly reduced as a result of:

- ✍ long-term persistence of concentrations with the values falling within the range of measurement,
- ✍ the temporary presence of concentrations substantially exceeding the measurement range,
- ✍ impact of extreme humidity (very dry or very humid air),
- ✍ too high ambient temperature,
- ✍ occurrence of abrupt pressure changes.

Classification of chemicals used at Atest-Gaz

Because of the need to present a **consistent and high level of maintenance services**, to ensure **the safety of the calibration process** and to **create a basis for a rational calculation of the costs** of this process, Atest-Gaz developed the "Classification of Chemical Substances" described below.

The classification determines the complexity of the calibration process of a particular detector type, consider two criteria:

- ✍ stability of the calibration mixture (criterion **A**):
 - ease of generate and its stability,
 - ergonomic complexity of operations,
 - required experience and knowledge of the employee performing the calibration,
 - required equipment,
 - environmental requirements for the process (e.g. weather conditions).
- ✍ safety / potential hazard generated by the mixture (criterion **B**).

These both criteria have an impact on the final cost of the calibration services and level of competence required from the employee conducting the calibration.

This classification is applied both by Atest-Gaz and the entities cooperating with it – distributors, authorized service providers and users of the systems.

In the case of calibration with the "crossover" substances, the classification is made in accordance with the substance category that is applied (e.g. for the detector with a PID sensor this substance is isobutylene, i.e. B0 A0).

The detector are classified on the stage of offer.

On the next page we present tables showing the above relationships.

Category	Description	Terms of facility calibration
A0	Cylinder gases, stable environment	No precipitations, and no strong winds, and temperature over -10°C^1 . In other cases, calibration at a location that meets the above conditions (necessary to remove the detectors).
A1	Cylinder gases, unstable environment or absorption by the moisture	No precipitations, and no strong winds, and temperature over $+10^{\circ}\text{C}^1$, and relative humidity under 70%. In other cases, calibration at a location that meets the above conditions (necessary to remove the detectors).
A2	Gases not available in cylinders can be generated at the relevant facilities	like A1 In other cases, calibration at a location that meets the above conditions (necessary to remove the detectors).
A3	Laboratory calibration	Facility calibration impossible, laboratory calibration only, probably at the manufacturer's. This group also includes conditions resulting from other reasons, e.g. the need for temperature compensation, non-linearity of the sensor, the need for calculation, the use of special tools, etc.

Table 1. Classification of chemicals used at Atest-Gaz. Criterion A: mixture stability

Category	Description	Classification criteria
B0	Safe substances	concentration of flammable components $< 60\% \text{ LEL}$, and concentration of toxic components $\leq \text{NDSch}^2$, and oxygen concentration $< 25\% \text{ vol}$, and tank $< 3 \text{ dm}^3$ (water capacity) and $p \leq 70 \text{ atm}$, or specified liquid chemical compounds, e.g.: glycerol, 1,2-propanediol.
B1	Low-risk substances	concentration of flammable components $< 60\% \text{ LEL}$, and concentration of toxic components $\leq \text{NDSch}^2$, and oxygen concentration $< 25\% \text{ vol}$, and tank $> 3 \text{ dm}^3$ (water capacity) or $p > 70 \text{ atm}$, or toxic gases with the concentration of $\text{STEL} \div 15 \times \text{NDSch}$, or specified liquid chemical compounds, e.g.: petrol, acetone, 1-methoxy-2-propanol.
B2	High-risk substances	inert gases having an oxygen concentration $> 25\% \text{ vol}$, or flammable gases with a concentration $> 60\% \text{ LEL}$, or specified liquid chemical compounds, e.g.: styrene, methanol, xylene, toluene, methyl methacrylate.
B3	Extremely dangerous or extremely flammable substances	toxic gases with the concentration of $> 15 \times \text{NDSch}^2$, or specified liquid chemical compounds, e.g.: benzene, formaldehyde, formic acid, epichlorohydrin.

Table 2. Classification of chemicals used at Atest-Gaz. Criterion B: OHS

- 1 Is allowed to perform calibrations at lower temperatures, if they meet the conditions of operation of the detector, e.g. ammonia refrigeration units.
- 2 In the absence of determined NDSch it is necessary to adopt $2 \times \text{NDS}$ as a criterion.

