Operating Manual

Multigas Detector ORION*plus*

Issue 3/04-2005

Order No.: 10046100

MSA AUER GmbH
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Germany

EC Declaration of Conformity

The manufacturer or his in the community established authorized representative

MSA AUER GmbH
Thiemannstraße 1
D-12059 Berlin

declares that the product

MSA AUER ORION^{plus}

based on the EC-Type Examination Certificate:

BVS 03 ATEX E 270 X

complies with the ATEX directive 94/9/EC, Annex III. The quality monitoring centre according to Appendix IV of ATEX Directive 94/9/EC is EXAM at Bochum, test center number: 0158.

We further declare that this product is in conformance with the EMC directive 89/336/EC, changed by directive 91/263/EC, 92/31/EC, 93/68/EC, with the following harmonized norms or normative documentation:

EN 50 270 Type 2 EN 61 000 - 6 - 3

MSA AUER GmbH
Berlin, June 2004

Dr. Axel Schubert
R & D Instruments

Contents

1. Safety Regulations

1.1. Correct Use

The ORION*plus* is a portable instrument for measuring toxic and combustible gases and vapours in the workplace, and for monitoring oxygen deficiency, excess or inerting. It should only be used by trained and qualified personnel.

The ORION*plus* has 4 slots for Ex and Tox sensors for gas measurement, as well as a infrared sensor. The ORION*plus* may only be used for the gases and vapours for which a MSA configured sensor has been installed (available sensors → Ch. 6 and 7).

It is imperative that this operating manual be read and observed when using the ORION*plus*. In particular, the safety instructions contained within, as well as the information for the use and operation of the instrument, must be carefully read and observed. Furthermore, the national regulations applicable in the user's country must be taken into account for a safe use.

Alternative use, or use outside the specifications will be considered as non-conformant. This also applies especially to unauthorised alterations to the instrument and to commissioning work that has not been carried out by MSA.

Danger!

This product is supporting life and health. Inappropriate use, maintenance or servicing may affect the function of the device and thereby seriously compromise the user's life.

Before use the product operability must be verified. The product must not be used if the function test is unsuccessful, it is damaged, a competent servicing/maintenance has not been made, genuine MSA AUER spare parts have not been used.

1.2. Liability Information

MSA accepts no liability in cases where the product has been used inappropriately or not as intended. The selection and use of the product are the exclusive responsibility of the individual operator.

Product liability claims, warranties also as guarantees made by MSA with respect to the product are voided, if it is not used, serviced or maintained in accordance with the instructions in this manual.

1.3. Safety and Precautionary Measures to be Adopted

The following safety instructions must be observed implicitly. Only in this way can the safety and health of the individual operators, and the correct functioning of the instrument, be guaranteed.

Check calibration and pump operation each day before use:

Before each use, check for correct operation of the pump and then check the calibration of the instrument. Otherwise there is a danger that incorrect results will be displayed. Checking the measuring ranges for the toxic gases is accomplished by means of a suitable test gas.

Also check calibration after mechanical stress:

The calibration should also be checked after severe mechanical stress (fall, impact etc.) and when the instrument or the Ex sensors have been exposed to silicon, silicates, lead-containing substances, hydrogen sulphide or contaminated compounds.

Check the response times:

Before using the instrument, check that the alarm response times are sufficiently short to avoid hazardous situations. If required the alarm threshold should be set significantly below (above, if necessary, for oxygen) the safety limit.

Ensure adequate measuring time:

Ensure an adequate measuring time, as the response time for the correct display of the measurement depends on the sensor used. When a sampling line is used the response time is extended 3 seconds per metre depending on the length of sampling line.

Insert FX-Sensor for combustible vapours:

Use the FX-Sensor for measuring combustible vapours with flash points above 38°C, as the inset of the 20 mm sensors can possibly lead to values that are too low being displayed.

Ensure sufficient oxygen:

The Ex sensor requires an oxygen concentration of >10%vol. to display precise measurements. Oxygen-enriched atmospheres can affect the measurement and the electrical safety of the instrument.

Be aware of the influence of atmospheric pressure on oxygen measurements:

Pressure range 800 - 1200 kPa
Rapid changes in air pressure (e. g. when passing through an air lock) can temporarily distort the oxygen measurement and cause the instrument to display an alarm even though no danger exists.
On the other hand, a significant reduction in air pressure can lead to a dangerous lack of oxygen available for respiration (high altitudes) without the instrument indicating an alarm, as the oxygen content of the air is always approximately 20.8% Vol.

Be aware of the influence of humidity on oxygen measurements:

Humidity range: 5% - 95% relative humidity
With large changes in humidity (e. g. movement from a dry, air-conditioned room into a humid environment) the oxygen concentration measurement can change by up to 0.5% vol. This is a result of the displacement of the oxygen by the water vapour in the air and leads to falling measurements with rising humidity. The effect is not immediately apparent, but it will influence the oxygen measurements over several hours.

Be aware of the regulations for electrostatic elements:

The instrument contents electrostatically sensitive assembly units. An electrostatic discharge by unprotected touch of the assembly units is to be avoided by potential equalization. The warranty will be cancelled in case of deteriorations caused by electrostatic discharges.

The instrument must be fitted with a name plate:

There is a name plate on the rear of the instrument. It may not be removed and must be replaced if lost. Otherwise the instrument will not conform to its test report. The name plate carries the following information:

Manufacturer	MSA AUER GmbH Thiemannstraße 1 D-12059 Berlin
Product	MSA AUER ORION*plus*
Protection class	EN 50 014, EN 50 018, EN 50 020
Measuring functions	EN 50 054, EN 50 057, EN 50 271, EN 50 104, EN 45 544 -1/-2
Gas	methane, propane, oxygen, carbon dioxide, carbon monoxide, hydrogen sulphide
Marking	Ex II 2G EEx ia d e IIC T3/T4 -20 °C ≤ Ta ≤ +50 °C Alkaline T3: Varta 4006/8006, Eveready Energizer E91 Alkaline T4: Duracell MN 1500 NiMH T3: -20 °C ≤ Ta ≤ +50 °C NiMH T4: -20 °C ≤ Ta ≤ +40 °C
EC type examination certificate	BVS 03 ATEX E 270 X
Qualification test report	PFG No. 41300304
Quality monitoring test centre	0158
EMC Conformance	Directive 89/336/EC: EN 50 270 Typ 2 EN 61 000 - 6 – 3

2. Description

2.1. Instrument Overview

A Instrument viewed from rear	*6 Reset button/Alarm acknowledge*
B Instrument viewed from front	*7 ON/OFF button*
C Instrument with opened sensor cover	*8 Info button*
1 Pump inlet / Inlet fitting (Test gas hose connection)	*9 Pump filter*
2 LED alarm indicators	*10 Power supply (NiMH cells or battery module, selectable)*
3 Pump cover, with sensor cover below	*11 Ex and Tox sensors (for vacant slot)*
4 Information display	*12 20mm vacant slots for 2 Tox sensors, 1 Ex and 1 Ox sensor and 1 IR sensor (not visible)*
5 Measurement display	

2.2. Important Display Symbols

Symbol	Meaning
	Function display – blinks when instrument is operating.
	Pump function – pumpalarm display
	Zero calibration – display during Fresh Air Setup
	Battery display – display of the state of charge of the power supply. Battery alarm when all 4 segments are extinguished.
	Alarm indication – symbol appears when alarms are triggered.
	Symbol appears when setup or settings menus are called up
	Calibration display

3. Operation

3.1. Preparing for use

Instrument operation is dialogue driven from the display, with the aid of the 3 function keys. It is largely self explanatory.

Switch on and Fresh Air Setup

A Fresh Air Setup should be carried out as the zero calibration at instrument switch-on (except for the CO_2 measuring range).

(1) Switch the instrument on with the green **ON/OFF** key.

The instrument will perform a self test and then go directly to the Fresh Air Setup:

- The display is checked,
- Audible alarm sounds,
- Alarm LEDs light.

(2) Decide whether you want to carry out a Fresh Air Setup:

YES: Press the **Reset** button.
The Fresh Air Setup is performed then the instrument goes into the measuring mode and is ready for operation.

NO: Press the **Info** button.
The Fresh Air Setup is skipped and the instrument goes into the measuring mode.

If no button is pressed, the instrument goes automatically into the measuring mode after 5 s, without a Fresh Air Setup.

If a non-resettable alarm is triggered during the Fresh Air Setup, the instrument must be calibrated once more. Press the **Info** and the **Reset** buttons simultaneously until `PASSWORD` appears (→ continue on page 13).

If the ambient air contains higher concentrations of gases, the instrument ignores the Fresh Air Setup and goes directly into the measuring mode after the self test.

Checking the pump function

After switch-on, check the functioning of the pump before each use:

(1) Block the open sampling system (pump termination or the end of the connected hose).

The pump should stop and the **pump alarm** will be triggered. An error is indicated on the display.

(2) Cancel the alarm with the **Reset** button.

If the alarm is not triggered:

(3) Check the sampling system for leaks, repair the fault if necessary or exchange the part.

(4) Repeat the functional test.

Checking the calibration

Check the calibration before each use and after any severe mechanical stress:

(1) Check that the ORION*plus* is not indicating any gas or shortage or excess of oxygen.

(2) Attach the regulator to the test gas cylinder.

(3) Connect one end of the calibration set hose to the regulator and fit the other end to the inlet on the instrument.

(4) Open the valve on the regulator.

After about 1 min the displayed values should be in agreement with those on the test gas cylinder.

The ORION*plus* must be recalibrated if one or more values do not agree (→ following Ch. 3.2).

Displaying the set values for MIN, MAX, TWA and STEL

When you press the **Info** button, the values appear on the display in the following order:

MINIMUM	Minimum measurement since switch-on
MAXIMUM	Maximum measurement since switch-on
TWA	Time Weighted Average for the installed Tox sensors = average value of a toxic exposure, averaged over 8 hours
STEL	Short Term Exposure Limit for the installed Tox sensors = average value of a toxic exposure, averaged over 15 minutes

3.2. Changing instrument settings (Calibration)

Calling up the settings menus / Password entry

Proceed as follows to access the menus for the instrument settings:

(1) Switch the instrument on and press the **Info** and **Reset** buttons simultaneously until PASSWORD appears.

(2) Enter the password by pressing the **Info**, **ON/OFF** and **Reset** buttons in a defined sequence.

Default password setting, as supplied:
Press in order 1. **Info**, 2. **ON/OFF**, 3. **Reset**, 4. **ON/OFF,** 5. **Info.**

(3) Next, select the menu items to be set.

The password can be changed with a PC running the ORION Link software.

Automatic calibration of all sensors

During automatic calibration all sensors are calibrated simultaneously. A calibration interval of ≤ 3 months is recommended for toxic sensors. The instrument should also be calibrated if

- an alarm is indicated in the H_2S measuring range,
- an alarm is triggered after switching on.

Use only calibration gas mixtures that are approved by MSA and are suitable for the sensors.

For calibrating the zero point (Fresh Air Setup), use air that is completely free of the gas to be measured. Furthermore it is recommended that the instrument be calibrated at the temperature of use.

(1) After entering the password, press the **ON/OFF** button twice.

The automatic calibration begins with a Fresh Air Setup. After successful completion of the Fresh Air Setup, the display switches to the test gas.

(2) Connect the calibration gas mixture to the instrument as described in "Checking the calibration".

(3) Open the valve on the regulator.

(4) Start the calibration with the **Reset** button.

The sensors are simultaneously set to the values of the calibration gas mixture in approx. 90 s. After successful calibration, the instrument returns to the measuring mode.

Calibrating the sensors individually

(1) After entering the password, press the **ON/OFF**, **Reset** and **ON/OFF** buttons in sequence.

(2) Select the sensor to be calibrated and follow the displayed menu instructions.

The expected test gas is displayed. If the test gas differs from this, the concentration must be entered using the menus.

For calibrating the zero point (Fresh Air Setup), use air that is completely free of the gas to be measured.
The permissible test gas concentrations are specified by MSA.

Changing the contrast setting

The contrast adjusts itself to follow temperature changes. At low temperatures, however, it can happen that the display can no longer be read clearly. In this case, readjust the contrast as follows:

(1) After entering the password, select the `Contrast` menu item

(2) Set the lower bar on the display to approximately 3/4 black.

Setting time and date

The time and date are required for monitoring the calibration intervals and for datalogging.

(1) After entering the password, select the `Time` menu item

(2) Follow the instructions on the display.

Setting the saving interval

The instrument is equipped with a data memory. The saving interval can be set to 15 s, 30 s, 60 s, 2 min, 3 min, 5 min or 10 min. The data memory can be read with a PC running the ORION Link software.

(1) After entering the password, select the `Saving interval` menu item

(2) Follow the instructions on the display.

Deactivating/activating the function sound

The function sound is an acoustic signal which confirms the fault-free operation of the instrument. This signal is issued every 60 seconds. It is activated at the factory and should remain active for the purpose of monitoring the instrument. It can be deactivated and reactivated again:

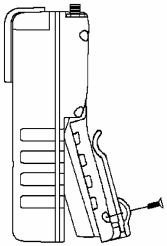
(1) After entering the password, select the `Function sound` menu item

(2) Follow the instructions on the display.

3.3. Changing and charging the power supply

The battery alarm indicates that there is only a further 15 minutes of operating time remaining. The area at risk must be vacated as quickly as possible and the exhausted supply (rechargeable NiMH or alkaline) replaced by a charged one.

Removing / Fitting the rechargeable battery



(1) Switch the instrument off.
(2) Remove the two screws on the rear of the instrument at the lower corners of the supply unit.
(3) Carefully raise the supply at the lower end and then withdraw it completely.
(4) Refit the charged unit in the reverse sequence.
(5) Retighten the two screws.

Charging the rechargeable battery

Attention!
Never charge the battery in an Ex area. There is a risk of injury arising from the electric current.

Attention!
The battery may only be charged with the MSA chargers. The use of other chargers can lead to damage to the battery or to the instrument itself.

(1) Remove the battery from the instrument.

(2) Connect the charger to the charging connector on the rear of the battery. The colour of the LEDs indicates the charging status:
Red: Battery is being charged.
Green: Charging process ended; battery is ready for use.
Blinking red: Failure mode – remove the battery from the charger.
LED off: No battery connected.

Batteries that are very cold should not be charged immediately. Wait for approx. half an hour at room temperature before charging. This will increase the operating life of the battery.

Changing the alkaline battery pack, fitting the batteries

The battery pack can be used as the main or as a replacement power supply.

Attention!

Never change the batteries in an Ex area. There is a risk of injury arising from the electric current.

(1) Remove the battery pack from the instrument in exactly the same way as for the rechargeable unit.

(2) Undo the quick release fastener on the battery cover (Allen screw, 1/4 turn).

(3) Replace the spent batteries. Observe the polarity (+) when doing this. The instrument cannot work with wrongly fitted batteries.

(4) Refit the battery cover, then the battery module into the instrument in the reverse order.

Spent batteries should be returned to the distributor or manufacturer for disposal. In any event they do not belong in the domestic waste.

3.4. Remedial measures in case of error messages

Message	Remedy/Measures
RAM error ROM error Parameter memory error Data memory error	Acknowledge the error, instrument switches off automatically. Arrange for service by the manufacturer.
Low battery	Acknowledge the alarm, instrument switches off automatically. Charge or replace the battery.
Gas flow interrupted	Acknowledge the error (Reset button), unblock the filter, check and perform restart.
Sensor error for CO_2, EX	Acknowledge the error, switch off the instrument, carry out maintenance.
No alarm voltage	Switch off the instrument and arrange for service by the manufacturer.
Battery type not recognised	Change the battery pack or have the instrument checked by the manufacturer.
Device restarts automatically	If there are repeated occurrences, arrange for service by the manufacturer.
▲ or ▼ next to the measurement unit	Measurement above or below measuring range, calibration required.
Fresh Air Setup error	Supply fresh air (no measuring gas) and repeat. If error recurs, calibration is required.
Test gas error	Check the gauge on test gas regulator. Set the correct test gas concentration. If message recurs fit new sensor.

4. Alarms

4.1. Alarm types

Pre and main alarm

When there are toxic or combustible gases in the work area, the ORION^{plus} will trigger an alarm if it is equipped with the appropriate sensor for these gases. There are two alarms for each measuring range:

- LO Alarm = Pre-warning, alarm is non-latching.
- HI Alarm = Main alarm, or LockAlarm^{TM}, alarm is latching.

When the LockAlarm^{TM} is triggered, leave the contaminated area immediately!

The minimum concentration of a combustible gas in air that can ignite is defined as the Lower Explosive Limit (LEL). An indication of 100% LEL means that an explosion hazard exists. The instrument activates the LockAlarm^{TM} when the concentration reaches 125% LEL.

TWA and STEL alarms

For the installed Tox sensors there are additionally a further two factory-set alarm thresholds for

- TWA (Time Weighted Average) = Average value of a toxic exposure, averaged over 8 hours
- STEL (Short Term Exposure Limit) = Average value of a toxic exposure, averaged over 15 minutes.

The factory-set alarm thresholds for the sensors can be found in the section "Technical Data".

Battery alarm and automatic switch-off

The instrument can recognise the type of power source fitted (rechargeable cells or battery module) and automatically sets the internal alarm thresholds accordingly for:

- Battery warning = visual signal, all bars on the battery indicator blink
- Battery alarm = audible signal, the instrument has only another 15 min operating time

The instrument switches itself off automatically when the power source can no longer supply it adequately or after silencing the battery alarm.

4.2. Alarm responses

Alarm type	Display/Signal	Response
Combustible gases **LO Alarm** when alarm threshold reached/exceeded	▪ Audible alarm activated ▪ Alarm LEDs blink ▪ Measurement highlighted	Acknowledge alarm with **Reset** button.
HI Alarm when alarm threshold reached/exceeded	▪ Audible alarm activated ▪ Alarm LEDs blink ▪ Measurement highlighted, measurement range exceeded if 100% LEL displayed	Alarm cannot be reset. Report fall-back when 100% LEL reached. Display continues to 125 % LEL then the LockAlarm^{TM} is initiated.
LockAlarm^{TM} 125% LEL reached/exceeded	▪ Audible alarm activated ▪ Alarm LEDs blink ▪ Display indicates measuring range exceeded, measurement is discontinued.	Alarm cannot be acknowledged. Leave the contaminated area immediately. Switch the instrument off and on again in a safe place.
Oxygen **HI Alarm** on reaching the alarm threshold for too little (deficiency) or too much (excess) oxygen.	▪ Audible alarm activated ▪ Alarm LEDs blink ▪ O_2 symbol above the measurement blinks	Alarm cannot be reset. When using the instrument as a warning device: Leave the affected area immediately. When using as a measuring instrument: Only enter the area with protective equipment.

Alarm type	Display/Signal	Response
Toxic gases **Alarm** on reaching one of the 2 preset thresholds.	▪ Audible alarm activated ▪ Alarm LEDs blink ▪ Tox symbol above the measurement blinks	Acknowledge alarm with **Reset** button.
STEL Alarm **Alarm** on reaching/exceeding the 15 minute average for Tox sensors	▪ Audible alarm activated ▪ Alarm LEDs blink ▪ STEL symbol blinks	Acknowledge alarm with **Reset** button. Observe you operating regulations.
TWA Alarm **Alarm** on reaching/exceeding the 8 hour average for Tox sensors	▪ Audible alarm activated ▪ Alarm LEDs blink ▪ TWA symbol blinks	Acknowledge alarm with **Reset** button. Observe you operating regulations.
Battery alarm when only approx. 15 minutes of operation remain	▪ Battery symbol extinguishes then blinks ▪ Audible alarm sounds ▪ Alarm LEDs blink	Leave the danger area immediately or replace the spent power source with a charged one. Replacement permitted in Ex area.

5. Maintenance

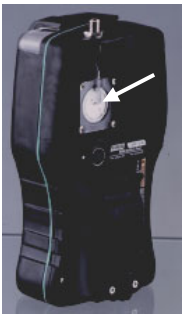
The product should be regularly checked and serviced by specialists. The results of the inspections and maintenance activities should be recorded. Only original parts from MSA should be used for repair work.

The MSA warranty for sensors, pump, rechargeable batteries, housing and electronics (→ Ch 6.1) is only valid if the instrument is annually maintained by the manufacturer or an authorized person in accordance with the operating manual.

5.1. Changing the pump filter

The pump filter protects the gas path and the pump from contamination. Dirty filters can block the gas flow and overload the pump. This could lead to erroneous readings.

Filter condition:	Filter change:
Discoloration of the filter	immediately
Heavy exposure to dust	after 200 hours



(1) Remove the four filter cover screws on the rear of the instrument.
(2) Carefully lift the filter cover.
(3) Remove the old filter and replace it with a new one.
(4) Replace the filter cover and tighten the four screws.

5.2. Changing/Replacing the sensors

Observe the following when changing sensors: Each sensor must be fitted in its allocated slot. Make sure, therefore, that the gas type printed on the sensor label matches the slot in the instrument.

(1) Switch the instrument off and remove the power source.

(2) Remove the screw on the pump cover.

(3) Remove the screws on the sensor cover and carefully withdraw it.

(4) Gently lift out the sensor that is to be replaced.

(5) Carefully align the new sensor with the socket and press it in.
Don't touch the sensor membrane by any means, as this could spoil it.

(6) Refit the sensor cover and the pump cover back in the reverse order.

Electrochemical sensors should be disposed of properly. In any event they do not belong in the domestic waste.

Electrochemical sensors should only be ordered for immediate use. Other replacement sensors should be stored at a temperature between +5 C and +12 °C.

5.3. Cleaning the instrument

The ORION^{plus} should be cleaned regularly with a damp cloth:

Attention!

The surface of the sensors is very sensitive. Therefore do not clean the sensor cover plate in the assembled state, as the sensors might be damaged or destroyed.

Attention!

The sealed holes in the sensor cover plate which have no sensor fitted behind them may not be opened. This could cause incorrect measurements.

6. Technical Data

6.1. Technical Specification of the ORION*plus*

Weight	410 g (Instrument with battery pack)
Dimensions	165 x 92 x 66 mm (L x B x H)
Alarms	Two super bright LEDs with 320° viewing angle and a loud audible alarm
Displays	Large display for indicating measurements, separate display for indicating state of charge and additional information
Battery type	Rechargeable NiMH battery pack or 1.5 V dry cells AA (Alkaline), battery module can be changed in Ex-atmospheres
Battery life	NiMH: 11 h Alkaline: 9 h
Charging time	≤ 3 h with the MSA AUER rapid charging unit (100-250 VAC)
Warm up time	2 min
Temperature range	- 20°C to +50°C, Storage from -5°C to +40°C
Humidity range	15 - 90% rel. humidity, non condensing, short term 5% – 95% rel. humidity
Atmospheric pressure range	800 to 1200 kPa
Flow rate	0.2 to 0.5 l/min
Dust and spray protection	IP 54
Function tested gases	CO, CO_2, H_2S, O_2 lt. Testreport 41300304P
Warranty	5 years for housing and electronics 2 years for sensors, rechargeable batteries and pump
Approvals	EN 50014/EN 50018/EN 50019/EN 50020 Ex II 2G EEx iade IICT4/T3 –20°C to +40°C/+50°C NiMH T4 –20°C to +40°C Alkali Duracell T4: –20°C to +50°C Alkali Varta T3: –20°C to +50°C

6.2. Measurable Gases, displays, resolution

Measurable Gases*	Display	Resolution	Response time at 20°C
20 mm sensors			
Combustible gases:	0 – 100% LEL	1% LEL	$t_{50} \leq 10$ s methane ≤ 15 s propane $t_{90} \leq 26$ s methane ≤ 35 s propane
O_2	0 – 25 % Vol.	0.1 % Vol.	≤ 10 s
CO	0 – 999 ppm	1 ppm	= 45 s
H_2S	0 – 200 ppm	1 ppm	= 20 s
CO_2	0 – 5 % Vol.	0.01 % Vol.	≤ 40 s
Cl_2	0 – 10 ppm	0.1 ppm	$t_{50} < 10$ s / $t_{90} < 30$ s
NH_3	0 – 100 ppm	1 ppm	$t_{50} < 20$ s / $t_{90} < 60$ s
SO_2	0 – 20 ppm	0.1 ppm	$t_{90} \leq 35$ s
NO_2	0 – 20 ppm	0.1 ppm	$t_{90} \leq 25$ s
ClO_2	0 – 1 ppm	0.02 ppm	$t_{50} < 20$ s / $t_{90} < 120$ s
PH_3	0 – 5 ppm	< 0.05 ppm	t_{90} 30 s
O_3	0 – 1 ppm	0.02 ppm	$t_{50} < 30$ s / $t_{90} < 60$ s
$COCl_2$	0 – 1 ppm	0.02 ppm	$t_{50} < 60$ s / $t_{90} < 120$ s
IR sensors:			
HC, Butane	0-25 % Vol.	0,1 % Vol.	
HC, Propane	0-25 % Vol.	0,1 % Vol.	
HC, Ethylene	0-25 % Vol.	0,1 % Vol.	
CH_4, Methane	0-100 % Vol.	1 % Vol.	
CH_4, Methane	0-100 % LEL	1 % LEL	
C_3H_8, Propane	0-100 % Vol.	1 % Vol.	
C_3H_8, Propan	0-100 % LEL	1 % LEL	
CO_2	0 – 10 % Vol.	0,01 % Vol.	

* The gases can only be measured when the appropriate sensors are used.

6.3. Self-Adjusted Tox sensors alarm thresholds

Sensor	LO	HI	TWA	STEL
CO	30 ppm	60 ppm	30 ppm	60 ppm
CO_2	0.5 % Vol.	2.0 % Vol.	0.5 % Vol.	2.0 % Vol.
H_2S	5 ppm	10 ppm	5 ppm	10 ppm
O_2	22.0 % Vol.	19.5 % Vol.	--	---
Cl_2	0.5 ppm	1.0 ppm	0.5 ppm	1.0 ppm
NH_3	25 ppm	50 ppm	25 ppm	50 ppm
SO_2	5 ppm	10 ppm	5 ppm	10 ppm
NO_2	5 ppm	10 ppm	5 ppm	10 ppm
ClO_2	0.1 ppm	0.1 ppm	0.1 ppm	0.1 ppm
PH_3	0.1 ppm	0.3 ppm	0.1 ppm	0.3 ppm
O_3	0.1 ppm	0.1 ppm	0.1 ppm	0.1 ppm
$COCl_2$	0.1 ppm	0.1 ppm	0.1 ppm	0.1 ppm

6.4. Sensor cross sensitivity

Input ➔ Output ⬇	20,9 Vol % O_2	300 ppm CO	20 ppm H_2S	5 Vol % CO_2	33 % LEL CH_4	20 ppm Cl_2	50 ppm NH_3
O_2 / 30 % Vol	20,9 % Vol	20,9 % Vol	20,9 % Vol	20,9 % Vol	20,9 % Vol	20,9 % Vol	20,9 % Vol
CO / 300 ppm	0 ppm	300 ppm	0 ppm	0 ppm	0 ppm	2 ppm	23 ppm
H_2S / 200 ppm	0 ppm	0 ppm	20 ppm	0 ppm	0 ppm	9 ppm	0 ppm
CO_2 / 5 % Vol	0 % Vol	0 ppm	0 ppm	5 % Vol	0 ppm	0 ppm	0 ppm
Comb /100 LEL	0 LEL	0 LEL	0 LEL	0 LEL	33 % LEL	0 LEL	0 LEL
Cl_2 / 20 ppm	0 ppm	0 ppm	0 ppm	0 ppm	0 ppm	20 ppm	0 ppm
NH_3 / 100 ppm	0 ppm	0 ppm	2 ppm	0 ppm	0 ppm		50 ppm
SO_2 / 20 ppm	0 ppm	4 ppm	0 ppm Fi (200ppmh)	0 ppm	0 ppm	-140 ppm*	0,25 ppm
NO_2 / 100 ppm	0 ppm	≤0,1 ppm	≤40 ppm	0 ppm	0 ppm	200 ppm	≤0,25 ppm
PH_3 / 5 ppm	0 ppm	1,5 ppm	0 ppm	0 ppm			
ClO_2 / 1 ppm	0 ppm	0 ppm	0 ppm	0 ppm	0 ppm	6 ppm	
O_3 / 1ppm	0 ppm	0 ppm	0 ppm	0 ppm	0 ppm	24 ppm	-1,5 ppm
HCN / 50 ppm	0 ppm	0 ppm	0 ppm	0 ppm	0 ppm	0 ppm	0 ppm
$COCl_2$ / 1 ppm	0 ppm	0 ppm	0 ppm	0 ppm	0 ppm	8 ppm	0,15 ppm

* These sensor combination shouldn't be selected.

Input ➔ Output ➓	20 ppm SO_2	100 ppm NO_2	5 ppm PH_3	1 ppm ClO_2	1 ppm O_3	50 ppm HCN	1 ppm $COCl_2$
O_2 / 30 % Vol	20,9 % Vol	20,9 % Vol	20,9 % Vol	20,9 % Vol	20,9 % Vol	20,9 % Vol	20,9 % Vol
CO / 300 ppm	1 ppm	-6 ppm				0,5 ppm	
H_2S / 200 ppm	0,2 ppm	-7 ppm				0,5 ppm	
CO_2 / 5 % Vol	0 ppm	0 ppm	0 ppm	0 ppm	0 ppm	0 ppm	0 ppm
Comb / 100 LEL	0 LEL	0 LEL	0 LEL	0 LEL	0 LEL	0 LEL	0 LEL
Cl_2 / 20 ppm	-2,5 ppm	20 ppm		0,5 ppm	0,12 ppm	-0,5 ppm	
NH_3 / 100 ppm							
SO_2 / 20 ppm	20 ppm	-500 ppm					
NO_2 / 100 ppm	≤ -2,5 ppm	100 ppm					
PH_3 / 5 ppm	4 ppm		5 ppm				
ClO_2 / 1 ppm		37 ppm		1 ppm	0,06 ppm	-2,1 ppm	
O_3 / 1ppm	-0,2 ppm	60 ppm		1,5 ppm	1 ppm		
HCN / 50 ppm	0 ppm Fi	-7,3 ppm		-2 ppm	-0,04 ppm	50 ppm	
$COCl_2$ / 1 ppm	0 ppm	10 ppm		-3 pmm	0 ppm	0 ppm Fi	1 ppm

7. Ordering Information

Description	Part No.
Instrument configurations	
ORION*plus* P, Ex/Ox/CO/H_2S/CO_2, NiMH	10046094
ORION*plus* P, Ex/Ox/CO/ CO_2, NiMH	10046095
ORION*plus* P, Ex/Ox/H_2S/CO_2, NIMH	10046096
Sensors	
LEL sensor	10024247
O_2 sensor	10025940
CO sensor	711306
H_2S sensor	711307
CO_2 IR sensor	10045992
CI_2 sensor	10060772
NH_3 sensor	10060773
SO_2 sensor	10060774
NO_2 sensor	10060775
ClO_2 sensor	10060776
PH_3 sensor	10060777
O_3 sensor	10060780
$COCl_2$ sensor	10060791
IR sensors	
ORION*plus*, IR sensor HC 0-25 % Vol Butane	10062201
ORION*plus*, IR sensor HC 0-25 % Vol Propane	10062202
ORION*plus*, IR sensor HC 0-25 % Vol Ethylene	10062204
ORION*plus*, IR sensor CH_4 0-100 % Vol	10062205
ORION*plus*, IR sensor CH_4 0-100 % ELE	10062206
ORION*plus*, IR sensor C_3H_8 0-100 % Vol	10062207
ORION*plus*, IR sensor C_3H_8 0-100 % ELE	10062208
ORION*plus*, IR sensor CO_2	10062209

Description	Part No.
Power supply	
NiMH rechargeable battery pack	10031091
Alkaline battery pack	10031092
Vehicle charger	10034276
NiMH charger, complete	10041970
Calibration gases	
1.45% Vol. methane/15 % Vol. O_2/ 300 ppm CO/10 ppm H_2S	10024230
0.986% Vol. propane/15 % Vol. O_2/ 300 ppm CO/10 ppm H_2S	10044001
0.986% Vol. propane/15 % Vol. O_2/ 300 ppm CO	10044002
0.812% Vol. pentane/15 % Vol. O_2/ 300 ppm CO/10 ppm H_2S	10045913
0.812% Vol. pentane/15 % Vol. O_2/ 300 ppm CO	10045912
1.45% Vol. methane/15 % Vol. O_2/ 300 ppm CO/10 ppm H_2S/2.5% Vol. CO_2	10050744
Accessories	
Software incl. infrared sensor (ORION Link Control)	710946
Leather carrying case (black)	10020485
Protective rubber boot (black)	10022036
Carrying belt	474555
Swivel belt loop	710962
Hand probe EU	D6203723
Liquid surface probe	D6071039
Sampling line 1.5 m Teflon, PTFE conductive	10021925
Sampling line 3 m Teflon, PTFE conductive	10021926
Sampling line 5 m Teflon, PTFE conductive	10021927
Sampling line 5 m, with liquid surface probe	D6203730
Gas miser regulator, model RP	710288
Flow regulator 0.25 l/min	467895

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