



Operating instructions Converter Checker CC-100E

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1 General information

Copyright© 2021 HORIBA Europe GmbH, all rights reserved.

This manual describes the operation of the NO_x Converter Checker CC-100E (with integrated ozone generator), which can be used to check the efficiency of NO_x-to-NO converters used in gas analysers during emission measurements or for process gas analysis.

Be sure to read this manual before using the product to ensure proper and safe operation of the unit.

Keep the manual in a safe place so that it is always available when needed.

Product specifications and the appearance and contents of this manual are subject to change without notice.

All procedures and illustrations described in this manual refer to a unit with specific features. Please note that your unit may differ. If you have any questions, please contact us.

1.1 Address of the manufacturer

HORIBA Europe GmbH
Hans-Mess-Straße
661440 Oberursel / Germany

Phone: +49 6172 1396 0 Fax:

+49 6172 137 385 E-mail

:

info.he@horiba.com Internet: www.horiba.com

1.2 Warranty and liability

The appliance is supplied by HORIBA with a warranty for a period of one (1) year.

In case of malfunction or damage within this year attributable to HORIBA, please contact HORIBA.

The warranty does not cover the following situations:

- Any malfunction resulting from improper operation.
- Any malfunction due to modifications or repairs not having been carried out or authorised by HORIBA.
- Any malfunction due to the use of the unit in an unsuitable environment.
- Any malfunction resulting from failure to observe the instructions in this operating manual.
- Any malfunction resulting from use of the appliance that does not comply with the instructions in this manual.
- Any disruption resulting from natural disasters, accidents or breakdowns in which HORIBA is not involved.
- Any malfunction due to the unit falling down.
- Signs of use such as rust etc. that are due to corrosion.
- consumables and the replacement of wear parts.

HORIBA is not liable for any damage caused by any malfunction of this product, any deletion of data, or any other use of this product.

1.3 Trademarks

In general, company and brand names are either registered trademarks or trademarks of the respective companies.

1.4 Applied EU directives and standards

This appliance complies with the following directives and standards:

Directive 2014/35/EU	of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits (Low Voltage Directive)
Directive 2014/30/EU	of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive)
EN 61010-1:2011-07	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements
EN 61326-1:2013-07	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements - Part 1: General requirements

1.5 Intended use

HORIBA's CC-100E is used to check the efficiency of the conversion of NO_x to NO, as is common in NO_x analysers in flue gas analysis or process gas measurement. By means of ozone production through high-voltage discharge and mixing with externally supplied nitrogen monoxide (NO), exact NO₂ concentrations are generated in a short reaction time.





2 Safety

2.1 Spellings used

Warnings used in these operating instructions consist of a signal word, a warning, mandatory or instruction symbol, the type of hazard incl. consequences and the instructions for avoiding it.

GEFAHR	indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
WARNUNG	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
VORSICHT	indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or property damage.
HINWEIS	indicates important information about the product or actions that must be observed for the correct functioning of the unit.

The following symbols are used in these operating instructions and to identify hazardous points on the system:

Symbol	Meaning
	Warning of a general danger
	Warning of electrical voltage
	Hot surface warning
	General note

2.2 General safety instructions

Target group

These instructions are intended for skilled personnel who are familiar with the general hazards involved in the installation, maintenance and operation of equipment in commercial or industrial environments.

Before installation and first commissioning, the personnel must obtain knowledge of the intended use of the system by carefully reading these operating instructions.

- Operation - instructed competent personnel with required expertise
- Maintenance - qualified personnel with required knowledge, electrician

The warnings must be observed.

Electrical safety

DANGER



Electrical voltage

Danger of electric shock

- ✓ There are parts in the unit that are under dangerous voltage
 - a) The unit may only be opened by instructed, skilled personnel.
 - b) Disconnect the unit from the mains at all poles when carrying out maintenance work on electrical components. To do this, pull out the mains plug. Simply switching off the unit at the mains switch is not sufficient!
 - c) Secure the unit against unintentional restart.
 - d) Work on the opened device when it is live may only be carried out by a specialist who is familiar with the associated dangers.

Switch off in an emergency

WARNING



Emergency

- ✓ Uncontrollable operation of the appliance, occurrence of fire and smoke.
 - a) Switch off the unit and disconnect the mains plug.
 - b) Close the valves on the gas cylinders or the external feeds.

Hazardous substances

WARNING



Toxic gases

- ✓ The unit handles toxic gases. Uncontrolled leakage of these gases can cause a serious accident such as poisoning.
 - a) Connect the system according to this manual.
 - b) Use the specified connections as well as hoses and pipes and connect them gas-tight.
 - c) Check that the applied gas pressure corresponds to the nominal value.
 - d) Ensure that your working environment is properly ventilated.

CAUTION



Handling auxiliary materials and consumables

- ✓ Auxiliary materials and consumables may contain substances that are hazardous to health or the environment.
 - a) Follow the instructions for action written in the safety data sheets of the auxiliary materials and consumables.
 - b) Wear your personal protective equipment if necessary.

The following safety instructions are on the unit:

Reverse side:



3 Unit overview

3.1 Scope of delivery

Designation	Quantity
NOx Converter Checker CC-100E	1 piece
Operating instructions	1 piece
Mains connection cable 230V	1 piece

3.2 Labelling



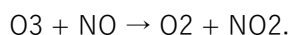
Fig. 1: Example of a type plate

The nameplate of the CC-100E is located on the back above the O₂ inlet.

3.3 Description

The HORIBA Converter Checker CC-100E is a compact device for checking the reliability of gas analysers for determining the NO_x content in exhaust gases. For this purpose, the device generates ozone from an oxygen-saturated atmosphere in a high-voltage unit, mixes the ozone with externally supplied NO and produces a gas mixture with a precise NO₂ concentration. The CC-100E is optimised for high stability and short reaction times.

The operating principle of the NO_x Converter-Checker CC-100E is based on gas phase titration (GPT). Gas phase titration generally refers to any titration carried out in the gas phase. More specifically, it is a method for determining reactive fractions in the gas phase by reacting with the excess of another gas that serves as the titrant. In our case, the gaseous analyte is ozone, which can be "titrated" with nitric oxide according to the following reaction



The unknown NO concentration can then be determined from measuring the concentration of the reaction products.

Compared to simple spectrophotometry, gas phase titration has two advantages:

The measurement is not dependent on the path length of the gas path, as the same gas path is used for both the measurement of the excess titrant and the measurement of the product.

The measurement also does not depend on the linear change in absorbance as a function of the concentration of the gas to be analysed (Beer-Lambert law). Therefore, the method is particularly suitable for such samples whose components interfere at similar wavelengths as the analysis gas.

3.4 Unit views

Front view



Fig. 2: Front view

Position	Designation
1	ON/OFF switch
2	Touch screen for operation
3	USB 1 (not in use)
4	USB 2 (service interface for updating the firmware)

Rear view



Fig. 3: Rear view

Position	Designation
1	Oxygen inlet for ozone generation (inlet valve 1)
2	Nitrogen inlet as reference (inlet valve 2)
3	NO Calibration gas inlet (inlet valve 3)
4	Connection to the gas inlet of the analyser
5	Mains connection (Power)
6	RS232 interface
7	Bypass

Interior view

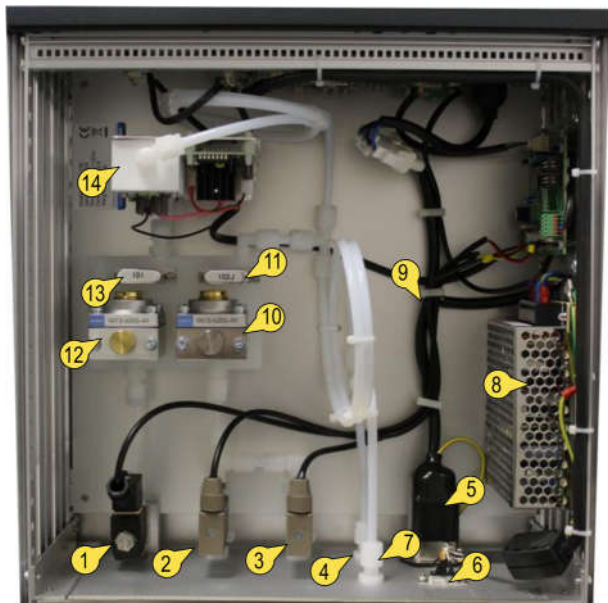


Fig. 4: Interior view

Position	Designation
1	Inlet valve 1; oxygen inlet
2	Inlet valve 2; nitrogen inlet
3	Inlet valve 3; Calibration gas (NO) inlet
4	Output to the analyser
5	Mains connection
6	RS232 interface
7	Bypass
8	Power supply unit
9	Mixing area
10	Pressure regulator 2
11	Capillary line 2
12	Pressure regulator 1
13	Capillary line 1
14	Ozone generator

4 Installation and commissioning

4.1 Before installation

Be sure to observe the following instructions before installation and commissioning:

NOTE



Installation

Installation must only be carried out by qualified personnel.

- a) Follow all instructions in this manual.
- b) Modifications to the unit are prohibited.
- c) Operate the unit only within the specified limits.

WARNING



Transport damage

Inspect the unit carefully for damage before operation. Safe operation is not possible,

- if there is visible damage to the unit,
- if the unit no longer works correctly or
- After storage under damaging conditions

If one of these points applies, you must put the unit out of operation and secure it against unintentional operation.

DANGER



Electrical voltage

Improper connection may result in electric shock or fire.

- a) Make sure that the supply voltage corresponds to the specifications on the type plate.
- b) Only connect the unit with the mains cable supplied. Do not use the mains cable for other devices.
- c) Do not open the unit! There are high-voltage components in the unit.
- d) Only connect the unit to an earthed socket.

WARNING



Potentially hazardous gases

Hazardous gases are passed through the appliance. There is a risk of poisoning and/or suffocation if the gas is not connected properly.

- a) Make sure that the operating pressure complies with the specifications.
- b) Use only high purity gas.
- c) Ensure that the work area is well ventilated and that exhaust fumes are safely discharged.
- d) Only use the specified connectors and lines and connect them gas-tight without leaks.

4.2 Environmental conditions

The unit is designed for the following environmental conditions.

- Overvoltage category: II
- Pollution degree: 2
- EMC: EN61326-1: 2013-07 Class A, Industrial
- Mains connection: AC 90 V to 240 V, 50/60 Hz
- Gas pressure: 20 kPa (200 mbar)
- Operating temperature: 5 ° C to 35 ° C
- Rel. humidity: < 80 %, non-condensing
- No direct exposure to heat and sunlight

4.3 Installation

WARNING

Hot surfaces on the appliance, risk of burns



- ✓ During operation, the surface of the appliance becomes hot.
 - a) Do not touch the surface during operation.
 - b) Allow the unit to cool down before starting installation or maintenance work.

Connect



Fig. 5: Rear view

Place the unit on a level, stable surface.

1. Connect the gas supply lines (1 to 3).
2. Connect the bypass line (7) to a venting system.
3. Connect the "Analyser" output (4) of the CC-100E to the gas input of your analyser.
4. Make sure that all screw connections and lines are connected gas-tight before using the system for the first time.
5. Set the correct inlet pressure according to the specification.
6. Connect the mains cable.
7. Switch on the unit.
8. The HORIBA start screen appears.
9. Operate the function via touch screen.

5 Operation

Overview of the test procedure:

Prepare the converter as described in the chapter "Installation" and allow the downstream analyser to warm up.

NOTE



Preparation and settings

✓ Prepare the following:





Use an ozone number of 5 or more.

Make sure that the flow rate in the analyser does not fluctuate during the test.

Do not change the flow rate during the test.

Prepare a data entry sheet (see example below).

	On the CC-100E	At the analyser	Status	Reading log
				
Select the operating mode of the analyser		Select the NO mode		
	Press the UP key once		The N2 gas flows into the analyser.	
Step "Z" (zero calibration of the analyser)		Perform a zero calibration after the reading has become stable.		
	Press the UP key once		The NO gas flows into the analyser.	
Step "A" (range calibration of the analyser)		Perform the range calibration after the reading has become stable.		Reading (A)
	Press the UP key once		The NO and O2 gas flows into the analyser	
Step (a)				Reading (a)
	Press the UP key once		The O3 gas flows into the analyser	
Step (b)	Set the measured value (ozone) to 10% to 20% of the measuring range.	NO2 is produced, which decreases the NO value		Reading (b)
	Press the UP key once			
Step (c)		Changing the mode from NO to NOx		Reading (c)

	On the CC-100E	At the analyser	Status	Reading log
		Press the UP key once		The O3 gas stops, NO and O2 flow into the analyser.
Step (d)				Reading (d)
		Press the UP key once		O2 delivery is stopped, only NO flows into the analyser.
Step (B)				Reading (B)
		Press the UP key once		The N2 gas flows into the analyser.
Step (Z)				The step ends automatically about 60 seconds later.
				
End				

Tip: To scroll back through the steps, press the DOWN button each time.

Data entry form

The efficiency of the converter is calculated as follows:

$$\text{Efficiency of the converter} = \left(1 + \frac{c-d}{a-b}\right) \times 100 (\%)$$

Test sheet: Converter efficiency: Analyser no., XXXXXXXX									
Date	Auditor	Efficiency (in %)	Reading						Reading before and after the check
			(a)	(b)	(c)	(d)	(A)	(B)	

5.1 Operation

Switch on

After switching on the CC-100E, the main screen appears:

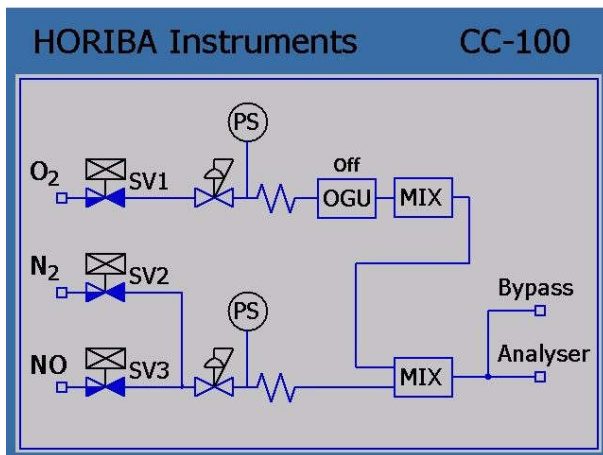


Fig. 6: Main screen

The main screen schematically represents the gas flow through the unit. The components are controlled by tapping on the corresponding symbol.

Control valves, supply oxygen

Tap the "SV" icons to open or close the inlet valves. A selection window with a yellow background appears:

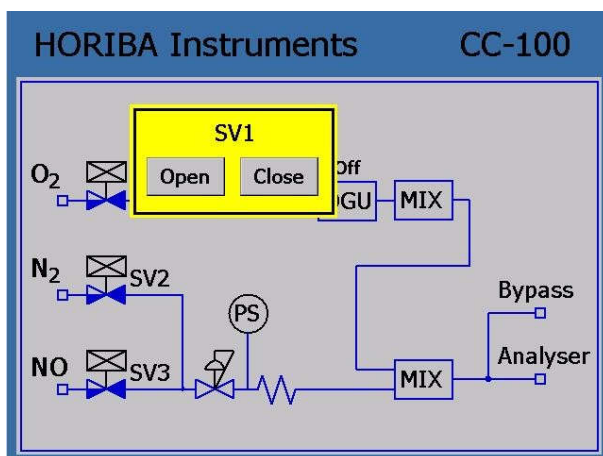


Fig. 7: Open or close inlet valves

Open the corresponding valve with "Open". The colour of the valve and the gas path changes from blue (valve closed) to yellow (valve open).

Close the corresponding valve with "Close".

Set ozone concentration and start ozone generator

Tap the "OGU" symbol. The window for setting the ozone concentration appears

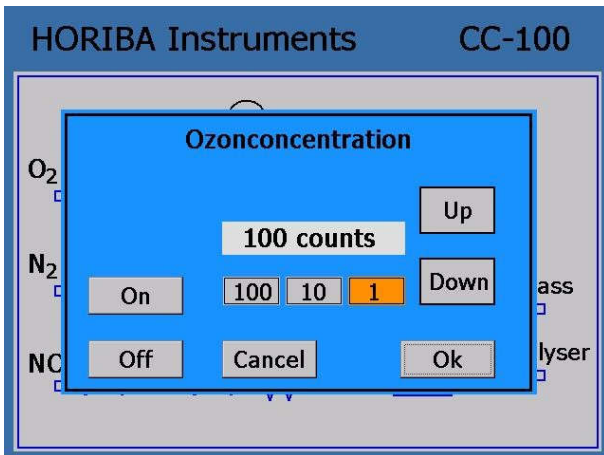


Fig. 8: Ozone generation

Set the "counts" using the 100s / 10s / 1s key and the "Up" and "Down" keys. Switch the generator on with the "On" key.

You can then work through the test sequence with the "Up" and "Down" buttons.

The set "counts" are displayed in the main screen.

NOTE

Relationship between counts and NO concentration



The value for "counts" should be 10 times the NO concentration in ppm.

Example:

For an NO concentration of 100 ppm, "counts" must be set to 1000

Supply external gas

To supply N2 (SV2) or NO (SV3) externally, open the respective inlet valve as described above.

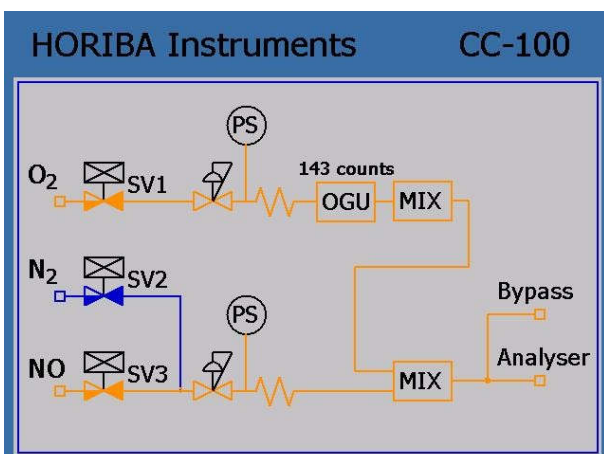


Fig. 9: Opening the valves

NOTE

Supply external gas

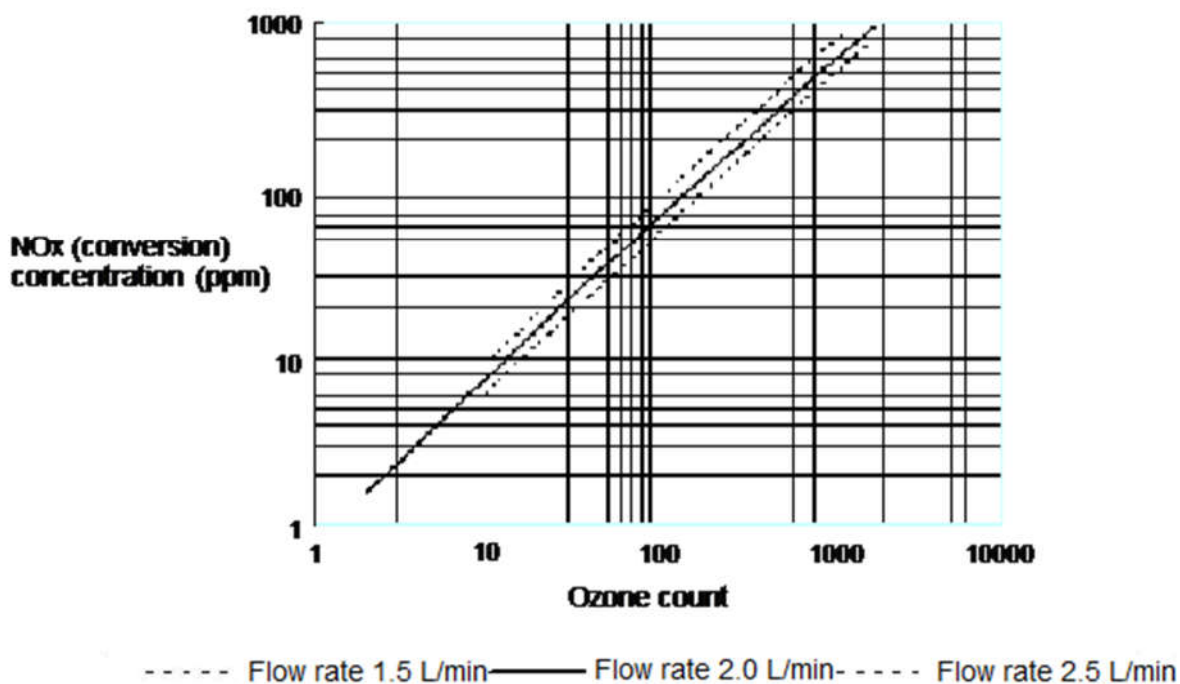


The inlet valves SV2 and SV3 are interlocked. Only either N2 or NO can be supplied.

Switch off gas supply

1. Stop the ozone production by pressing the "OGU" button and then "OFF".
2. Close the SV3 valve and stop the NO supply.
3. Start a flushing process with nitrogen for at least one minute. To do this, open valve SV2 for the N₂ supply.
4. Close the SV1 valve and stop the O₂ supply.
5. Close the SV2 valve and finish the flushing process.
6. Switch off the unit at the mains switch.

5.2 Relationship between ozone generation and NO_x concentration



6 Maintenance

6.1 Safety instructions for maintenance

 **DANGER**

Electrical voltage



Danger of electric shock

- ✓ There are parts in the unit that are under dangerous voltage
 - a) The unit may only be opened by instructed, skilled personnel.
 - b) Disconnect the unit from the mains at all poles when carrying out maintenance work on electrical components. To do this, pull out the mains plug. Simply switching off the unit at the mains switch is not sufficient!
 - c) Secure the unit against unintentional restart.
 - d) Work on the opened device when it is live may only be carried out by a specialist who is familiar with the associated dangers.

6.2 Maintenance plan

The specified intervals for checking the following components are recommendations. More frequent replacement may be necessary depending on the application, installation environment, purity of gases used and other factors.

Component	Exchange interval	Description	Action
Ozone generator	1 to 3 years	Check for contamination	Exchange by HORIBA
Inlet valves SV1 to SV3	In case of defect	Check for contamination	Exchange by HORIBA
Pressure regulator	In case of defect	Check for contamination	Exchange by HORIBA
Capillaries	In case of defect	Check for contamination	Exchange by HORIBA

6.3 Troubleshooting and fault rectification

Situation	Possible causes	Remedial action
The CC-100E cannot be switched on.	– The main power line is switched off.	Check the main power line.
	– The supply voltage is wrong.	Connect the correct voltage
	– The power switch is OFF.	Turn on the power switch.
	– The fuse has blown.	Replace the fuse with a fuse of the same type.
The display does not change.	– NO gas is not supplied.	Open the inlet valve for the NO gas supply. Check the gas pressure
	– A leak has occurred.	Check the gas lines and screw connections. Connect the gas lines properly.
	– The gas line is not connected properly.	Connect the piping properly.
The display is unstable.	– The pressure produced is out of specification.	Regulate the pressure to a value in the specified range.

Situation	Possible causes	Remedial action
	– The pressure generated at the outlet is out of specification.	Regulate the pressure to a value in the specified range.
The reaction speed is slow.	– The residual pressure of the gas is too low.	Regulate the pressure to a value in the specified range. Connect a new bottle if necessary.
	– The inlet pressure is too low.	Regulate the pressure to a value in the specified range.
	– A leak has occurred.	Check the gas lines and screw connections. Connect the gas lines properly.
	– The flow is too low	Ensure a sufficient flow rate.

6.4 Spare parts

The following spare parts can be obtained from the manufacturer:

Spare part	Type	Item no.
Inlet valve 1 (oxygen)	Type 6011	1000067176
Inlet valve 2 (nitrogen)	Type 127	1000067178
Inlet valve 3 (nitrogen oxide)	Type 127	1000067178
Pressure regulator 1	UA13-S202-AV	3011014227
Pressure regulator 2	UA13-L202-SV	3011021069
Capillary 1	SA-101	3014056923
Capillary 2	SA-102-J	3014056400
Ozone generator	OGU	3014061759

7 Decommissioning

To put the unit out of operation, carry out the following steps:

Switch off gas supply

1. Stop the ozone production by pressing the "OGU" button and then "OFF".
2. Close the SV3 valve and stop the NO supply.
3. Start a flushing process with nitrogen for at least one minute. To do this, open valve SV2 for the N2 supply.
4. Close the SV1 valve and stop the O2 supply.
5. Close the SV2 valve and finish the flushing process.
6. Switch off the unit at the mains switch.

Store unit

1. Remove the mains cable.
2. Remove the gas connections.
3. It is best to store the unit in its original packaging in a dry and dust-free place.

8 Disposal

For disposal, observe the local/national regulations for the disposal of electrical and electronic equipment as well as auxiliary and consumable materials.

For the safe disposal of the appliance, commission an appropriate specialist company.

Dispose of used aids in an environmentally friendly way.

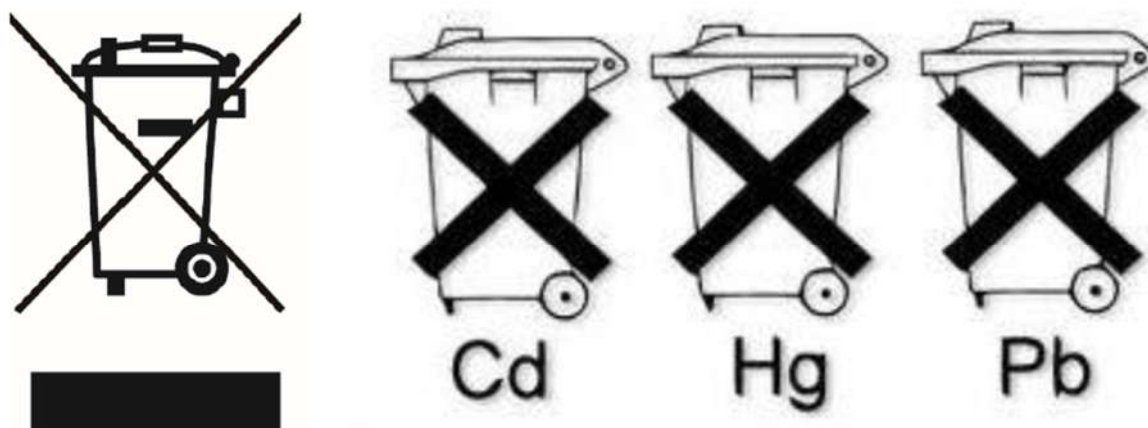
Information on the disposal of electrical and electronic equipment and the disposal of batteries and accumulators

The symbol of the crossed-out wheeled bin with lower bar on the product or accompanying documents indicates that the product requires appropriate treatment and collection in accordance with Directive 2002/96/EC (WEEE) and/or of waste batteries and accumulators in accordance with Directive 2006/66/EC in the European Union.

The symbol may be used together with one of the chemical symbols below. In this case it fulfils the requirements of Directive 2006/66/EC for the chemical article.

This product should not be disposed of as unsorted municipal waste.

Their correct disposal of WEEE, spent batteries and accumulators helps to reduce wasteful consumption of natural resources and to protect human health and the environment from possible negative effects caused by hazardous substances in products.



9 Appendix

9.1 Technical data

Gas supply:	
Concentration range NO _x	10 ppm - 1 000 ppm
External gas required:	
Gas for ozone generation: Pressure:	O ₂ , saturation ≥ 99.9% 100 kPa ± 10 kPa
Range gas: pressure:	NO 100 kPa ± 10 kPa
Zero gas: pressure:	N ₂ 100 kPa ± 10 kPa
Gas consumption:	Approx. 1.1 l/min (1000 ml NO + 100 ml O ₂)
Flow rate:	1 l/min
Gas pressure:	20 kPa (200 mbar)
Gas pipes: N ₂ : NO: O ₂ :	 6 mm Teflon 6 mm Teflon 3 mm SUS

Electrical connection	
Power supply:	AC 90 V to 240 V, 50/60 Hz 1Ph/N/PE

Environmental conditions	
Overvoltage category	II
Pollution level of the environment	2
EMC classification	EN 6126-1:2013-07, Class A, Industry
Operating temperature:	5 ° C to 35 ° C
Humidity:	Rel. humidity < 80 % , non-condensing

Mechanical properties	
Dimensions (H x W x D):	150 mm x 360 mm x 340 mm
Weight:	Approx. 7 kg

Due to continuous product improvement, the specifications listed here are subject to change without notice.

9.2 Flow diagram

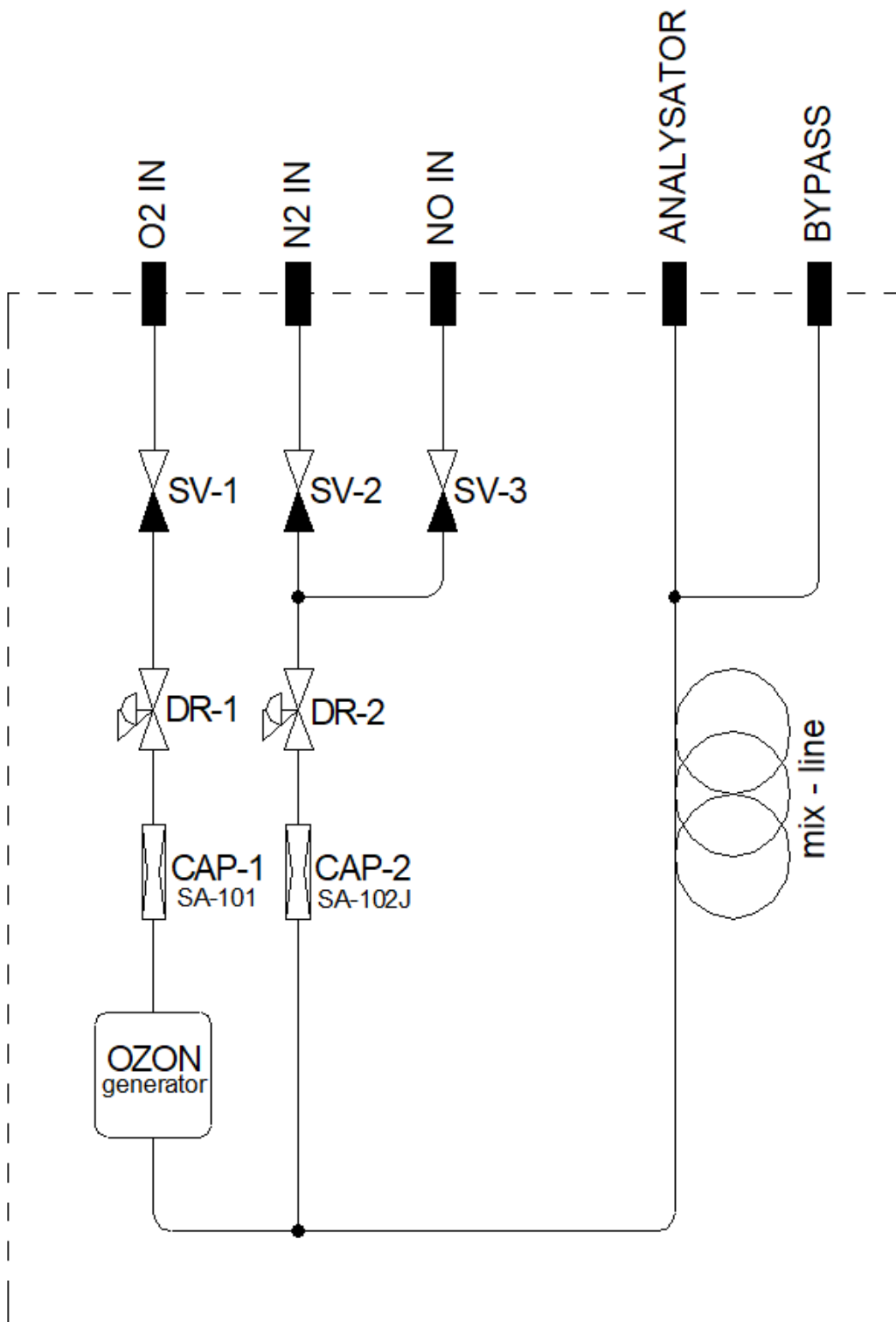


Fig. 10: Flow diagram