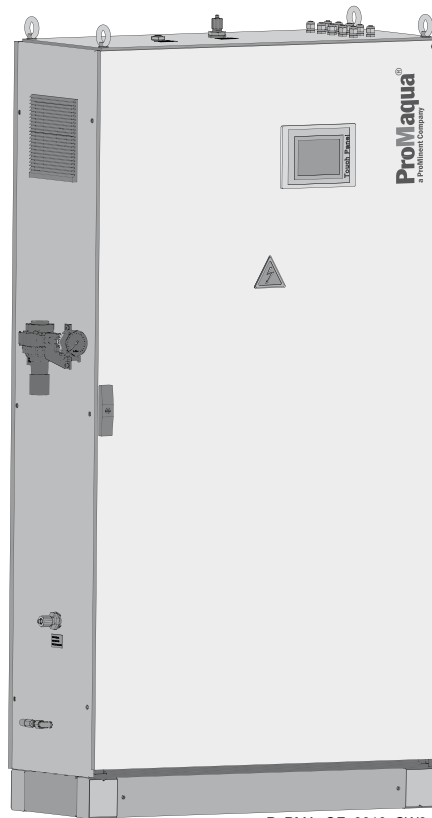


Operating instructions

Ozone Generation System

OZONFILT® Type OZMa 1 - 6 A/O

EN

P_PMA_OF_0010_SW3

Please carefully read these operating instructions before use. · Do not discard.
The operator shall be liable for any damage caused by installation or operating errors.
The latest version of the operating instructions are available on our homepage.

Supplementary information

Read the following supplementary information in its entirety!
Should you already know this information, you will benefit more from referring to the operating instructions.

The following are highlighted separately in the document:

- Enumerated lists
- ▬ Operating guidelines

Keys: *[UP]*key

Software interface text: *'Software interface text'*.

Menu sequences: *'Main menu → Configure → ...'*

Information



This provides important information relating to the correct operation of the unit or is intended to make your work easier.

Safety notes

Safety notes are identified by pictograms - see "Safety Chapter".

Note for the system operator

This document includes notes and quotes from German guidelines relating to the system operator's scope of responsibility. This information does not discharge the operator from his responsibility as an operator and is intended only to remind him or make him aware of specific problem areas. This information does not lay claim to being complete, nor applicable to every country and every type of application, nor to being unconditionally up-to-date.

Table of contents

1	About the Product.....	6
2	Identity code.....	7
3	Safety.....	9
3.1	Identification of safety notes.....	9
3.2	Warning symbols denoting different types of danger....	9
3.3	Intended use.....	9
3.4	Personnel qualification.....	10
3.5	General Safety Requirements.....	10
3.6	Safety equipment.....	11
3.7	Notes for the System Operator.....	11
4	Components of the System and Their Role.....	13
4.1	Overview of OZONFILT® OZMa 1-6 A/O.....	13
4.2	Description of the Ozone Generation System OZON- FILT® OZMa.....	21
4.2.1	Air-conditioning System (air-conditioning unit, optional).....	21
4.2.2	The OZONFILT® OZMa 1-6 A Drying Unit.....	21
4.2.3	The OZONFILT® OZMa 1-6 O Gas Supply.....	22
4.2.4	The OZONFILT® OZMa 1-6 O Gas System.....	22
4.2.5	The Ozone Generator.....	23
4.2.6	The Ozone Gas Transfer Equipment.....	23
4.2.7	Mixing Equipment (Accessory).....	23
4.2.8	Cooling Water System.....	24
4.2.9	Electrical System Components.....	24
4.3	Safety equipment.....	25
4.3.1	Flow Detector (Accessory).....	25
4.3.2	Door Safety Switch.....	25
4.3.3	Emergency Stop Switch in the Operating Room of the Ozone Generation Systems (Accessory).....	26
4.3.4	Main Switch on the System.....	26
4.3.5	Pressure Control Valves.....	26
4.3.6	Non-return Valves.....	26
4.3.7	Ozone Warning Device (Accessory).....	26
5	Operation of the OZONFILT® OZMa.....	28
5.1	Electric power.....	28
5.2	Operating Gas Flow.....	28
5.3	Cooling Water Flow.....	29
5.4	Raw Water Flow.....	29
5.5	Schematic diagram of water treatment using the OZONFILT® OZMa 1-6 A (with air as the operating gas).....	30
5.6	Schematic diagram of water treatment using the OZONFILT® OZMa 1-6 O (with oxygen as the oper- ating gas).....	31
6	Scope of Delivery, Storage and Transport.....	32
6.1	Scope of Delivery.....	32
6.2	Storage.....	32
6.3	Transport.....	33
7	Assembly and installation.....	34
7.1	Safety Guidelines and General Requirements.....	34

7.2	Requirements Relating to the System Installation Place.....	34
7.3	Requirements Relating to System Components.....	36
7.3.1	Mixing Modules (Accessory).....	36
7.3.2	Ozone Removal from Filters and Reaction Section.....	37
7.4	Assembly.....	38
7.4.1	Raw Water Piping.....	38
7.4.2	Oxygen Supply System.....	39
7.4.3	Ozone Gas System.....	39
7.4.4	Cooling Water System.....	40
7.4.5	Air-conditioning System (air-conditioning unit, optional).....	40
8	Electrical Installation.....	41
8.1	Information Relating to Electrical Connections.....	41
8.2	System Electrical Inputs and Outputs.....	41
9	Commissioning.....	44
9.1	Adjusting the Initial Gas Pressure.....	47
9.2	Adjusting the Process Gas Flow.....	47
9.3	Adjusting the Cooling Water Flow Rate.....	48
10	Operation.....	49
10.1	Touch panel.....	49
10.2	Operating Principles.....	49
10.3	Operation of the Control for System Calibration.....	50
10.3.1	Operating Keys and Control Information.....	51
10.3.2	Process Flowchart Displays.....	52
10.4	Authorisation Scheme.....	53
10.4.1	OPERATOR User.....	54
10.4.2	EXPERT User.....	55
10.5	Operating Modes and Settings.....	56
10.5.1	Operating modes.....	56
10.5.2	Ozone Sensor (only with Ozone Sensor).....	62
10.5.3	Ozone Sensor Limit Values (only with Ozone Sensor).....	64
10.5.4	Dewpoint sensor (option).....	64
10.5.5	Control parameter.....	65
10.5.6	Gas Flow mode (optional).....	67
10.5.7	Protocol Output.....	70
10.5.8	System.....	71
10.5.9	Keyboard lock.....	71
10.5.10	Info.....	72
10.5.11	Login - Logout.....	72
10.6	Functional Process.....	72
10.7	Important System Statuses.....	72
10.7.1	"Start with Ozone Generation" Operating Status... ..	72
10.7.2	"Start without Ozone Generation" Operating Status.....	73
10.7.3	"Fault" Operating Status.....	73
10.7.4	"Process Water Flow Rate Too Low" Operating Status.....	73
10.7.5	"Stop" Operating Status.....	74
10.7.6	"Pause" Operating Status.....	74

10.7.7	Behaviour Upon Switching on Power.....	74
10.8	Display.....	75
10.8.1	Complete System.....	75
10.9	Display Values on the Touch Panel.....	75
10.9.1	Control Variable in "Internal" Operating Mode.....	75
10.9.2	Setpoint in "External" Operating Mode (Option)....	75
10.9.3	Ozone Output.....	75
10.9.4	Gas flow rate.....	75
10.9.5	Ozone generator pressure.....	76
10.9.6	Cooling water.....	76
10.9.7	Primary current.....	76
10.9.8	Primary voltage.....	76
10.9.9	Status Page.....	76
10.9.10	Control range.....	76
10.9.11	Ozone reduction in%.....	77
10.9.12	"Internal" / "External" Operating Mode.....	77
10.9.13	0/4-20 mA.....	77
10.9.14	Language.....	77
11	Maintenance.....	78
11.1	Safety Guidelines for Maintenance and Repair.....	78
11.2	Routine Inspection.....	78
11.3	Regular Maintenance.....	79
12	Troubleshooting.....	82
13	Technical Data.....	87
13.1	Complete System	87
13.2	OZMa Electrical Inputs and Outputs.....	93
13.3	Supplementary information for modified designs.....	96
14	Accessories.....	97
14.1	Classification.....	97
14.2	Description.....	97
15	Dimensional Drawings.....	101
16	Operating Report.....	107
17	Wiring Diagram.....	108
18	EC Declaration of Conformity.....	109
19	Information on the legally compliant use of ozone.....	110
20	Index.....	111

1 About the Product

OZONFILT® OZMa ozone generator systems are designed as pressurised systems, in which an operating gas - either air (OZMa 1-6 A) or oxygen (OZMa 1-6 O) - is fed into the ozone generator under pressure.

The ozone is generated using medium-frequency high voltage and is primary current controlled. The introduction of the electronic power unit, developed in-house by ProMinent, provides extensive protection for the electrical components (high voltage transformer and power stage) and also permits the correct digital display of the ozone output in "grams/hour".

As a result, any required ozone output between 3 and 100 % of the nominal capacity can be set reproducibly, and largely independently of voltage and pressure fluctuations.

The use of an integrated pressure swing dryer and a dielectric with optimum thermal conductivity makes the system extremely compact.

The novel design of the generator ensures outstanding cooling performance with low cooling water consumption and removes the heat produced quickly before the ozone produced can decompose due to excessive heat. Operation under pressure means that the ozone generated can be introduced directly into water systems with back pressures of up to 2 bar.

Additional booster pumps and injectors can therefore be dispensed with in many applications.

A DULCOTEST® OZE ozone sensor can be connected directly to the PID control (optional) integrated in the controller. This ensures that the systems are especially useful for measured value dependent and measured value controlled operation.

The ozone concentration is maintained constant using the "control valve" option, independent from the required ozone output insofar as this is possible. Consequently the solubility of the ozone, which is essentially dependent on the ozone concentration, remains constant even with low setpoints. Moreover, the gas quantity injected into the raw water is reduced and consequently the system's gas consumption also.

The integrated data logger (option) writes data to an SD card. The screen recorder can be used to visualise the measured values (optional).

2 Identity code

Ozone generation system type OZONFILT® OZMa					
OZMa	Type *	Air	Oxygen	* of the ozone generator	
	01	70 g/h	105 g/h		
	02	105 g/h	150 g/h		
	03	140 g/h	210 g/h		
	04	210 g/h	320 g/h		
	05	280 g/h	420 g/h		
	06	420 g/h	630 g/h		
	Operating gas				
	A	Operating gas - air			
	O	Operating gas - oxygen			
	Design				
	P	ProMaqua			
	S	Special version			
	C	ProMaqua with air-conditioning			
	Mechanical design				
	0	Standard (packaging for transport by HGV)			
	1	Standard (packaging for sea/air freight)			
	2	In stainless steel cabinet (packaging for transport by commercial vehicle)			
	3	In stainless steel cabinet (packaging for sea/air freight)			
	M	Modified	*order-related design. Unit properties, see order documentation		
	Operating voltage				
	A	Single phase 230 V ± 10 %, 50/60 Hz (only types 01-03)			
	S	Single phase 230/400 V ± 10 %, 50/60 Hz (only types 04-06)			
	Gas treatment				
	0	Gas treatment not integrated (operating gas - oxygen design)			
	1	Gas treatment integrated without filter package (operating gas - air design)			
	2	Gas treatment integrated with filter package (operating gas - air design)			
	3	Gas treatment not integrated (operating gas - oxygen design), includes gas control valve			
	4	Gas treatment integrated, without filter package (operating gas - air design), includes gas control valve			
	5	Gas treatment integrated, with filter package (operating gas - air design), includes gas control valve			
	Pre-set language				
	DE	German			
	EN	English			

Ozone generation system type OZONFILT® OZMa

											FR	French
											IT	Italian
											ES	Spanish
											Control	
											0	Basic version with digital input to control two adjustable power stages
											1	External power control via 0/4-20 mA input, data logger
											2	External power control, ozone measurement and visualisation via screen recorder, 2 freely configurable 0/40-20 mA inputs, 1 freely configurable 0/4-20 mA output
											3	As 2 with additionally integrated PID controller for control of the ozone concentration independent of measured value and flow
											Communication interfaces	
											0	None
											4	PROFIBUS® DP interface
											Additional options	
											0	None
											1	Dewpoint sensor
											Certifications	
											01	CE mark
											Hardware	
											0	Standard
											Software	
											0	Standard

Tab. 1: Explanation of the identity code:

Mechanical design:	With designs 0 and 1, the system is installed in a standard control cabinet made of powder-coated steel.
Gas treatment:	Without filter package for oil-free generated or de-oiled compressed air. With filter package for compressed air with residual oil content.

3 Safety

Please read this chapter carefully before operating the system and keep this instruction manual easily accessible in the vicinity of the system.

3.1 Identification of safety notes

Identification of safety notes

The following signal words are used in these operating instructions to denote different levels of danger:

Signal word	Meaning
DANGER!	This combination of symbol and signal word indicates an immediate dangerous situation that will result in death or serious injury if it is not avoided.
WARNING!	This combination of symbol and signal word indicates a possible dangerous situation that can result in death or serious injury if it is not avoided.
CAUTION!	This combination of symbol and signal word indicates a possible dangerous situation that can result in minor injury if it is not avoided.

3.2 Warning symbols denoting different types of danger

Warning symbols denoting different types of danger

The following warning symbols are used in these operating instructions to denote different types of danger:

Warning signs	Type of danger
	Warning – high-voltage.
	Warning – toxic substances.
	Warning – danger zone.

3.3 Intended use

- The OZONFILT® OZMa is intended solely to generate and meter an ozoniferous gas mixture from compressed air or oxygen.
- All other uses or a modification of the system are only permitted with the written authorisation of ProMinent GmbH, Heidelberg.
- The system may not be operated in conditions other than those described in this document.

- The system is not intended for operation outside.
- The system is not intended for portable operation.
- The correct and proper operation of the system cannot be guaranteed if non-genuine parts or third party accessories are used.
- The OZMa ozone generation system may only be operated by qualified personnel (refer to the following table).
- Observe the information contained in the operating instructions at the different phases of the device's service life.
- Please observe the relevant national regulations and guidelines throughout every phase of the system's service life.

3.4 Personnel qualification

Action	Qualification
Assembly / installation	Service technicians
Initial commissioning	Service technicians
Start up	Technical experts
Operation	Instructed personnel
Maintenance / Repair	Service technicians
Decommissioning	Service technicians
Troubleshooting by operator	Instructed personnel
Troubleshooting by experts	Service technicians

Explanation of the table

Technical experts

A technical expert is deemed to be a person who is able to assess the tasks assigned to him and recognize possible hazards based on his/her technical training and experience, as well as knowledge of applicable regulations.

Instructed person

An instructed person is deemed to be a person who has been instructed and, if required, trained in the tasks assigned to him/her and possible dangers that could result from improper behaviour, as well as having been instructed in the required protective equipment and protective measures.

Service technicians

The Service department refers to service technicians, who have received proven training and have been authorised by ProMinent® to work on the system.

3.5 General Safety Requirements

- To ensure maximum safety, all persons, who are involved in working with the ozone generation system, must be familiar with the safety regulations and operation of the ozone generation system.
- The ozone generation system must be used in compliance with all relevant regulations. The use of the system for a purpose other than the purpose intended by the manufacturer will incur unforeseeable risks.

- All guarantee and liability claims on the part of the system operator will not be admitted following interference by unauthorised personnel.
- Please observe all locally applicable
 - laws
 - health and safety regulations
 - environmental regulations
- Immediately report any malfunctions or risks, which you, as the user, notice to the operator of the system or to your supervisors.
- As a matter of principle no protective or safety equipment may be removed while the system is in operation. Never attempt to bypass the safety equipment.
- If protective or safety equipment has to be removed to set up or service the plant or to carry out repairs, switch off the system beforehand and ensure that it cannot be reconnected. Prior to switching the system on, refit the safety and protective equipment and ensure that it is complete, securely fitted and that it can perform its task properly.
- Work on technical equipment (such as work on the pneumatic, hydraulic or electrical equipment) may only be done by appropriately qualified technical personnel.
- All safety and warning signs on the plant must be visible at all times.

3.6 Safety equipment

The safety equipment is described in the chapter "Assembly and Installation".

Further safety equipment is described in the chapter "Components of the System and Their Role" - "Safety Equipment".

3.7 Notes for the System Operator

Prior to commissioning the system, the operator is obliged to:

- Obtain current safety-related information on oxygen (if relevant), ozone and ozoniferous water.

The operator should create the legal framework for safe operation of the system, based on the information provided in the data sheets concerning health and safety, water and environmental protection and taking into consideration the actual operating environment on site.

The operator is also obliged to produce operating instructions (including information on danger prevention and an alarm plan) on "Handling Ozone" and (only with system type "O") "Handling Oxygen".

The OZONFILT® OZMa 1-6 O ozone generation systems generate ozone from pure oxygen with a concentration of over 90 volume percent. For this reason the guidelines relating to the handling of oxygen should also be noted.

In addition to the operating instructions, the following German regulations issued by the Federation of Commercial Professional Associations (HVGB) and the Professional Association of the Chemical Industry (BG Chemie) should also be included as information:

- a) - ZH 1/474 "Guidelines on the Use of Ozone in Water Treatment"
- b) - ZH 1/262 "Bulletin 052 Ozone"
- c) - Accident Prevention and Insurance Association regulation BGV UVV Oxygen
- d) - Accident prevention regulation "Occupational Health and Safety Labelling" (BGV A 8)

4 Components of the System and Their Role

4.1 Overview of OZONFILT® OZMa 1-6 A/O

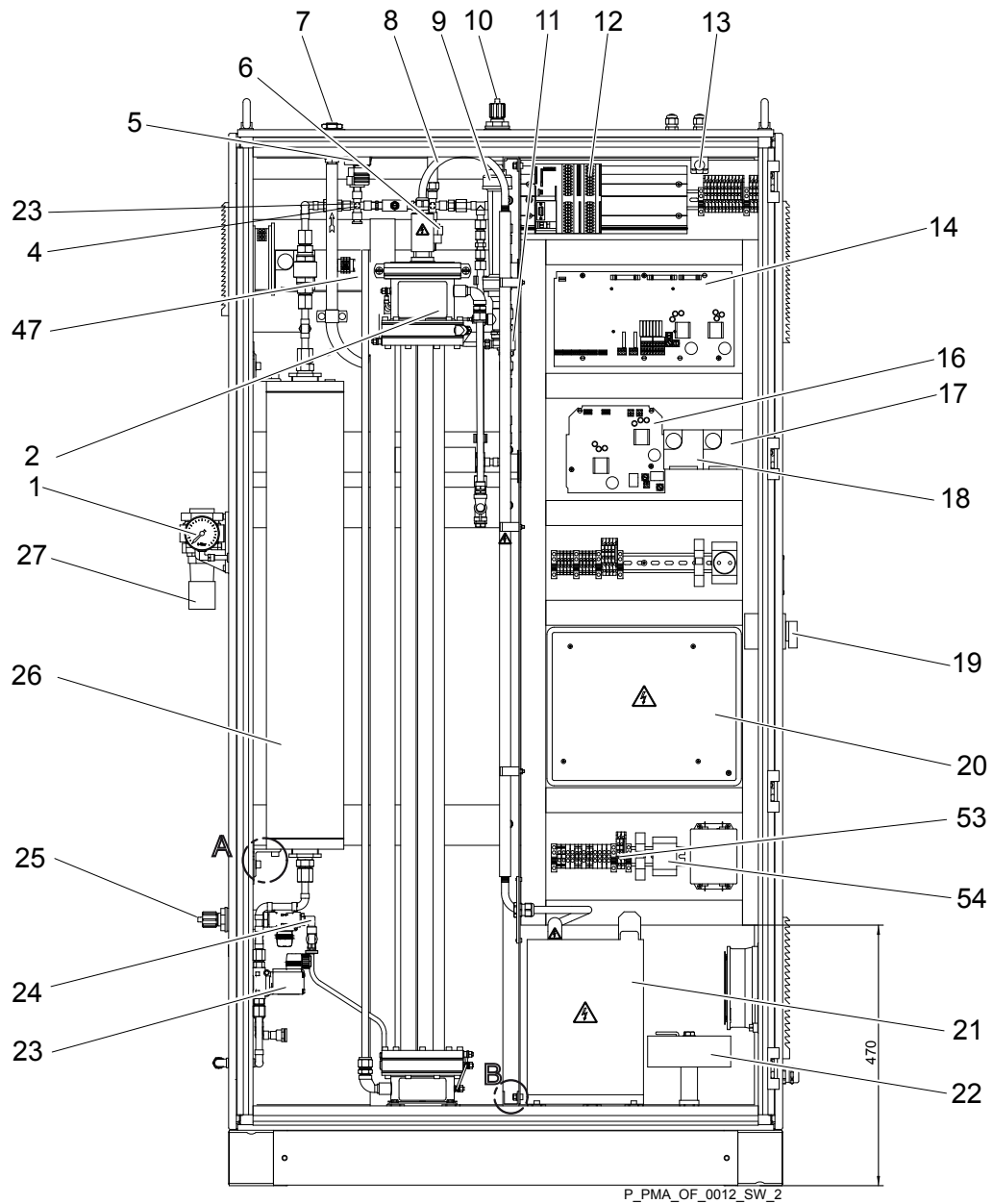


Fig. 1: Ozone generation system OZONFILT® OZMa 1-3 A - without air-conditioning and without door

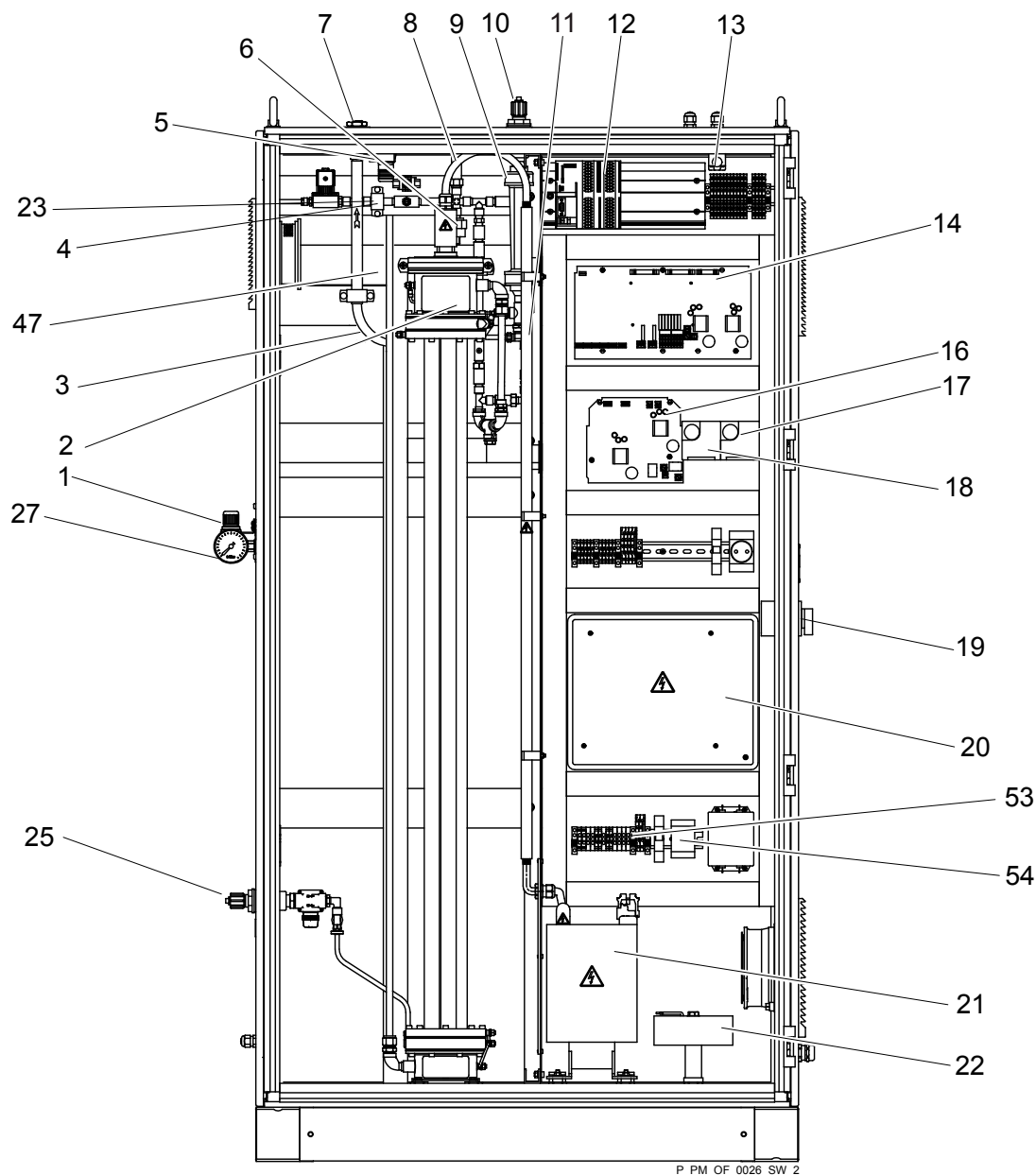


Fig. 2: Ozone generation system OZONILT® OZMa 1-6 O - without air-conditioning and without door

No.	Component	Function
1	Pressure regulating valve with pressure sensor	Unit for adjusting and displaying the priming pressure of the system.
2	Ozone generator	A portion of the oxygen in the operating gas is converted into ozone in the water-cooled ozone generator.
3	Ozone outlet non-return valve	The non-return valve prevents the backflow of process water into the ozone generator (only with OZMa 4-6).
4	Adjustable operating gas throttle valve	The flow of operating gas for ozone generation can be adjusted using the throttle valve.
5	Ozone outlet diaphragm valve	The diaphragm valve protects each ozone generator against the backflow of process water
6	Operating pressure sensor	The pressure sensor displays and monitors the operating pressure in the ozone generator.
7	Ozone outlet	-

No.	Component	Function
8	Ozone generator pressure relief valve	The pressure relief valve limits the operating pressure in the ozone generator.
9	Flow meter with minimum contact	Used to display and monitor the cooling water flow rate through the ozone generator.
10	Cooling water outlet	-
11	Gas flow meter	The gas flow meter provides a measured value and monitors the operating gas flow rate for ozone generation.
12	Control (PLC Programmable Logic Controller)	The control (PLC Programmable Logic Controller) is used to control and monitor the entire system.
13	Door switch	The door switch stops the generation of ozone as soon as the control cabinet door is opened.
14	Communication circuit board	The communication circuit board provides the link from the internal and external electrical components to the electronic control.
16	Internal power supply 24 Volt	-
17	Fan control	The fan control is used to actuate the control cabinet fan according to the temperature.
18	Control cabinet temperature monitor	The temperature monitor is used to monitor the temperature in the control cabinet.
19	Main switch	The main switch connects or disconnects the system from the mains voltage or from the mains/power supply.
20	Power unit for HV transformer	Supplies the primary side of the high-voltage transformer with electrical signals for ozone generation.
21	HV transformer (High-voltage transformer)	The high-voltage transformer converts the electrical signals supplied by the power unit into the high-voltage signals required for ozone generation.
22	Choke coils	The choke coils are used to adjust the profile of the electrical signals on the primary side of the high-voltage transformer.
23	Solenoid valve block - drying unit	Used to control the gas flows in the system's drying unit, if one is integrated.
24	Cooling water inlet angle valve	The cooling water flow rate through the ozone generator can be adjusted using the angle valve.
25	Cooling water inlet	-
26	Storage tank for drying unit	The storage tanks accommodate the molecular sieves for the drying unit.
27	Pressure regulating valve	The pressure for the drying unit of the system can be adjusted using the pressure regulating valve.
28	Operating gas inlet	-
29	Touch panel (display and operating unit)	The touch panel (display and operating unit) acts as an interface between the system and the operating personnel.
30	Water mixed with ozone	-
31	Mixing section (accessory)	Mixes the ozoniferous gas with the process water.
32	Point of injection non-return valve	Should be fitted vertically pointing downwards.

Components of the System and Their Role

No.	Component	Function
33	Point of injection non-return valve	The non-return valve prevents the backflow of process water into the pipework at the ozone outlet of the system.
34	Ozone entry	-
35	Raw water	-
36	Bypass opening for gas flow meter	The bypass opening adjusts the gas flow through the gas flow meter
37	Opening for regeneration air	The opening adjusts the gas flow for regeneration on systems with an integral drying unit.
38	Drying unit non-return valves	The non-return valves prevent the backflow of operating gas into the regeneration gas duct.
39	Solenoid valve block - drying unit	-
40	Cooling water inlet solenoid valve	The solenoid valve on the cooling water inlet stops the flow of cooling water when the system is idle.
41	Compressor unit (accessory)	The compressor unit provides the compressed ambient air required for the drying unit.
42	Cooling water outlet temperature gauge	The temperature gauge is used to display and monitor the temperature of the cooling water at the system's cooling water outlet.
43	Drying unit operating pressure sensor	The pressure sensor is used to display and monitor the pressure at the outlet of the drying unit as well as to control it.
44	Silencer for regeneration gas	The silencer provides controlled pressure relief for the drying unit storage tanks.
45	Filter unit (optional accessory)	The filter unit filters particles and separates oil and water from the compressed ambient air.
47	Ozone outlet non-return valve	-
51	Regeneration air outlet	(Only OZMa 1-6 A)
53	Ozone generation safety cut-out	Switches off ozone generation when the power consumption is too high.
54	Control safety cut-out	Switches off all control components and low voltage consumers in the system when the power consumption is too high.
55	Oxygen inlet solenoid valve	-

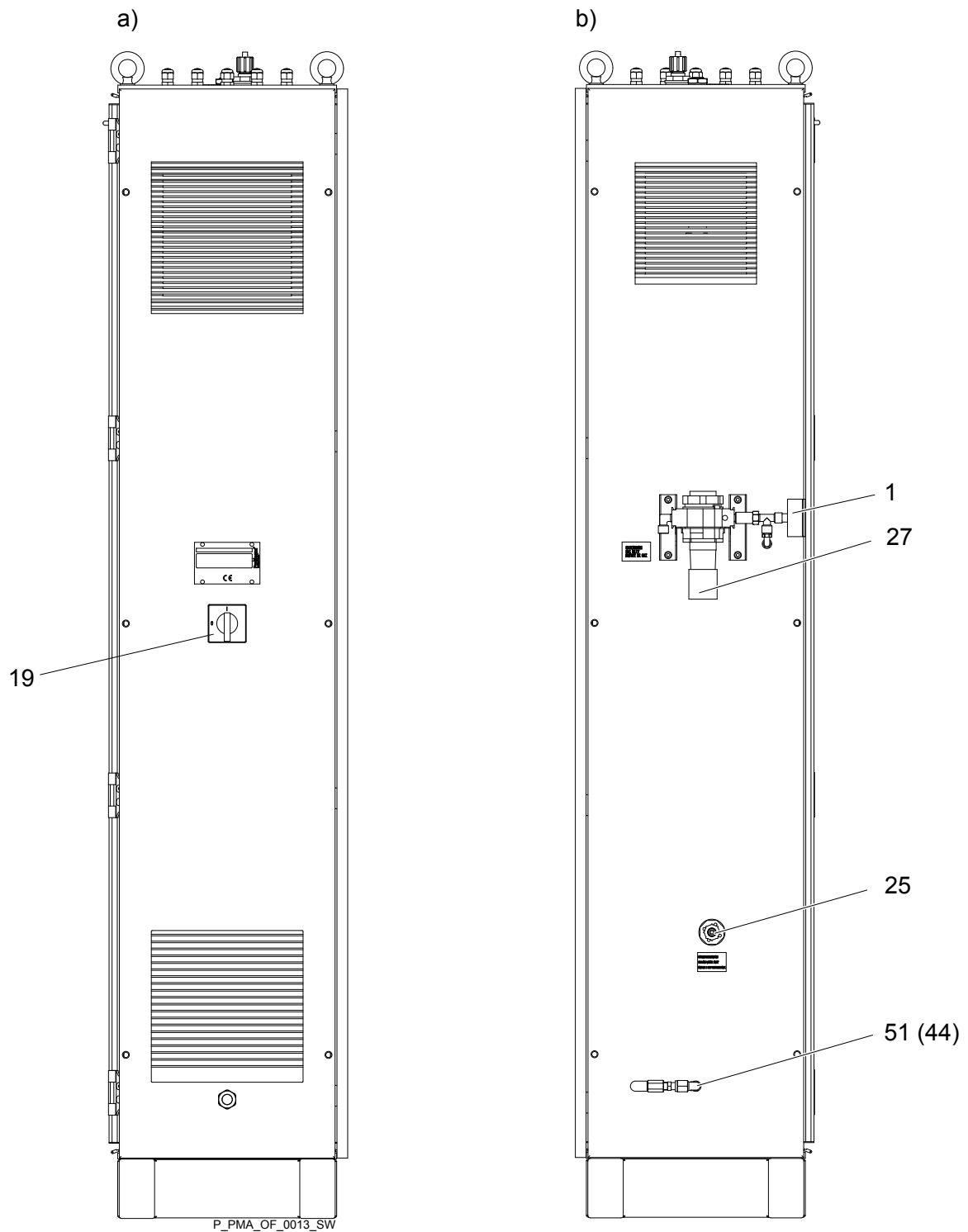
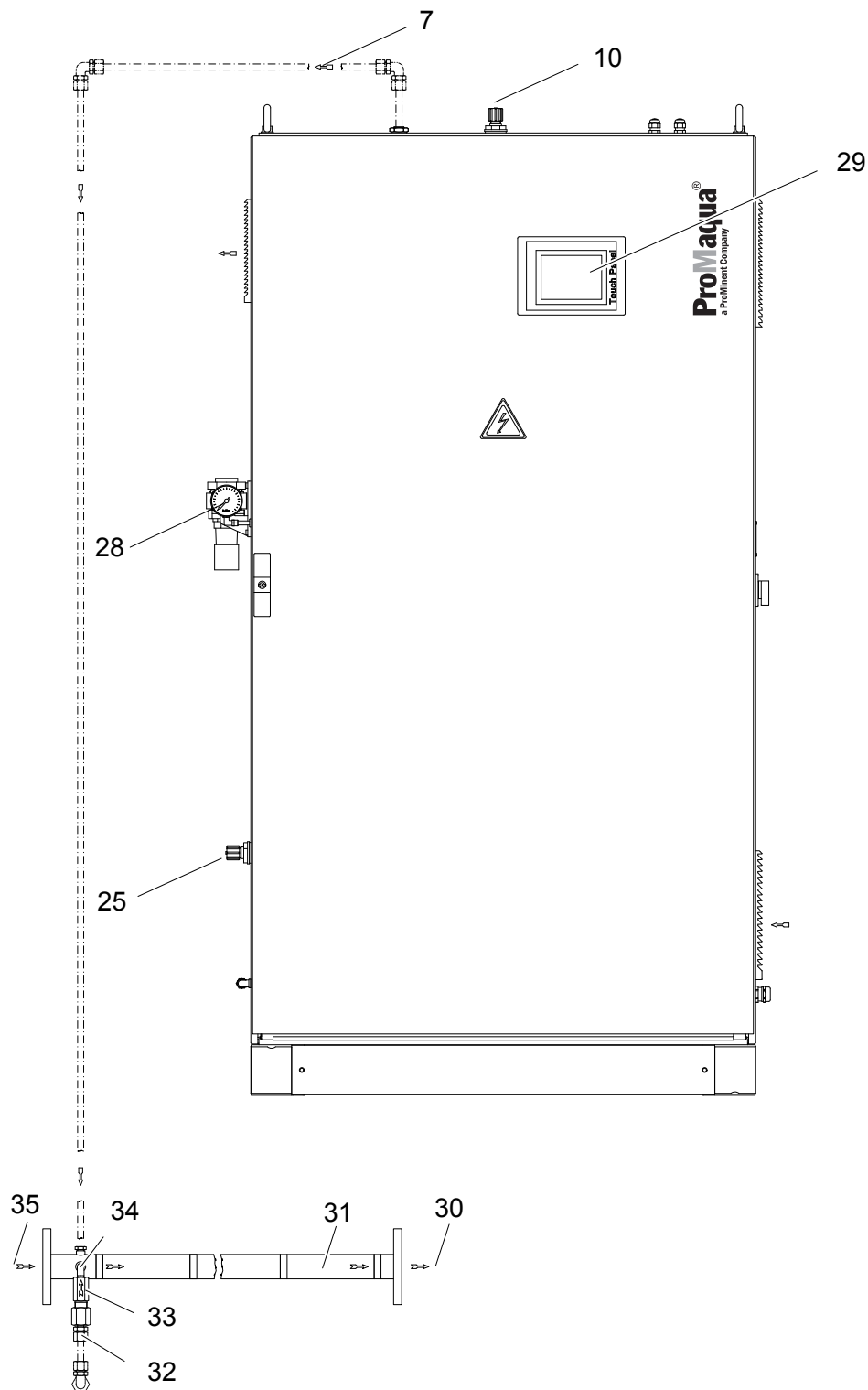


Fig. 3: Ozone generation system OZMa - without air-conditioning; top view of the right and left side

- 1 Pressure regulating valve with pressure sensor
- 19 Main switch
- 25 Cooling water inlet
- 27 Pressure regulating valve
- 44 Silencer for regeneration gas (only OZMa 1-6 A)
- 51 Regeneration air output (only OZMa 1-6 A)



P_PMA_OF_0015_SW

Fig. 4: Ozone generation system OZMa with mixing equipment - without air-conditioning

- | | |
|-------------------------------|--|
| 7 Ozone outlet | 31 Mixing section (accessory) |
| 10 Cooling water outlet | 32 Should be fitted vertically pointing downwards. |
| 25 Cooling water inlet | 34 Ozone entry |
| 28 Operating gas inlet | 35 Raw water |
| 29 Display and operating unit | 40 Cooling water inlet solenoid valve |
| 30 Water mixed with ozone | |

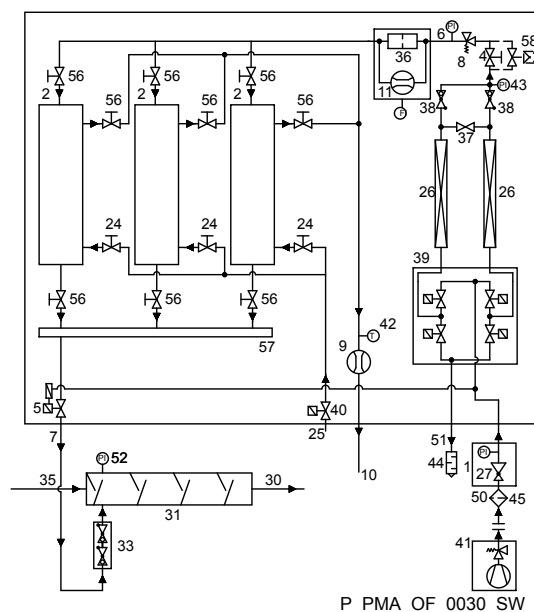


Fig. 5: Schematic pneumatic and hydraulic flow in the ozone generation systems OZMa 1-6 A with drying unit for use with air as an operating gas

- 1 Pressure regulating valve with pressure sensor
- 2 Ozone generator #
- 3 Ozone outlet non-return valve
- 4 Adjustable operating gas throttle valve
- 5 Diaphragm valve with ozone outlet pilot valve
- 6 Operating pressure sensor on ozone generator
- 7 Ozone outlet
- 8 Ozone generator pressure relief valve
- 9 Flow meter with minimum contact
- 10 Cooling water outlet
- 11 Gas flow meter
- 24 Cooling water inlet angle valve
- 25 Cooling water inlet
- 26 Storage tank for drying unit
- 27 Pressure regulating valve
- 30 Raw water outlet
- 31 Mixing section (accessory)
- 33 Point of injection non-return valve
- 35 Raw water inlet
- 36 Bypass opening for gas flow meter
- 37 Opening for regeneration air
- 38 Drying unit non-return valve
- 39 Solenoid valve block - drying unit
- 40 Cooling water inlet solenoid valve
- 41 Compressor unit (accessory)
- 42 Cooling water outlet temperature gauge
- 43 Drying unit operating pressure sensor
- 44 Silencer for regeneration gas
- 45 Filter unit (optional accessory)
- 50 Compressed air inlet
- 51 Regeneration air outlet
- 52 Raw water pressure sensor (accessory)
- 56 Stopcock (only with OZMa 4-6)
- 57 Ozone collector (only with OZMa 4-6)
- 58 Control valve (optional)

2 Ozone generator with OZMa 4 A and OZMa 5 A

3 Ozone generator with OZMa 6 A

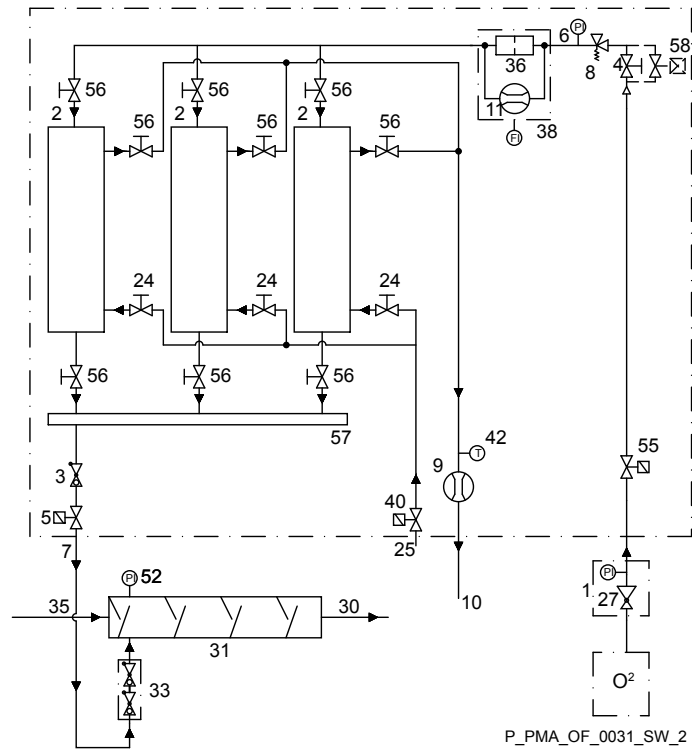


Fig. 6: Schematic pneumatic and hydraulic flow in the ozone generation systems OZMa 1-6 O with drying unit for use with oxygen as an operating gas

- 1 Pressure regulating valve with pressure sensor
- 2 Ozone generator #
- 3 Ozone outlet non-return valve
- 4 Adjustable operating gas throttle valve
- 5 Ozone outlet solenoid valve
- 6 Operating pressure sensor on ozone generator
- 7 Ozone outlet
- 8 Ozone generator pressure relief valve
- 9 Flow meter with minimum contact
- 10 Cooling water outlet
- 11 Gas flow meter
- 24 Cooling water inlet angle valve
- 25 Cooling water inlet
- 27 Pressure regulating valve
- 30 Raw water outlet
- 31 Mixing section (accessory)
- 33 Point of injection non-return valve
- 35 Raw water inlet
- 36 Bypass opening for gas flow meter
- 40 Cooling water inlet solenoid valve
- 42 Cooling water outlet temperature gauge
- 50 Compressed air inlet
- 52 Raw water pressure sensor (accessory)
- 55 Oxygen inlet solenoid valve
- 56 Stopcock (only with OZMa 4-6)
- 57 Ozone collector (only with OZMa 4-6)
- 58 Control valve (optional)

2 Ozone generator with OZMa 4 O and OZMa 5 O

3 Ozone generator with OZMa 6 O

4.2 Description of the Ozone Generation System OZONFILT® OZMa

Ozone generation systems of the OZMa type are intended for operation with pure or enriched oxygen (type OZMa xxO) or for operation with ambient air (type OZMa xxA) as the operating gas.

4.2.1 Air-conditioning System (air-conditioning unit, optional)

OZMa systems with the identity code "System design" – "C" are equipped with an air-conditioning unit. The air-conditioning unit regulates the temperature of the electrical components in the control cabinet to 25°C (pre-set on the air-conditioning unit by a mechanical temperature controller).

The control cabinet's temperature control indirectly also monitors the operation of the air-conditioning unit.

4.2.2 The OZONFILT® OZMa 1-6 A Drying Unit

The system requires compressed, de-oiled or oil-free compressed air at the inlet of the pressure regulating valve (1-27). A detailed description relating to the pressure range, quality of compressed air and temperature can be found in Chapter 14.1 "Technical Data". When using compressed air systems, which are fed by oil-greased compressors, fit a filter assembly with automatic condensation drainage between the compressed air system and the inlet of the pressure regulating valve (1-27). The filter assembly should consist of at least one particle filter and an oil filter and is optionally available (see Identity code).

The compressed and, if necessary, de-oiled compressed air passes through the pressure regulating valve with pressure sensor (1-1) to the inlet of the solenoid valve block (4-39). Ensure that there is a constant system priming pressure set on the pressure regulating valve (1-27). The system priming pressure can be read on the pressure sensor on the outside of the cabinet. The permissible values can be found in Chapter 14.1 "Technical Data".

Before the compressed air can be used for ozone generation, it has to be dried by the pressure swing dryer integrated within the system to a dewpoint of approx. –60°C. The gas flows for the pressure swing dryer are controlled by the solenoid valve block (4-39). This is provided with the relevant electrical signals by the control (1-31) and the communication circuit board (1-14).

The storage tanks (1-26) of the pressure swing dryer are filled with a drying agent that draws out the residual moisture from the compressed air. The two drying units (1-26) alternate between a drying and a regeneration phase. This mode of operation ensures that the ozone generator is permanently supplied with dry air for ozone generation. Compressed ambient air flows through the storage tank (1-26), which is used for drying, in the direction of the ozone generator.

A partial flow of the dried air is expanded in the counterflow to atmospheric pressure and discarded to regenerate the drying agent located in the other storage tank. This process removes from the drying agent the moisture adsorbed in the previous cycle and prepares it for the next drying phase. The so-called regeneration air can escape from the system cabinet through the outlet (1-51) via a silencer (1-44).

The pressure swing dryer is designed for minimal consumption of compressed air and energy. The volume of regeneration air required for drying is automatically adjusted by the control to the conditions in the compressed air system and the volume of gas currently set. This is what differentiates the drying process in the Ozonfilt OZMa from conventional pressure swing dryers, where the regeneration air is consumed throughout the entire cycle period, independently of external conditions. On the other hand, the volume of the drying agent present in the storage tanks (26) is designed in such a way that the drying process produces dew-points of approx. -60°C even at low system priming pressure levels (cf. Chapter 14.1 "Technical Data"). This drastically reduces the energy required for compression.

The pressure sensor (1-43) measures the operating pressure of the drying process. The flow volume of gas required for ozone generation can be set using the throttle valve (1-4). With systems with automatic gas regulation, the flow volume is adjusted via the control and the control valve (1-58). It is registered by the gas flow meter (1-11) and displayed on the touch panel. The gas pressure for ozone generation is monitored by the pressure sensor (1-6) and limited by the pressure relief valve (1-8). The actual gas pressure in the ozone generator depends on the pressure of the process water at the point of injection, the back pressure of the pneumatic equipment (1-3, 1-5, 3-33) between the ozone inlet and the point of injection and the flow rate of the gas. This is measured by the gas flow meter (1-11).

Once the gas has passed the gas flow meter (1-11) or the bypass opening (5-36), it arrives in the ozone generator (1-2).

4.2.3 The OZONFILT® OZMa 1-6 O Gas Supply

The OZONFILT® OZMa 1-6 O system generates ozone from pure or enriched oxygen. The oxygen supply system must supply dry, pure, compressed oxygen to the OZONFILT® OZMa 1-6 O. There are various options available for doing this:

- A so-called PSA unit (pressure swing adsorption unit), which uses air from a compressor and concentrates the oxygen using a special molecular sieve.
The molecular sieve separates nitrogen and water from the oxygen and leaves dry, compressed and concentrated oxygen behind (typically 90 – 95% by volume).
- Oxygen in bottles
- Evaporation of liquid oxygen

4.2.4 The OZONFILT® OZMa 1-6 O Gas System

The ozone generation system OZONFILT® OZMa 1-6 O has to be fed with dry, pure and compressed oxygen through the inlet of the pressure regulating valve (1-27). A more detailed description of the technical requirements can be found in Chapter 14 "Technical Data". The pressure regulating valve has the function of regulating the pressure of the incoming gaseous oxygen. Please read Chapter 8 "Assembly and Installation" in connection with this.

When the OZONFILT® OZMa 1-6 O is running, the solenoid valve (5-55) is open and lets the gas flow into the OZONFILT® OZMa 1-6 O. The volume of gas required for ozone generation can be set either using the throttle valve (1-4) or on the control, if a control valve (1-58) is fitted.

The gas pressure for ozone generation is monitored by the pressure sensor (1-6) and limited by the pressure relief valve (1-8). The actual gas pressure in the ozone generator depends on the pressure of the process water at the point of injection, the back pressure of the pneumatic equipment (1-3, 1-5, 3-33) between the ozone inlet and the point of injection and the flow rate of the gas. This is measured by the gas flow meter (1-11).

Once the gas has passed the gas flow meter (5-11) or the bypass opening (5-36), it arrives in the ozone generator (1-2).

4.2.5 The Ozone Generator

The ozone generator includes several ozone generation elements (2-4), depending on the version of the OZMa. Each element consists of an earthed outer pipe made of metal, a high-voltage electrode and a heat-conducting dielectric.

The gas passes through the slit between the high-voltage electrode and the dielectric into the ozone generator, where ozone is formed by silent electric discharge.

The silent electrical discharge is enabled by a medium range frequency alternating high voltage signal applied between the high voltage electrode and the outer pipe, and causes a portion of the oxygen to be converted into ozone. The heat generated during the discharge is released through the wall of the heat-conducting dielectric to the cooling water flowing between the outer pipe made of metal and the outer surface of the dielectric. This direct cooling and the exceptional heat conductivity of the dielectric provide excellent heat transmission to the cooling water and thus an outstanding degree of efficiency of the ozone generating elements.

4.2.6 The Ozone Gas Transfer Equipment

From the outlet of the ozone generator, the ozone gas mixture passes via the diaphragm valve (A versions) / solenoid valve (O versions) (4-47), the non-return valve (1-3) and the solenoid valve (1-5) to the ozone outlet of the OZONFILT® OZMa. The non-return valve (1-3) prevents the backflow of process water from the mixing equipment into the ozone generator. Stainless steel pipes or PTFE pipes (accessory) transport the ozone-carrying gas from the ozone outlet of the OZONFILT® OZMa to the mixing equipment (3-31).

4.2.7 Mixing Equipment (Accessory)

The ozone gas mixture is conveyed to the flow of process water via the non-return valve (3-33) arranged directly at the inlet of the mixing equipment (3-31). The non-return valve (3-33) prevents the backflow of the water in the pipe between the ozone outlet of the OZONFILT® OZMa and the inlet of the non-return valve (3-33).

The mixing equipment (3-31) accommodates individual mixing elements for mixing the ozone into the process water. The mixing equipment has to be appropriately configured to the process water throughput for optimum incorporation of the ozone into the process water. There cannot be optimum mixing if the throughput is too low.

4.2.8 Cooling Water System

The cooling water has the task of absorbing and dissipating the heat produced during ozone generation in the chamber of the ozone generator (1-2). This heat dissipation is important in order to keep the ozoniferous gas at a low temperature to maintain the excellent ozone output and to protect the internal components of the ozone generator.

The cooling water travels from the cooling water inlet to the angle valves (1-24), with which the flow can be regulated. From there the cooling water enters the ozone generator (1-2).

A flow detector (1-9) downstream of the cooling water outlet of the ozone generator switches off the system if the flow falls below the requisite minimum coolant flow rate.

The cooling water temperature is also measured by a temperature sensor (4-42) and the system is switched off with a corresponding fault alert, should the maximum temperature be exceeded.

Detailed information on water quality, temperature and flow rates can be found in the Chapter entitled "Technical Data".

4.2.9 Electrical System Components

4.2.9.1 Control

The system is fully controlled and monitored by a control (1-12). The control

- Controls the electronic power units (1-20) for high voltage generation,
- Measures and monitors the supply voltage to the system,
- Measures and monitors the primary voltage of the HV transformer (1-21),
- Measures and monitors the primary current of the HV transformer (1-21),
- Measures and monitors the frequency during high voltage generation,
- Measures and monitors the gas flow through the ozone generator,
- Measures and monitors operating hours, number of faults and number of mains power failures in the system,
- Monitors the cooling water flow rate,
- Measures and monitors the temperature at the cooling water outlet of the system,
- Controls the temperature of individual components (HV transformers, cabinet, ozone generator, electronic power units),
- Controls the solenoid valves at the cooling water inlet, gas inlet and gas outlet of the system,
- Activates the fault display relay to report system faults/malfunctions,
- Enables the use of an electrically isolated interruption input,
- Enables the use of an electrically isolated standard signal output (0/4-20 mA) for the automatic control of the ozone volume (accessory)
- Permits the connection of an ozone sensor DULCOTEST® OZE to measure the ozone volume metered and regulate ozone generation via the integral PID controller (optional).

4.2.9.2 Electronic Power Units

Every electronic power unit (1-20) supplies a HV transformer (1-21) with medium frequency alternating voltage. The HV transformer (1-21) generates the alternating high voltage needed for the ozone generation process from this voltage. The medium frequency technology provides significant advantages over the mains frequency conventionally used in ozone generation. Medium frequency high voltage signals improve the efficiency of ozone generation and also enable the ozone generator to have more compact dimensions at the same time.

The control (1-12) provides complete control over the electronic power unit (1-20) and all of the parameters in the ozone generation process.

4.3 Safety equipment

4.3.1 Flow Detector (Accessory)

In line with the safety guidelines ZH 1/474 and GUV 18.13 (Guidelines on the Use of Ozone for Water Treatment) applicable in Germany, ozone can only be fed into the mixing equipment if the required minimum flow rate of raw water can be guaranteed.

A flow detector with a minimum contact can be connected via an input, which switches off the system as soon as the flow of raw water becomes too low.

The system should also be locked by the water treatment system circulation pump via the Pause input on the control (1-12).

The system starts up automatically with the pre-set "Ozone volume control variable" if

- the Pause signal is inactive (contact closed on the Pause input of the system), and
- there is no other fault.

4.3.2 Door Safety Switch

To ensure that no live parts can be touched, the OZONFILT® OZMa is provided with a door safety switch (1-22).



DANGER!

Potentially fatal high voltage

If the door safety switch (1-13) is bypassed, parts of the system can become live with potentially fatal high voltage. Even if the door safety switch is unlocked or the main switch (1-19) is switched off, parts of the system's electrical system can still carry mains voltage.

- Bypassing the door safety switch is prohibited!
- Disconnect the system from the mains/power supply to ensure that there can be no unauthorised access to the system cabinet and ensure that it cannot be reconnected (e.g. padlock on the main switch).
- Only open the system cabinet 5 minutes after the system has been disconnected from the mains/power supply.

4.3.3 Emergency Stop Switch in the Operating Room of the Ozone Generation Systems (Accessory)

In line with the safety guidelines ZH 1/474 and GUV 18.13, it must be possible to switch off ozone generation systems using an emergency stop switch (emergency command device). Install this emergency stop switch in an easily accessible, invulnerable position in the vicinity of the door of the operating room of the ozone generation systems and label it as such. The emergency stop switch must disconnect the electrical supply equipment connected to the system from the mains.

4.3.4 Main Switch on the System

The system is switched on via a mains/power supply on/off switch (1-19).

4.3.5 Pressure Control Valves

The pressure control valve downstream of the choke to adjust the process air (1-4) limits the pressure in the ozone generator. It thus also protects the electronic components from overloading.

4.3.6 Non-return Valves

The non-return valve (1-3) on the outlet of the ozone generation system between the solenoid valve (1-5) prevents process water from flowing back from the mixing equipment into the ozone generator.

4.3.7 Ozone Warning Device (Accessory)

In line with safety regulations issued by the Commercial Professional Associations currently applicable in Germany (ZH 1/474 and GUV 18.13), premises in which ozone could be released in the event of a fault or malfunction must be monitored by a gas detector.

These regulations apply to ozone generation systems with ozone production of greater than or equal to 2 g/h, irrespective of whether the ozoniferous gas is generated above (positive pressure system) or below (negative pressure system) atmospheric pressure.

Install the gas detector at positions where the highest concentrations of ozone are likely in the event of a fault/malfunction. With positive pressure systems, install the gas detector in the vicinity of the ozone generation system and, with negative pressure systems, in the vicinity of the residual ozone destruction system. The OZMa is a positive pressure system.

Set the alarm threshold of the gas detector to an ozone concentration of 0.5 ppm.

The gas detector must have a visual and an acoustic display.

With the OZONFILT® OZMa, the gas detector must have an electrically insulated alarm contact, which must be connected to the input of the control (1-12) as per the enclosed wiring diagram (Appendix) - see also  *Chapter 8.2 'System Electrical Inputs and Outputs' on page 41.*

Adhere to the applicable regulations and guidelines in other countries.

5 Operation of the OZONFILT® OZMa

The operation of the system can be understood with the aid of the general layout drawings in chapter 4 and the following description with block diagrams.

5.1 Electric power

Functions within the system

The control (1-12) controls the power units (1-20) via the communication circuit board (1-14). The power units make available signals to the HV transformer (1-21). Every HV transformer (1-21) supplies high voltage for silent electric discharge in the ozone generator.

The other roles of the electronic control are as follows:

- Control of the solenoid valves
- Monitoring of the system
- Control of alarm equipment

The electronic control has appropriate connections to fulfil these tasks.

5.2 Operating Gas Flow

OZONFILT® OZMa 1-6 A

The pressure regulating valve (1-27) at the gas inlet of the system is supplied with compressed oxygen-containing gas. The system pre-pressure can be adjusted at the pressure regulating valve (1-27) and read off from the pressure gauge. The compressed gas then passes the solenoid valve block (1-23) and is conveyed to one of the drying chambers (1-26). Residual moisture is drawn out of the gas in the drying chamber. Through the opening (4-37), a partial flow of the dried gas is expanded via the other storage tank to atmospheric pressure. In this way the drying agent is regenerated in this storage tank. Once the drying time has finished, the roles of the storage tanks are swapped by the corresponding control of the solenoid valve block. The dry gas passes the non-return valves (4-38). The pressure of the gas is measured by the pressure sensor (4-43) and the value is displayed on the touch panel. The gas then passes the needle valve (4-4) or the control valve (4-58) and is conveyed to the gas flow meter (1-11) operating in the bypass (4-36). The pressure sensor (1-6) measures the operating pressure of the ozone generator, while the safety valve (1-8) limits it. The value of the gas flow and the pressure is displayed on the touch panel. The gas finally arrives in the ozone generator (1-2), in which ozone is generated from a proportion of the oxygen by silent electric discharge. The ozoniferous gas finally passes through the diaphragm valve (4-47), the non-return valve (1-3) and the solenoid valve (1-5) and via a further non-return valve (4-33) to the mixing equipment (4-49). There the ozoniferous gas is mixed with raw water. If the system is idle and a fault or malfunction occurs, all of the solenoid valves at the system inlet and outlet are closed.

OZONFILT® OZMa 1-6 O

The pressure regulating valve (1-27) at the gas inlet of the system is supplied with compressed, dry oxygen. The system pre-pressure can be adjusted at the pressure regulating valve (1-27) and read off from the pressure gauge. The compressed gas then passes the solenoid valve (5-55), then through the needle valve (4-4) or the control valve (4-58) to reach the gas flow meter (1-11) operating in the bypass (4-36). The pressure sensor (1-6) measures the operating pressure of the ozone generator, while the safety valve (1-8)

limits it. The value of the gas flow and the pressure is displayed on the touch panel. The gas finally arrives in the ozone generator (1-2), in which ozone is generated from a proportion of the oxygen by silent electric discharge. The ozoniferous gas finally passes through the solenoid valve (4-46), the non-return valve (1-3) and a further solenoid valve (1-5) and via a further non-return valve (4-33) to the mixing equipment (4-49). There the ozoniferous gas is mixed with raw water. If the system is idle and a fault or malfunction occurs, all of the solenoid valves at the system inlet and outlet are closed.

5.3 Cooling Water Flow

The cooling water travels from the cooling water inlet to the angle valves (1-24), with which the cooling water flow can be regulated. From there the cooling water enters the ozone generator element (1-2). The flow meter (1-9) monitors the minimum flow rate. The warmed cooling water passes to the cooling water outlet. If there is a fault/malfunction of the system or should it be idle, the cooling water flow is blocked by a solenoid valve (1-40) fitted to the cooling water inlet.

5.4 Raw Water Flow

The mixing equipment (1-31) is fitted into the raw water pipework. There the raw water is mixed with the ozoniferous gas. The diameter of the mixing equipment should be coordinated with the water flow rate.

5.5 Schematic diagram of water treatment using the OZONFILT® OZMa 1-6 A (with air as the operating gas)

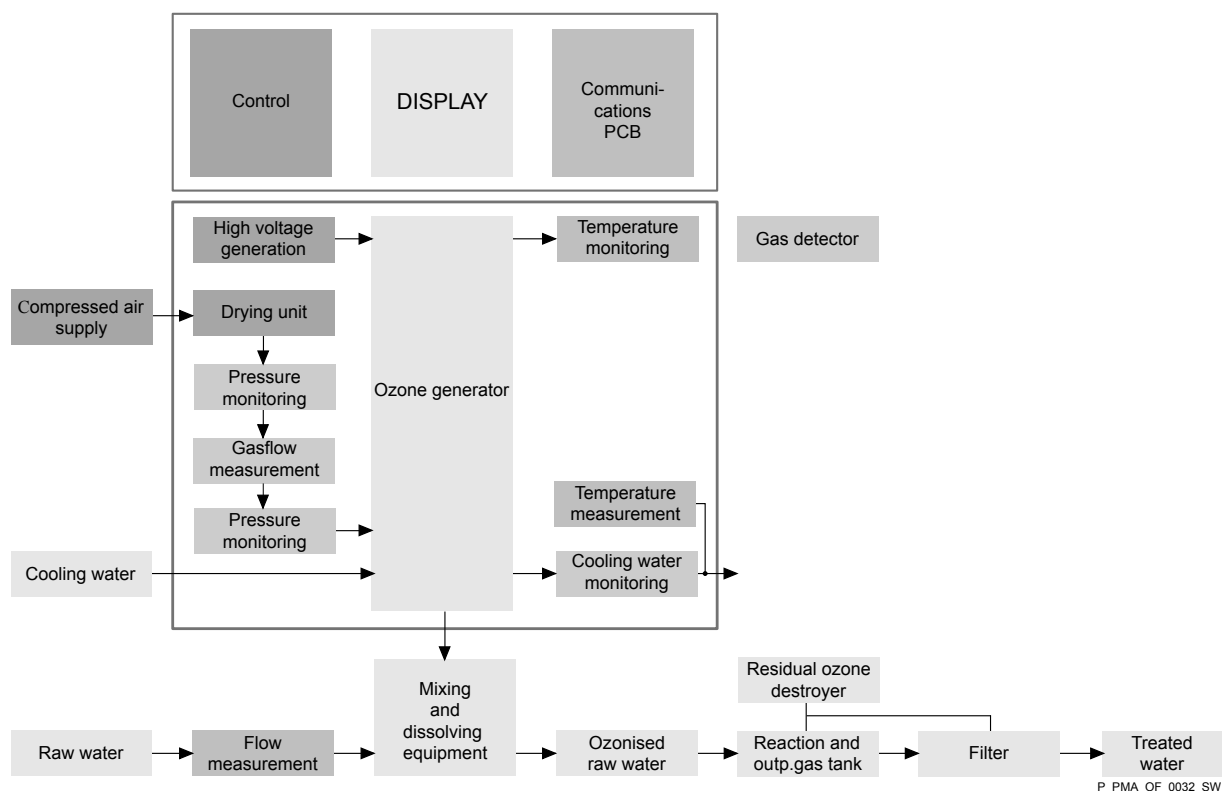


Fig. 7: Block diagram of the OZONFILT® OZMa 1-6 A system

5.6 Schematic diagram of water treatment using the OZONFILT® OZMa 1-6 O (with oxygen as the operating gas)

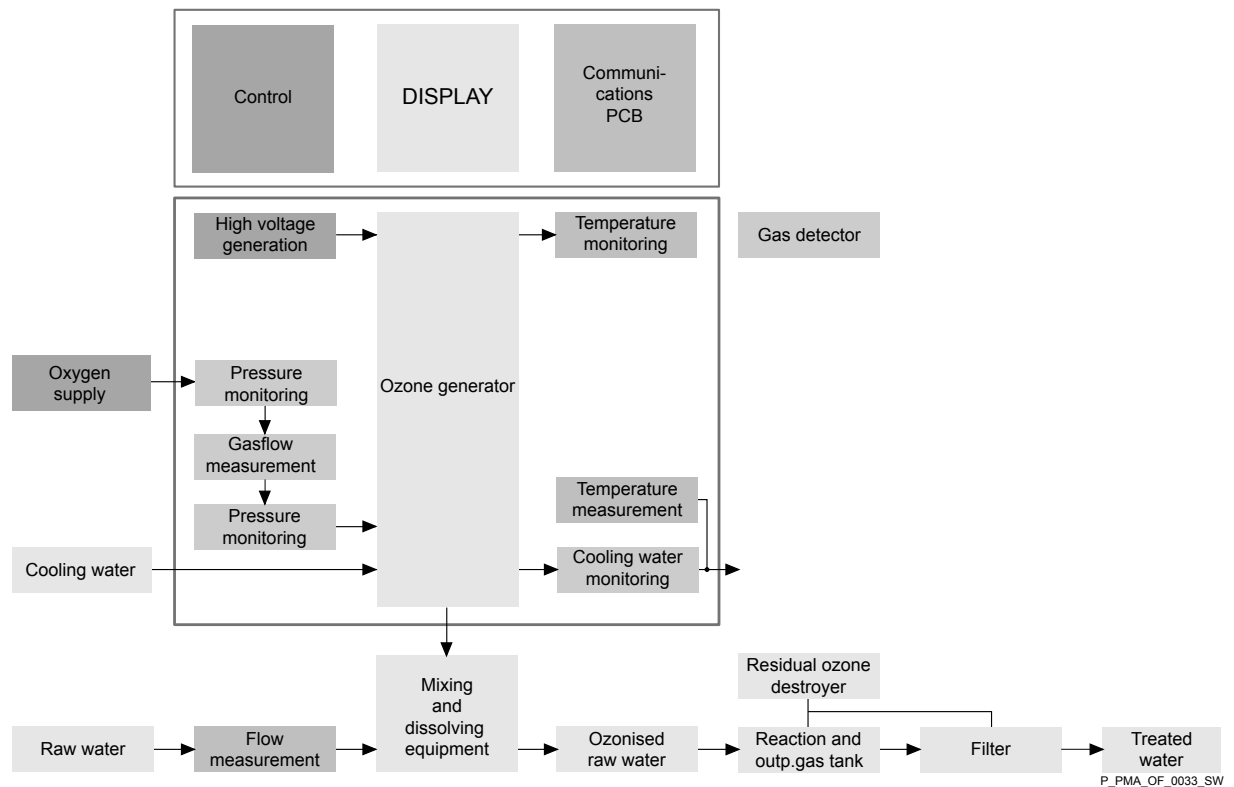


Fig. 8: Block diagram of the OZONFILT® OZMa 1-6 O system

6 Scope of Delivery, Storage and Transport

6.1 Scope of Delivery

The system is sub-divided into units:

Minimum scope of delivery

- Control cabinet
- Instruction manuals
- Wiring diagram
- Test report
- Mounting materials

Extended installation (accessories)

- Residual ozone destruction vessel
- Ozone warning device
- Oxygen warning device
- Mixing equipment
- Compressor system
- Oxygen supply system
- Reaction vessel



WARNING!

Incorrect use of the system due to the absence of prescribed components.

- Read the regulations on the correct and proper use of the system relating to the units required.
- Required units, which are not included in the scope of delivery, such as adsorption filters, reaction section and residual ozone destructor, should be procured and integrated correctly and properly into the system.

Incorrect and improper use of the system can result in danger to personnel and in material damage to the system.

6.2 Storage



WARNING!

Storage of the system in unsuitable ambient conditions.

- It is mandatory that the following storage instructions are adhered to.

Unsuitable ambient conditions can lead to incorrect operation and malfunction of the installed system and, in due course, to danger to personnel (smoke poisoning).

The system must be stored in its original transport packaging in a sealed room and also

- at a temperature of between 5 °C and 50 °C,
- at a relative air humidity of below 95% without condensation,

- in a non-aggressive environment (no harmful vapours, chemicals etc.),
- protected from direct sunlight, rain and moisture,
- stored vertically.

6.3 Transport



WARNING!

Incorrect transportation of the system using non-seaworthy wooden crates or horizontal wooden crates.

- It is mandatory that the following instructions are adhered to.

Incorrect transportation can result in damage to personnel and material damage.

- Appropriate lifting equipment may only be connected to the lifting eyes on the top of the system - see Fig. 3. The transportation weight is given in Chapter 14 "Technical Data".
- The system must be transported vertically with care (see label on the transportation packaging).
- Avoid mechanical impacts
- Protect the OZONFILT® system from direct sunlight, rain and moisture during transportation.



CAUTION!

Toppling System Cabinet

- After unpacking the OZONFILT® OZMa secure the system with lashing straps to prevent it from falling over.

If the system topples over it can result in injuries to personnel and material damage.

7 Assembly and installation

7.1 Safety Guidelines and General Requirements



WARNING!

Fatal injury by electrocution

The system produces high voltage.

- For safety reasons, only allow appropriately qualified technical personnel to install, operate and service this system.
- Ensure that all technical personnel are trained by the manufacturer about the specific system.

Handling of the system by unauthorised personnel can result in severe personal injury or even death.



WARNING!

Fatal injury by leakage of toxic gas.

The system generates highly concentrated (up to 150 g/Nm³), compressed (up to 2 bar) ozone gas from air or pure or enriched oxygen.

- For safety reasons, only allow appropriately qualified technical personnel to install, operate and service this system.
- Ensure that all technical personnel are trained by the manufacturer about the specific system.

Handling of the system by unauthorised personnel can result in personal injury or even fatal injury.

7.2 Requirements Relating to the System Installation Place



WARNING!

Danger from operation of the system in unsuitable locations

- National and local regulations relating to the use of oxygen and ozone must be adhered to.
- The operator of the ozone generation system is responsible for ensuring that the regulations are implemented!

Disregard of the safety regulations can result in damage to personnel and material damage.

- The regulations on the use of ozone for water treatment (ZH 1/474 and GUV 18.13) prescribe that ozone generation systems should be accommodated in sealed rooms, to which only authorised personnel have access.
- Permanent work places may not be located in rooms, in which ozone generation systems are situated. If this precondition is not met, then it must be ensured by technical measures that the concentration of ozone does not exceed the permitted maximum figure of 0.2 mg/m³.

- The room in which the system is installed must be monitored by an ozone warning device, which switches off the plant in the event of a leakage of ozone. The gas detector must provide a visual and acoustic warning. The ozone sensor should be installed where the highest concentration of ozone is to be expected in the event of an accident.
- Ozone warning devices should be provided in all rooms, in which there is ozone gas pipework with removable fittings. Rooms in which only pipework with non-removable fittings is located, do not need to be fitted with an ozone warning device, if a specialist engineer has conducted a leakage test on the pipework.
- The room has to be free of dust and aggressive vapours and chemicals.
- The room temperature and air humidity must not exceed the permitted levels - see chapter 14 "Technical Data". If this cannot be guaranteed, then an air conditioning system must be installed in the room.
- The OZONFILT® OZMa must be protected from direct sunlight.
- The room must be adequately mechanically ventilated so that oxygen or ozone cannot enrich the room air. Ventilation must ensure that the room air is completely exchanged at least three times per hour, possibly more often. Should it not be possible for ventilation equipment to reliably prevent the ambient air from being enriched by oxygen then an oxygen warning device must be fitted.
- Ozone unit OZMa 1-6 O: The walls and floor of the room may not contain any combustible materials.
- It is mandatory that there is a minimum spacing of 30 cm for the cooling filter and for service and maintenance to the left and right of the control cabinet of the system.
- The room must have suitable, adequate mains voltage connections for the operation of the respective OZONFILT® OZMa (cf. Chapter 14 "Technical Data").
- The room must have an adequate supply of cooling water.
- The floor must be even and horizontal and have a solid base surface.
- The OZONFILT® OZMa must be prevented from falling over by, for example, fixing the control cabinet to the wall or floor. Should the latter not be possible, the OZONFILT® OZMa control cabinet has to be secured in another way.
- Also check the requirements for accessories that are operated in the same room as the OZMa system, for example the air separation systems. Use the documentation of the accessories.

7.3 Requirements Relating to System Components



WARNING!

Material damage due to the use of unsuitable materials for system components, which come into contact with ozone.

- Ozone-resistant materials must be used for all components of the system, which come into contact with ozone, either as a gas or in an aqueous solution.
- All materials, which come into contact with ozone and/or pure oxygen, must be completely free from oil and grease.

This can result in material damage, particularly with pipework systems, reaction vessels (reaction section) and filters and parts which carry exhaust gas.

7.3.1 Mixing Modules (Accessory)

The best results can be achieved if the mixing modules are selected according to the flow rate of the raw water.

A stainless steel pipe fitting or a PTFE pipe for gas and a non-return valve must be fitted directly at the inlet of the mixing modules to connect the ozone outlet of the OZONFILT® OZMa 1-6 to the feed point into the raw water (at the point of injection).

Stainless steel or PVC mixing modules, with integral non-return valve made of high-alloy stainless steels are used by ProMinent.

The non-return valve prevents damage to the OZONFILT®, which can be caused by backflow of raw water into the gas system. The mixing module must be installed in such a way that the non-return valve is easily accessible for service and maintenance. Moreover, the non-return valve has to be fitted vertically so that it can operate properly.

Please refer to the chapter entitled "Technical Data" for further information on ProMinent mixing modules and on the permissible pressure at the ozone point of injection.



CAUTION!

Electronic components may be damaged if the maximum permissible pressure at the ozone outlet is frequently exceeded.

If the maximum permissible pressure at the ozone outlet (2 bar) is exceeded, it leads to a safety shutdown. Too frequent safety shutdowns may damage the control's electronic components.

Avoid too frequent exceeding of the maximum permissible pressure at the ozone outlet.


CAUTION!

It is imperative that a non-return valve is fitted directly at the point of injection for the correct and proper operation of the ozone generation system. The pressure drop through the valve with a nominal gas flow rate must be low (< 0.1 bar), and the valve may only be manufactured from ozone-resistant materials. As this valve has contact both with the gaseous and also with the liquid phase, a double valve seat is required. Recommended materials for this valve are ceramic (Al_2O_3 , ZrO_2), rust-proof steel and PTFE. Operation without a non-return valve can result in damage to the ozone generation system. The valve should be fitted in such a way that no foreign materials can penetrate the valve from the raw water side and it should be serviced regularly. The non-return valve can be supplied on request.

A stainless steel pipe is needed to provide the gas connection at the point of injection. Stainless steel pipes and angle connectors are available on request. Alternatively a PTFE pipe can be used.


CAUTION!

- For reasons of safety, the length of the pipe and the number of removable connections should be limited to a minimum. In accordance with safety regulations applicable in Germany, a gas detector is required in every room, which contains a removable gas pipe connection.
- The complete pipework should undergo a leakage test by a person with appropriate experience once it has been laid.

7.3.2 Ozone Removal from Filters and Reaction Section

So that the ozone can produce its full effect, a reaction vessel may be required, depending on the application, in order to guarantee a sufficiently long reaction time of the ozone with the raw water. The substances in the water are oxidised in the reaction vessel and the water is disinfected. In many cases, dissolved residual ozone, destabilized colloids, lumpy or coated micro organisms and flocculated organic reaction products may also have to be removed completely from the water upstream of the discharge point. This can be done using multi-layer filters, active carbon filters or mixed bed filters. Reaction vessels and/or filters must be provided with an effective system for extraction of residual ozone from the system. This system must be ozone-resistant and should also be checked regularly to ensure that it is working correctly.


CAUTION!

The purified, ozone-free gas mixture has to be vented into the open air so that the oxygen does not become concentrated in the plant room.

The pipework must be designed in such a way that it ensures that no condensation flows back into the residual ozone destruction vessel.



CAUTION!

If the correct and proper functioning of the removal system in the filters or reaction vessels cannot be guaranteed, there is a risk that ozoniferous water may inadvertently pass through the system to the discharge point. Service and maintenance to comply with regulations is thus important.



WARNING!

During ozone destruction by active carbon destructors, there is a risk of explosion, specifically with systems, which generate high concentrations of ozone gas, if the ozone accumulates in the active carbon layer. This means that destruction systems for gaseous ozone, in which active carbon is used, are not suitable for OZONFILT® OZMa 1-6 O systems.

7.4 Assembly



WARNING!

- Position the OZONFILT® OZMa on a flat surface, once the packaging material has been removed, and support the control cabinet in such a way that it cannot topple over.
- Then ensure that all systems are freely accessible for service and maintenance. For this reason and so that the cooling fans can work effectively, allow a gap of at least 30 cm on the left-hand and right-hand side of the control cabinet. Avoid the entry of warm exhaust air from other units into the inlet openings of the OZONFILT® OZMa air filters.

The OZONFILT® OZMa is delivered vertically standing in a wooden crate and should be positioned on a flat, even, horizontal and solid base surface.

7.4.1 Raw Water Piping

All raw water pipes

- to the system (raw water piping) and
- from the system (ozone water discharge line)

can be made of rigid PVC (Range 5), PVDF or stainless steel. The optimum material depends on the type of application and the type of corrosive substances dissolved in the process water.



CAUTION!

Danger of leakage!

- It is important that all pipes are laid free from tension to prevent the formation of cracks.
- Ensure that the sections of pipework are as short as possible.

7.4.2 Oxygen Supply System

The OZONFILT® OZMa 1-6 O can alternatively be supplied with gaseous oxygen by

- A so-called PSA unit (pressure swing adsorption unit), which works with compressed ambient air and separates nitrogen and water from the oxygen,
- A bottle station with compressed oxygen or
- A liquid oxygen station with an evaporator unit.



WARNING!

- The pipework connecting the outlet of the oxygen supply to the OZONFILT® OZMa 1-6 O inlet should be authorised to carry oxygen (>90 percent by volume) and should be free from dust, dirt, other foreign particles, oil and grease.
- Ensure when laying the pipework that the pipe sections are as short as possible and that no tensile stresses or bending stresses are produced.
- Have an expert perform a leak test on the finished pipework.



WARNING!

Please observe all locally applicable

- Laws
- Health and safety regulations
- Environmental regulations

Chapter 14 "Technical Data" includes full information on connections, pressure ranges and required oxygen quality.

7.4.3 Ozone Gas System



WARNING!

- The pipework connecting the ozone outlet of the OZONFILT® OZMa 1-6 to the point of injection in the mixing equipment should be made of stainless steel or PTFE hose.
- Ensure that the pipework is free from dust, dirt, other foreign particles, oil and grease.



WARNING!

- Ensure when laying the pipework that the pipe sections are as short as possible and that no tensile stresses or bending stresses are produced.
- Have an expert perform a leak test on the finished pipework.



WARNING!

Please observe all locally applicable

- Laws
- Health and safety regulations
- Environmental regulations

Chapter 14 "Technical Data" includes full information on connections and pressure ranges. Chapter 8.3.1 "Mixing Modules" includes information on installation.

The dimensional drawing of the OZMa system shows the position of the inlet connection for ozone on the OZONFILT® OZMa.

7.4.4 Cooling Water System

1. ➤ The cooling water connections are joined with PE hoses and the connection to the system cabinet is made using a PVC connector kit - see the dimensional drawing of the OZMa system - .
2. ➤ When connecting up the hose, ensure that the O-rings are sitting correctly in the groove of the PVC threaded connection.
3. ➤ The supply pipe can be connected to the cooling water inlet with a pipe fitting. The pipe fitting is supplied within the scope of delivery of the system.



CAUTION!

If the cooling water supply is susceptible to significant fluctuations in pressure or if it is contaminated, a filter release valve will be needed upstream of the cooling water inlet.

Chapter 14 "Technical Data" includes information on the cooling water quality required.

The dimensional drawing of the OZONFILT® OZMa system shows the position of the inlet and outlet connectors for refrigerant - see Appendix.

7.4.5 Air-conditioning System (air-conditioning unit, optional)

Ensure that there are adequate gaps when setting up the system - refer to the operating instructions for the air-conditioning unit.



WARNING!

Disconnect the mains voltage prior to opening the unit.

Discharge the condensate produced during the cooling process in the usual way - refer to the operating instructions for the air-conditioning unit.

8 Electrical Installation

8.1 Information Relating to Electrical Connections



CAUTION!

Warning of incorrect operation and defects

- The mains cable enters at the bottom right; all of the other electric cables (signal leads) enter through the top of the control cabinet.

All of the electrical supply cables to the plant must pass through the strain relief screw connections into the inside of the system.

Lay the supply cables in the cable ducts provided there. Following installation, tighten all the threaded connectors. Tightly seal all the threaded connectors not in use with the blanking plugs provided.



CAUTION!

- The system is fully wired. It only has to be connected to the local single phase mains power supply. Ensure that the live, neutral and protective earth conductors are connected correctly as per the wiring diagram.

The electrical installation of the system must use fixed wiring. It must not be connected via a standard power lead to the local power supply network! If the connections to the power supply are incorrect, safety equipment, in particular the door position switch, which disables the system when the door is opened, may not work correctly.

- The electrical supply equipment must be capable of being disconnected by an emergency cut-off switch (emergency command device). Install this in an easily accessible position in the vicinity of the entrance door to the operating room.

1. ➤ The ozone generation system together with the feed pump of the water treatment system must be locked via the Pause input on the control circuit board - ➤ *Chapter 8 'Electrical Installation' on page 41.*
2. ➤ The gas detector needed to operate the system must have an isolated contact which must be electrically connected to the terminals – cf. terminal wiring diagram in the Appendix. This ensures that ozone generation is interrupted in the event of the release of ozone gas.
3. ➤ All other electrical connections must be wired according to the terminal connection diagram in the appendix.

8.2 System Electrical Inputs and Outputs

The system has the following inputs and outputs, which are available to the user to control and manage the generation of ozone - see the terminal connection diagram in the appendix:

- **"Pause" contact input**

This input can be used to place the system in PAUSE status. The input is isolated from all other electrical components of the system.

"Contact open" indicates that PAUSE status is activated.

- **"Ozone reduction" contact input**

This input is used to activate ozone reduction in the system. The input is isolated from all other electrical components of the system.

"Contact open" means that ozone reduction is activated.

The function of this input is explained in Chapter 11.3.2 "Operating Mode "External"" Menu.

- **"Process water flow rate" contact input**

This input can be used to place the system in PAUSE status by means of the minimum contact of a process water flow meter.

"Contact open" indicates that PAUSE status is activated.

- **"Sample water flow rate" contact input**

This input can be used to place the system in PAUSE status by means of the minimum contact of the flow meter in an in-line probe housing. Such an in-line probe housing is employed when an ozone sensor is used to control the ozone concentration. If the flow of sample water becomes too low, the system must be automatically switched off in order to avoid incorrect dosing.

"Contact open" indicates that PAUSE status is activated.

- **"Ozone detector" contact input**

The alarm output of an ozone detector can be connected to this contact. The ozone detector should have a potential-free alarm contact.

"Contact open" indicates ozone alarm.

- **Standard signal input 1 (optional)**

The function of the standard signal input 1 depends on the operating mode of the system:

- "Internal" operating mode:

Standard signal input 1 is not activated

- "External" operating mode:

The standard signal input 1 can be used to specify the ozone setpoint, either via a 4-20 mA or a 0-20 mA signal.

Thus a current value of 0 or 4 mA corresponds to a setpoint of 0% and a current value of 20 mA corresponds to a setpoint of 100%.

- "Control" operating mode:

In this operating mode, the standard signal input 1 is used to connect an ozone sensor to a standard signal output.

The input can alternatively be configured to 4-20 mA or 0-20 mA.

■ **Standard signal input 2 (optional)**

The function of the standard signal input 2 depends on the operating mode of the system:

- "Internal" operating mode:
Standard signal input 2 is not activated.
- "External" operating mode: Standard signal input 2 is not activated.
- "Control" operating mode:
In this operating mode, the standard signal input 2 is either used to issue an interference variable (disturbance) for the control or to externally specify the ozone setpoint. The input can alternatively be configured to 4-20 mA or 0-20 mA. In both cases a current value of 0 mA or 4 mA corresponds to a variable of 0% and a current value of 20 mA to a variable of 100%.

■ **"Collective alarm" relay output**

This output is used to report a fault in the system. This output is configured as a changeover contact.

■ **"Ozone operating status message" relay output**

This output is used to signal the "Operation with ozone" operating status. It is activated when the system is generating ozone. (setpoint 3% and higher, no PAUSE status, no fault alert).

■ **"Ozone limit value" relay output (optional)**

This output is only of significance in the "Control" operating mode if limit values are activated. It indicates a limit value transgression of the ozone measured.

This output is configured as a changeover contact.

■ **"Report" standard signal output (optional)**

The "Report" standard signal output is used to report a selectable measured variable of the ozone system. The output can alternatively be configured for a 0-20 mA or 4-20 mA signal.

9 Commissioning



WARNING!

- Commissioning must be performed by a specialist in accordance with ZH 1/474 and GUV 18.13.
- Outside of Germany, the regulations applicable in each respective country for the operation of ozone generation systems should be observed.
- Persons are deemed to be qualified as technical personnel, if they have undergone a training course from ProMinent and have the requisite authority.

All guarantee and liability claims on the part of the system operator will not be admitted following interference by unauthorised personnel.



WARNING!

Unauthorised access to the system or to parts of the system can endanger life.

Compressed air or pure oxygen and high voltage are used in the system to generate a toxic gas.



WARNING!

Adjustments may have to be made inside the control cabinet during the course of commissioning.

When the system is switched on, the electrical components inside the control cabinet represent a source of danger if touched.

- Wait at least 5 minutes after the supply of power to the system has been interrupted by the mains switch before you touch the components on the inside of the cabinet.

Preliminary Tests

A functional test must be performed once the system has been installed to check for any possible damage that could have been caused during transportation.

Prior to starting up the ozone generation system, it must be ensured that

- the system complies with local regulations - see chapters "Assembly and Installation" and "Safety",
- the requirements relating to the location of the system have been met,
- the system has been properly installed - see chapter "Assembly and Installation",
- pneumatic and hydraulic connections have been made in accordance with the regulations and are tight and have been pressure tested,
- all electrical connections have been made in accordance with the regulations and an emergency stop switch has been fitted at the entrance to the plant room,
- correctly functioning protective equipment is on hand,

- all system parameters are within the permissible range - see chapters "Technical Data", "Assembly and Installation" and "Safety",
- all safety equipment is on hand and working correctly,
- all safety signs have been fixed in place,
- the supply of pressurised air or oxygen complies with the regulations.

The ozone generation system can then be activated. To do so, ensure that

- the automatic circuit breakers (1-53 and 1-54) are ready,
- the safety switch (1-13) has not been triggered,

1. ➤ Switch on the system's main switch (1-19).
 - ⇒ This wakes the system in the "Stop" operating status - *↪ Chapter 10.7.5 "Stop" Operating Status' on page 74.*
2. ➤ Ensure that the "Ozone" setting indicates "0 %". Adjust the ozone setpoint, as necessary with the N key to 0 %. In this setting, the high voltage generator is deactivated and no ozone will be generated.
3. ➤ Start the system with the [START]/[STOP] key. The system adopts the operating status "Start without ozone generation" - *↪ Chapter 10.7.2 "Start without Ozone Generation" Operating Status' on page 73.*
 - ⇒ The control device will open the solenoid valves on the pneumatic side (Gas inlet 1-23 and Ozone outlet 1-5) and the cooling water inlet valve.
4. ➤ Adjust the cooling water nominal flow rate using the angle valve - *↪ Chapter 9.3 'Adjusting the Cooling Water Flow Rate' on page 48.*



CAUTION!

It is essential that you ensure that the ozone generator(s) is (are) fully filled with cooling water before setting an ozone setpoint of greater than or equal to 3 %. You will recognise this by the bubble-free flow of cooling water through the cooling water flow meter (1-24).



CAUTION!

Specified cooling water flows must be adhered to.

5. ➤ Observe both safety instructions.
6. ➤ Set the desired system initial pressure - *↪ Chapter 9.1 'Adjusting the Initial Gas Pressure' on page 47.*

7. ➤ Set the desired operating gas flow - ➤ *Chapter 9.2 'Adjusting the Process Gas Flow' on page 47.*



CAUTION!

The pressure sensor (1-6) in the control cabinet measures the pressure. The measured value is displayed on the touch panel with "___ bar g".

This pressure must lie within the permissible range. The pressure is determined by the:

- system initial pressure
- Current gas flow rate (to a lesser extent)
- Pressure in the raw water section (to a greater extent)

If the permissible pressure is exceeded, the pressure relief valve (1-8) will blow off and the gas flow rate will fall very significantly. In this case, the pressure in the raw water section is too high and has to be reduced. If this does not happen, the system will be switched off either with a "Gas flow" or "Primary voltage" fault alert. Continuous operation of the system with excess pressure could result in damage to the ozone generator(s) and/or the electrical system.

8. ➤ Ensure, before starting up ozone generation, that the ozone warning equipment is responsive, switched on and correctly wired. Also test the locking mechanism between the ozone warning device and the OZMa.
9. ➤ Check that the alarm device connected to the OZMa alarm relay is working correctly.
10. ➤ Check that all external devices and installations, such as ozone monitoring equipment, residual ozone destruction units and degasification valves, are correctly installed on the system and activated.



CAUTION!

It is essential that you ensure that the ozone generator(s) is (are) fully filled with cooling water before setting an ozone setpoint of greater than or equal to 3 %. You will recognise this by the bubble-free flow of cooling water through the cooling water flow meter (1-24).

11. ➤ Observe the safety information.
12. ➤ Adjust the ozone value from 0 % to 3 %. Shortly thereafter, ozone generation will start up and the generation rate will be displayed in the "Ozone generation rate" (g/h) field.
13. ➤ In operating mode 'Internal' set the required ozone generation rate using the arrow keys - ➤ *Chapter 10 'Operation' on page 49.*

**CAUTION!**

- During commissioning, the personnel responsible for the OZMa ozone generation system must be instructed on the operation of the system, as well as on its measuring technology (calibration of sensors etc.). They must also be trained in all safety-related issues.
- The responsible personnel must have access to the operating instructions and to all safety information. Those responsible should confirm this is the case in the OZONFILT® OZMa Commissioning Report.
- The Commissioning Report must be completed in full and signed by the customer, by the personnel responsible for the system and by the person who commissions the OZONFILT® OZMa.

9.1 Adjusting the Initial Gas Pressure

For OZMa 1-6 A systems, the pneumatic system is preset to a normal operating gas flow rate based on an initial pressure of 4 bar. However, the system can also be operated with other initial and ozone outlet pressures. The initial pressure can be adjusted using the pressure regulating valve (1-27) and the pressure sensor (4-43) on the outside of the control cabinet measures the pressure. The measured value is displayed on the touch panel with "___ bar g". The gas flow rate must be adjusted with a higher system pressure.

For OZMa 1-6 O systems, the initial pressure is not measured and displayed. It must be set dependent on the pressure conditions in the water that is being treated. The pneumatic system is adjusted to an oxygen pressure of 3 bar g.

9.2 Adjusting the Process Gas Flow

**WARNING!**

The following adjustments must be made when the system is running with the cabinet door open.

- Wait at least 5 minutes after the supply of power to the system has been interrupted by the mains switch before you touch the components on the inside of the cabinet.
- Do not touch any electrical components while the system is carrying current.
- Before making the following adjustments, ensure that the high voltage section is deactivated.
This is the case if the system is working in "Start without ozone generation" operating mode with an ozone setting of 0 %.

The operating gas flow rate can be adjusted using the adjustable operating gas regulating throttle valve (1-4) inside the cabinet or at the control valve above the control.

The "gas flow rate" is displayed on the touch panel.

Once the operating gas flow rate has been set, ensure that the adjustable operating gas throttle valve (1-4) is firmly fixed using the appropriate locking nut.



A gas flow rate below the nominal flow rate results in a higher concentration of ozone and lower ozone emissions from the system. Ensure that the gas flow rate does not exceed the permissible range, because the control device will otherwise switch off the system with a fault alert.

9.3 Adjusting the Cooling Water Flow Rate



WARNING!

The following adjustments must be made when the system is running with the cabinet door open.

- Wait at least 5 minutes after the supply of power to the system has been interrupted by the mains switch before you touch the components on the inside of the cabinet.
- Do not touch any electrical components while the system is carrying current.
- Before making the following adjustments, ensure that the high voltage section is deactivated.

This is the case if the system is working in "Start without ozone generation" operating mode with an ozone setting of 0 %.

The cooling water flow rate can be adjusted using the angle valve (1-24) in the system cabinet adjacent to the cooling water inlet connection on the system. The value is displayed on the flow meter (1-9) in the system cabinet. The nominal cooling water flow rate is given in Chapter 14 "Technical Data".



A cooling water flow rate below the nominal flow rate results in lower ozone emissions from the system and overheating of the ozone generator.

Ensure that the cooling water flow rate and temperature do not exceed the permissible range, because the control device will otherwise switch off the system with a fault alert.

Only OZMa 4 ... 6: There is only one flow meter for several ozone generators. Ensure that the flow is the same through all ozone generators.

The cooling water must be free from bubbles.

10 Operation

The system is switched on by turning the main switch (19) to the "1" position. The main switch (1-19) is located on the right-hand side of the control cabinet.

10.1 Touch panel

The information contained in the touch panel (1-29), as well as the operating options, are shown in Fig. 9.

The touch panel can be used to

- Start or stop the entire system,
- Set the volume of ozone required,
- Display the system variables measured and
- Set various system parameters.

Further information is provided by [Chapter 10.9 'Display Values on the Touch Panel' on page 75](#).

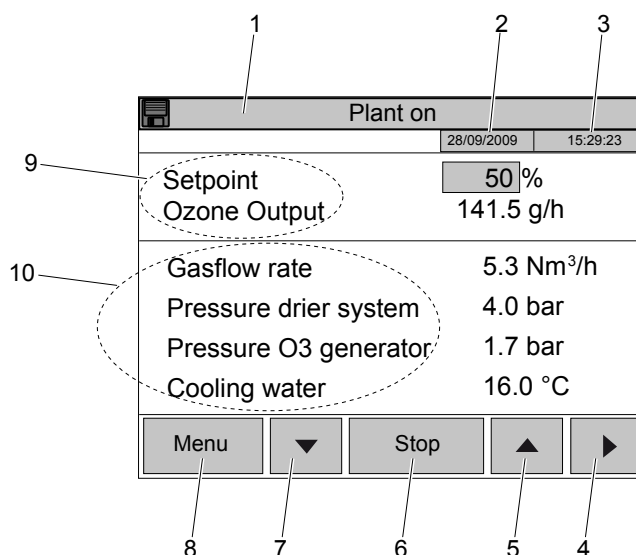


Fig. 9: Touch panel layout

- 1 Status bar (display of system statuses, such as: On, Off, Pause, Ozone reduction, Faults)
- 2 Date (dd/mm/yy)
- 3 Time
- 4 *[NEXT]* key
- 5 *[UP]* key
- 6 *[START]* / *[STOP]* key (selectable status will be displayed)
- 7 *[DOWN]* key
- 8 *[Menu]* key (change between menus)
- 9 Static window - fixed values (are always displayed in this type of window)
- 10 Changing values (dependent on the menu)

10.2 Operating Principles

You can adjust values on the touch panel regardless of the system status ('System Off', 'System On').

The last opened window remains, until another is selected. This is similar to a PC.

Sometimes there are 2 ways of reaching the same window: The window shown in Fig. 10

- can be displayed via 'Menu → Start → ...'.
- Shift from window to window with the [Next] key.

Sometimes there are 2 ways of changing values:

- Touch the box for the value and enter the value using the number block which appears
- If arrow keys appear next to the box, set the value using the [UP] and [DOWN] keys.

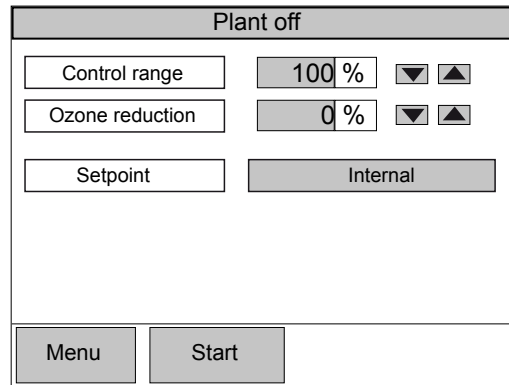


Fig. 10: Two options for changing a value

10.3 Operation of the Control for System Calibration

OZMa type ozone generation systems are equipped with a touch panel, which displays all of the process variables and is used to operate the system. Once the system has been switched on, a process image will be displayed, in which the key information for ozone generation is presented.

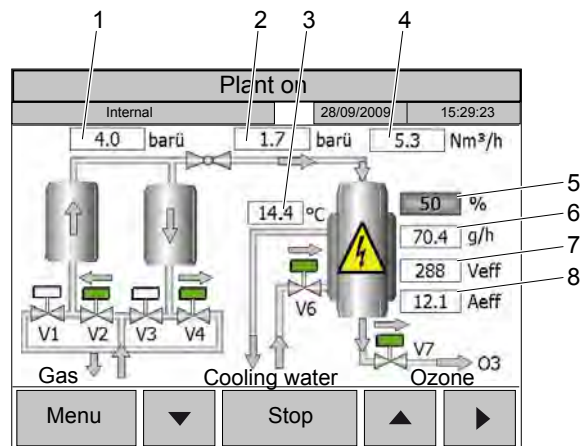


Fig. 11: Values displayed in the process flowchart OZMa 1-6 A (here under "System On" status)

- 1 Drier operating pressure
- 2 Ozone generator operating pressure
- 3 Cooling water temperature - outlet
- 4 Gas flow rate
- 5 Setpoint input field
- 6 Ozone Output
- 7 Primary voltage (for OZMa 4-6, display for individual generators in "Electrical operating data")
- 8 Primary current (for OZMa 4-6, display for individual generators in "Electrical operating data")

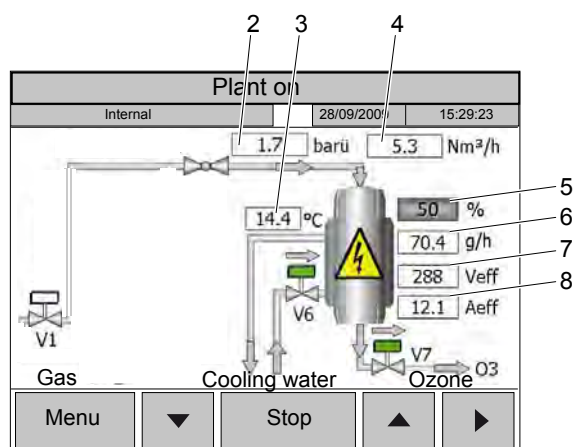


Fig. 12: Values displayed in the process flowchart OZMa 1-6 O (here under "System On" status)

- 2 Ozone generator operating pressure
- 3 Cooling water temperature - outlet
- 4 Gas flow rate
- 5 Setpoint input field
- 6 Ozone Output
- 7 Primary voltage
- 8 Primary current

10.3.1 Operating Keys and Control Information

A number of keys are provided to operate the system, which are superimposed at the lower edge of the touch panel.

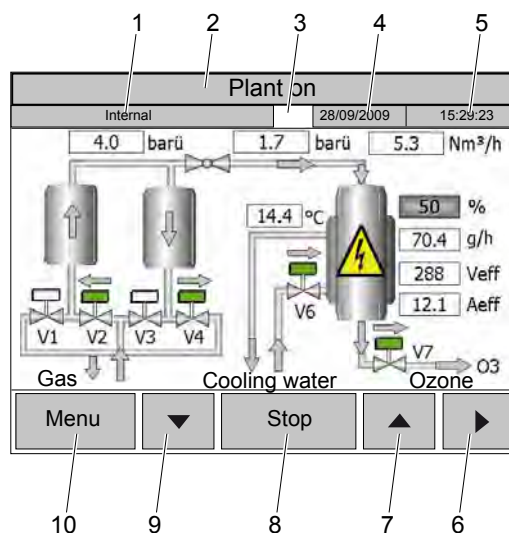


Fig. 13: System information and operating keys (here: OZMa 1-6 A)

- 1 Operating mode
- 2 Status
- 3 Additional information
- 4 Date
- 5 Time
- 6 [NEXT] key
- 7 [UP] key
- 8 [START] / [STOP] key
- 9 [DOWN] key
- 10 [MENU] key

- The **[MENU]** key:
This key is used to select further functions and is used as in other Windows applications: 'Menu → Start → ' (to further displays)
- The **[DOWN]** ▼ and **[UP]** ▲ buttons:
These keys are used to lower (or better said reduce) or increase set values, e.g.: the control variable. The operating keys **[UP]** ▼ and **[DOWN]** ▲ affect grey highlighted operating fields, such as: the control variable. Alternatively, an input can also be made directly via the keyboard, if the relevant field can be selected directly by touching it.
- The **[STOP]** / **[START]** key:
This key is used to stop or start the system manually and to acknowledge fault alerts. The text displayed within the key indicates the status that will be reached once the key has been pressed.
- The **[NEXT]** ► key: This key is used to move onto the next screen. This can however also be done directly by clicking on the **[MENU]** key: 'Menu → Start → ' (to further displays)

10.3.2 Process Flowchart Displays

The touch panel displays the components that are participating in the process:

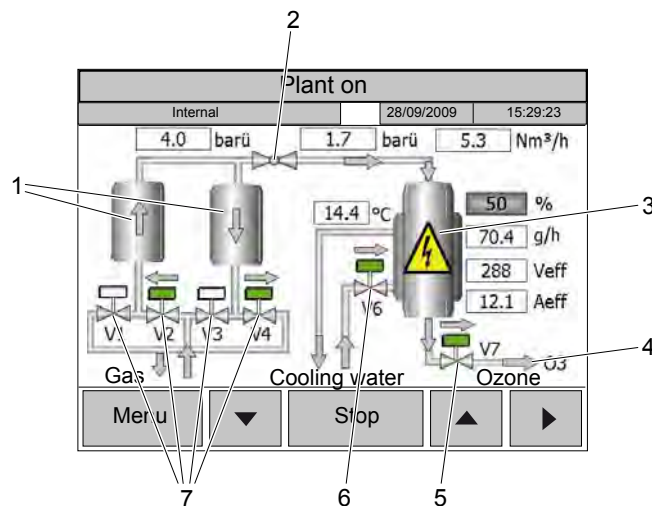


Fig. 14: Process diagram, here for OZMa 1-3 A

- 1 Pressure drier storage tank (only OZMa 1-3 A)
- 2 Control valve (optional) or needle valve for adjusting the operating gas flow
- 3 Ozone generator
- 4 Ozone outlet
- 5 Ozone outlet solenoid valve
- 6 Cooling water inlet solenoid valve
- 7 Pressure drier solenoid valves (only OZMa 1-3 A)

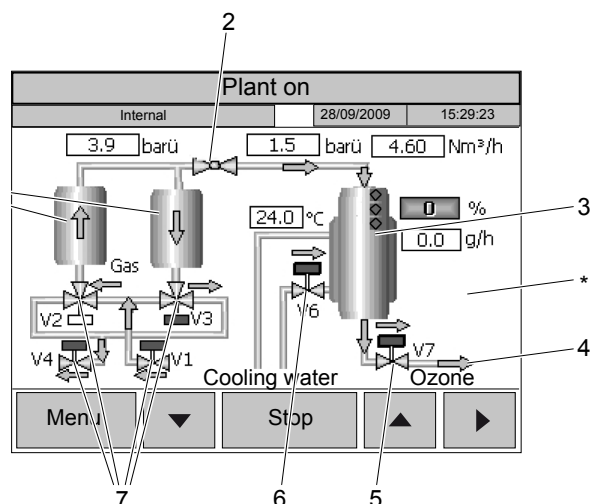


Fig. 15: Process diagram, here for OZMa 4-6 A

- 3 Ozone generators (solid dots indicate the number of working ozone generators)
- * Veff, primary voltage, and Aeff, primary current, can be read separately for each ozone generator in the "Electrical operating data" menu window – see [Further information on page 54](#)

10.4 Authorisation Scheme

The authorisation scheme is arranged according to the users and incorporates the keyboard lock.

Operating option	OPERATOR user with keyboard lock	OPERATOR user without keyboard lock	EXPERT User
Start / stop system	X	X	X
Enter control variable	-	X	X
Switch to next display screen	-	X	X
Change operating mode	-	-	X
Make adjustments to operating mode	-	-	X
Set up ozone sensor	-	X	X
Enter limit values	-	X	X
Set up dewpoint sensor	-	-	X
Set up protocol output	-	-	X
Handle system data	-	-	X
Handle keyboard lock	-	-	X
Read out information	-	-	X
Language *	-	-	-

* The language can be set by customer service or the subsidiary.

The following users are set up for customers:

10.4.1 OPERATOR User

The 'OPERATOR' user is automatically activated after system switch-on without any further action being required. The operator may

- start and stop the system at any time.
- adjust the setpoint if the key lock is not enabled.
- calibrate an optionally connected ozone sensor, if no key lock is enabled.
- change the limit values of an optionally connected ozone sensor, if no key lock is enabled.

The 'OPERATOR' user cannot clear the keyboard lock. This is only possible for the 'EXPERT' & 'Login' on page 55 user.

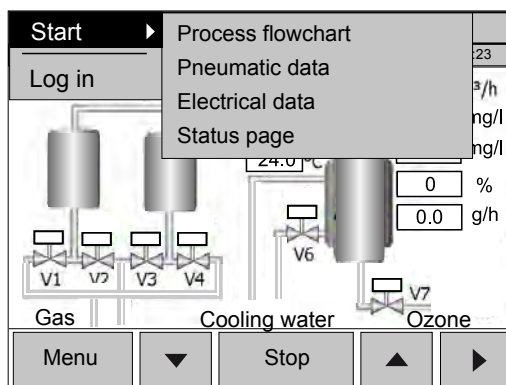


Fig. 16: This menu selection is available to the OPERATOR user, without ozone sensor and without control.

Plant on	
	28/09/2009 15:29:23
Setpoint	50 %
Ozone output	141.5 g/h
Gasflow rate	5.3 Nm ³ /h
Pressure drier system	4.0 bar
Pressure O ₃ generator	1.7 bar
Cooling water	16.0 °C
Menu ▼ Stop ▲ ▶	

Plant on	
	28/09/2009 15:29:41
Setpoint	100 %
Ozone output	141.5 g/h
Line voltage	219 Veff
Line current	11.4 Aeff
Primary voltage	271 Veff
Primary current	23.9 Aeff
Menu ▼ Stop ▲ ▶	

Plant on	
	28/09/2009 15:29:37
Setpoint	100 %
Ozone output	141.5 g/h
Operating hours	83 h
Operation with O ₃	13 h
Power on	12
Faults	5
Menu ▼ Stop ▲ ▶	

DB201_IIKali_OZVa	
	15:29:23
Low Limit:	0
High Limit:	100
70	50 %
	70.4 g/h
	288 Veff
	12.1 Aeff
	V7 → O3
	Ozone
Menu ▼ Stop ▲ ▶	

Fig. 17: "Process flowchart" menu window with control variable input, "Pneumatic operating data", "Electrical operating data" and "Status page"

In these sequentially occurring menu windows, the OPERATOR user can read-off the system parameters and set the control variable.

Deactivation of the keyboard lock

If the keyboard lock is activated and the touch screen is touched when a protected window is displayed (padlock symbol) the following code query is displayed:

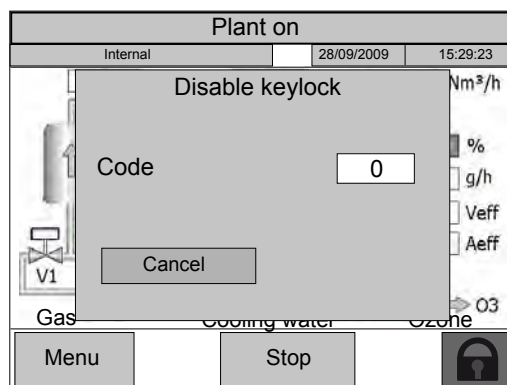


Fig. 18: Code query when the keyboard lock is activated

The 'EXPERT' user must know the code.

10.4.2 EXPERT User

The 'EXPERT' user

- sets up the key lock,
- changes the internal (always), external and control operating modes, depending on which operation mode options have been ordered,
- changes the adjustment range,
- changes the value of ozone reduction,
- sets the system time.

Login

The 'EXPERT' user logs in with his user name and password to arrive at 'EXPERT' mode. The 'EXPERT' user will have received the password at a ProMinent training session, from a service technician or from an authorised technical expert. The 'EXPERT' user can make all changes intended for the customer in this mode. He can also lock the keyboard in this mode.



Fig. 19: The EXPERT login window

Logout

If the 'EXPERT' user has not logged off, the 'EXPERT' user's login will expire after approx. 1 hour. If the keyboard lock is activated, it is not possible to make any further entries. A locked keyboard can be identified by a padlock at the bottom right-hand corner of the menu window.

10.5 Operating Modes and Settings

10.5.1 Operating modes

The ozone system is equipped with the following operating modes:

- 1 - 'Internal'
- 2 - 'External'
- 3 - 'Control' (option)

The 'EXPERT' user can select all of the menus displayed here using the following menu window.

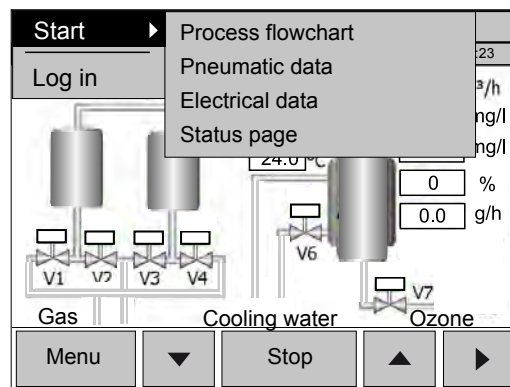


Fig. 20: Menu selection in "Internal" and "External" operating modes

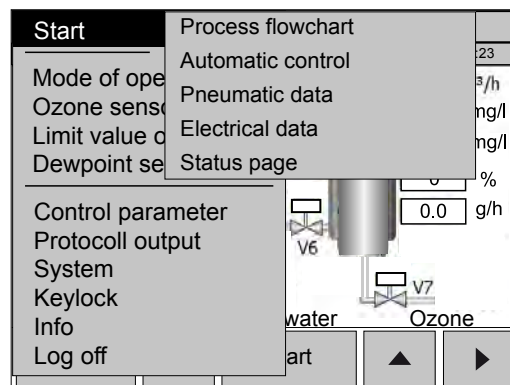


Fig. 21: Complete menu selection in "Control" operating mode (option)

10.5.1.1 "Internal" Operating Mode

In the '*Internal*' operating mode, the '*EXPERT*' user can set the control range, the ozone reduction and the control variable source.

The screenshot shows a control panel titled 'Plant off'. It contains three main input fields: 'Control range' set to '100 %' with up/down arrows, 'Ozone reduction' set to '0 %' with up/down arrows, and 'Setpoint' set to 'Internal'. At the bottom, there are two buttons: 'Menu' and 'Start'.

Fig. 22

Adjustment Options

■ '*Adjustment range*' in %

The '*adjustment range*' indicates what percentage of the nominal output is generated with an actuating variable of 100 %.

Adjustment range in %

Nominal output of the system 140 g/h with an actuating variable of 100 % and an adjustment range of 100 %.

With an adjustment range of 80 %, a maximum of $0.8 \cdot 140 \text{ g/h} = 112 \text{ g/h}$ is generated.

The reduction in the system output can be used in control loops to limit the maximum volume to be added. This will thus reduce over-shoots in controlled systems.

■ '*Ozone reduction*' in %

If the contact at the contact input for ozone reduction in the control is opened, the output of the system will be reduced by the percentage given in the '*Ozone reduction*' field.

Ozone Reduction in %

Ozone reduction 40 %, actuating variable 90 %, ozone volume 126 g/h, ozone reduction contact closed, generates an ozone volume of $126 \text{ g/h} \cdot (100 - 40 \%) = 75.6 \text{ g/h}$ when the contact is opened.

A timer can, for example, be connected to this input, with which night setback of the added ozone volume can be achieved.

■ '*Actuating variable (setpoint)*'

This field is used to specify from where the system should obtain its actuating variable:

- '*internal*':
Manual specification of the actuating variable on the touch panel
- '*external*':
Specification of the actuating variable via a standard signal interface 0/4-20mA. The type of 0-20mA or 4-20mA interface can be selected in the field underneath.
- '*Control*':
Specification of the actuating variable via a control integrated in the control

10.5.1.2 "External" Operating Mode

In the 'External' operating mode, the control variable is specified via a standard 0/4-20 mA signal interface. The type of 0-20 mA or 4-20 mA interface can be selected in the field underneath. The system switches off so that the specification can be monitored and possibly corrected. Thereafter the system must be started manually using the *[START]* key on the touch panel.

The screenshot shows a control panel titled 'Plant off'. It contains four rows of controls: 'Control range' with a value of 100% and up/down arrows; 'Ozone reduction' with a value of 0% and up/down arrows; 'Setpoint' with a dropdown menu currently showing 'External'; and '0/4 - 20 mA' with a dropdown menu currently showing '4 - 20 mA'. At the bottom are two buttons: 'Menu' and 'Start'.

Fig. 23

Adjustment Options

■ 'Adjustment range' in %

The 'adjustment range' indicates what percentage of the nominal output is generated with an actuating variable of 100 %.

Adjustment range in %

Nominal output of the system 140 g/h with an actuating variable of 100 % and an adjustment range of 100 %.

With an adjustment range of 80 %, a maximum of $0.8 \cdot 140 \text{ g/h} = 112 \text{ g/h}$ is generated.

The reduction in the system output can be used in control loops to limit the maximum volume to be added. This will thus reduce overshoots in controlled systems.

■ 'Ozone reduction' in %

If the contact at the contact input for ozone reduction in the control is opened, the output of the system will be reduced by the percentage given in the 'Ozone reduction' field.

Ozone Reduction in %

Ozone reduction 40 %, actuating variable 90 %, ozone volume 126 g/h, ozone reduction contact closed, generates an ozone volume of $126 \text{ g/h} \cdot (100 - 40 \%) = 75.6 \text{ g/h}$ when the contact is opened.

A timer can, for example, be connected to this input, with which night setback of the added ozone volume can be achieved.

■ 'Actuating variable (setpoint)'

This field is used to specify from where the system should obtain its actuating variable:

- 'internal':
Manual specification of the actuating variable on the touch panel
- 'external':
Specification of the actuating variable via a standard signal interface 0/4-20mA. The type of 0-20mA or 4-20mA interface can be selected in the field underneath.
- 'Control':
Specification of the actuating variable via a control integrated in the control

10.5.1.3 "Control" Operating Mode

10.5.1.3.1 Activating the control

Plant off	
Control range	100 % ▼ ▲
Ozone reduction	0 % ▼ ▲
Setpoint	Internal
Menu Start	

Fig. 24

➔ Press 'Operating mode' in the main menu and then press the 'Internal' field.

⇒ This then switches to 'Control' and the field 'Control parameters' in the main menu becomes accessible
 ➔ Chapter 10.5.5 'Control parameter' on page 65.

10.5.1.3.2 Configuring mA input 2

Plant off	
Automatic control 28/09/2009 15:29:23	
Control range	100 % ▼ ▲
Ozone reduction	50 % ▼ ▲
Setpoint	External
mA input 2	no function
Menu Start	

Fig. 25

If the control is active, the menu above opens under the main menu 'Operating mode'. The configuration is adjusted, on the grey field next to the 'mA input 2' field, by pressing 'No function', 'Interference variable' or 'External setpoint'.

If 'Interference variable' and 'External setpoint' have been clicked, an input option opens for assigning the mA signal ('4-20 mA' or '0-20 mA').

10.5.1.3.3 Adjusting the setpoint

Internal Setpoint

This is set by pressing the grey "mg/l" field in the main display (Fig. 6), which is reached by pressing the fields 'Menu ➔ Start ➔ Process flow chart'.

Alternatively it can be set via 'Menu ➔ Start ➔ Control'. Further information, e.g. about the interference variable (disturbance) is available here.

External Setpoint

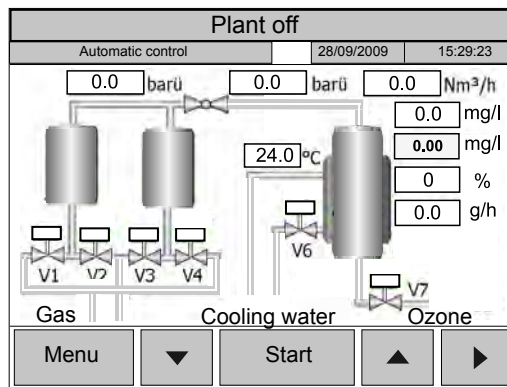


Fig. 26

If the setpoint is made available via an external mA signal:

- ➔ Set 'mA input 2' to 'External setpoint'.
- ⇒ The displayed main display then has no input option.



When configuring the signal generator it is important to note that the signal routing must be identical to that of the ozone sensor.

16 mA correspond to the measurement range of the sensor (e.g. 2 ppm = 2 mg/l),

0 or 4 mA corresponds to 0 mg/l.

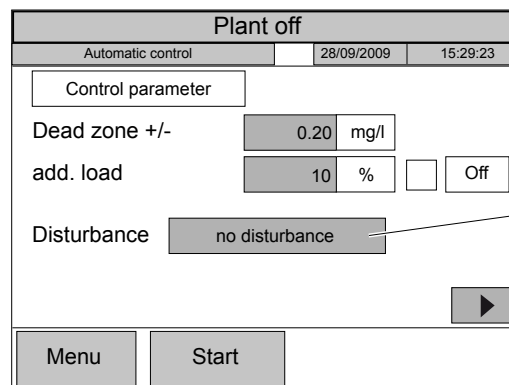


Fig. 27

1 Field 1

- ➔ In field 1 select "No interference variable", "add. interference variable" or "mult. interference variables".

Definition

Disturbance

The interference variable (disturbance) influences the actuating variable calculated by the PID controller depending on this external signal.

Depending on the nature of the effect on the setpoint, it is referred to either as a

- multiplicative interference variable.

The output from the PID controller is multiplied with the interference variable. The effect of the result on the setpoint can also be influenced by means of the attenuation factor.

- additive disturbance

The output from the PID controller is added to the interference variable. The maximum additive interference variable represents a factor with which the disturbance is first multiplied.

The sequences and effects of the various control parameters and interference variables are shown in the following figure.

Sequences and effects of the various control parameters and interference variables

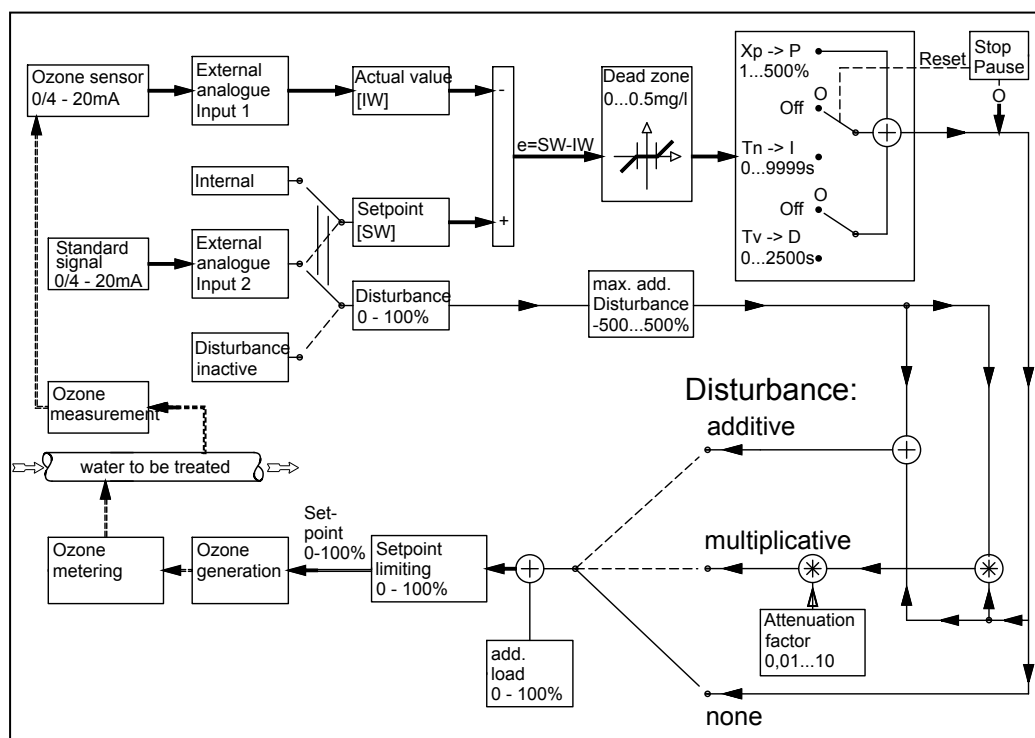


Fig. 28

10.5.2 Ozone Sensor (only with Ozone Sensor)

10.5.2.1 Configuring the ozone sensor

Plant on			
Internal	28/09/2009	15:29:23	
Ozone sensor	4 / 20 mA 1		
0/4 mA	=	0.00	mg/l 2
16 mA	=	2.00	mg/l
measured value		1.39	mg/l
Slope		6.00	mA / mg/l
Control time		5	s 3
Menu Stop Calibration			

Fig. 29

- 1 Field 1
- 2 Field 2
- 3 Field 3

The 'Ozone measurement' menu also appears in the 'Control' operating mode. This is where various settings are made in conjunction with the ozone sensor.

1. ➔ Press 'Ozone sensor' in the main menu.
2. ➔ Select the signal range 'inactive', '0-20 mA' or '4-20 mA' in field 1 of the menu that opens.
3. ➔ Enter the ozone sensor measuring range in field 2.
4. ➔ Enter the value for the control time in field 3.

10.5.2.1.1 Measured Value Checkout Time



CAUTION!

This function must not be activated in applications where it can be assumed that the reading will not change.

This function checks whether or not the reading from the sensor (at the measured value input) changes within the 'measured value checkout time'. It is assumed that it does change when the sensor is intact.

Should the reading not change during this control time, the control sets the setpoint to "0" and the alarm relay is deactivated. The prompt 'Check ozone sensor' appears in the LCD display.

10.5.2.2 Calibrating the ozone sensor

- ➔ Press the [CALIBRATION] key in Fig. 29 and enter the value measured by DPD for the calibration.
 - ⇒ The gradient is then recalculated on the basis of the entered value.

If the gradient reported is too low or too high, the DPD measurement and the ozone sensor should be checked. Only values inside the set measuring range can be entered.

Avoiding errors in photometric measurements



CAUTION!

Observe the following instructions relating to photometric measurements in order to avoid incorrect metering!

- The cells, covers and stirring rods should be thoroughly cleaned after each analysis, in order to avoid errors resulting from carry-over. Even slight reagent residue can lead to incorrect measurement results.
When cleaning the above components use the brush supplied with the system. If the fully reacted sample is left for any length of time it may produce stubborn coloured deposits, which can be dealt with by means of diluted (= 4 %) hydrochloric acid.
- The outer walls of the cells must be clean and dry before the analysis is carried out. Fingerprints or water droplets on the surfaces in the cell where light passes through will result in faulty measurements. The cell should therefore be wiped clean with a soft paper tissue (Kleenex, Lotus etc.) before carrying out the measurement.
- The zero correction and the test must both be carried out with the same cell, as each cell may show slightly differing tolerances.
- For the zero correction and the test, the cell must be positioned in the sample chamber in such a way that the white triangle on the graduation points towards housing marking : .
- The zero correction and the test must both be carried out with the cell cover closed.
- Formation of bubbles on the inside walls of the cell will result in faulty measurements. Should this happen, seal the cell with the cell lid and tip it back and forth to dissolve/remove the bubbles before carrying out the test.
- It is important to prevent water getting into the sample chamber. Water penetrating the photometer housing can lead to the destruction of electrical components and to corrosion damage.
- Contamination of the optics (LED and photo sensor) in the sample chamber leads to faulty measurements. The surfaces in the sample chamber where light passes through should be checked at regular intervals and cleaned as necessary. Damp tissues and cotton buds can be used.
- Pronounced differences in temperature between the photometer, the immediate environment and the sample can lead to incorrect measurements, e.g. due to condensation forming around the optics or on the cell.
- Any clouding that occurs during the colour reaction leads to exaggerated results. This error can often be prevented by pre-diluting the sample with oxidant-free water.

10.5.3 Ozone Sensor Limit Values (only with Ozone Sensor)

Plant off				
Internal		28/09/2009	15:29:23	
Limit value ozone sensor				
Lower limit	☒	On	0.50	mg/l
Upper limit	☒	On	1.50	mg/l
On delay			20	s
Off delay			5	s
Hysteresis		±	0.05	mg/l
Menu		Start		

Fig. 30

This menu opens after you press on 'Ozone sensor limit value' in the main menu. The limits, on and off delays and hysteresis can be input directly.

Adjustment Options

Switch on delay:

Length of time after the OZMa is switched on which must elapse before a limit transgression is reported.

Off delay:

The length of time within which a limit transgression must occur before the limit relay is triggered.

Hysteresis:

Relating to Hysteresis

'Upper limit'	= 1.50 mg/l
'Lower limit'	= 0.50 mg/l
'Hysteresis'	= ±0.05 mg/l

Therefore a limit transgression is shown when the measured values are greater than or equal to 1.50 mg/l and less than or equal to 0.50 mg/l.

A transgression of the 'MAX limit' is only resolved when the measured value falls below 1.45 mg/l. A transgression of the 'MIN limit' is only resolved when the measured value rises above 0.55 mg/l.

This lowers the limit transgression switching rate.

10.5.4 Dewpoint sensor (option)

The dewpoint sensor is correctly configured in the factory.

Therefore adjustments via the menu need only be made if a customer-supplied dewpoint sensor is to be used.

10.5.5 Control parameter

Plant off

Automatic control 28/09/2009 15:29:23

Control parameter

xp = 10% ▼ ▲

Tn = 10% ▼ ▲ ☐ Off

Tv = 10% ▼ ▲ ☐ Off

▶

Menu Start

Fig. 31

1. ➤ Press 'Control parameter' in the main menu.
⇒ The 'Control parameter' menu opens.
2. ➤ Press the [Next] key.
⇒ The next page of the 'Control parameter' menu for 'Dead zone', 'Additive basic load' and 'Interference value' opens, if the 'mA input 2' has been configured accordingly.

Plant off

Automatic control 28/09/2009 15:29:23

Control parameter

Dead zone +/- 0.20 mg/l

add. load 10% ☐ Off

Disturbance no disturbance 1

▶

Menu Start

Fig. 32

1 Field 1

Definitions

Control parameter

xp: - reciprocal proportional coefficient 100 %/ K_{PR}

Tn: - I-controller reset time (s)

Tv: - D-controller derivative action time (s)

If the control deviation is within then entered dead zone, the PID controller outputs the setpoint 0 %.

Control parameter

This would be: setpoint 0.50 mg/l actual value 0.45 mg/l dead zone 0.10 mg/l Setpoint 0 % output from the PID controller

Setpoint	0.50 mg/l
Actual value	0.45 mg/l
Dead zone	0.10 mg/l
output setpoint	0 %

Types of controller

There are the following types of controller:

- P controller: - The setpoint is directly proportional to the deviation of the actual value from the set point.
- PI controller: - In systems with continuous attrition a pure controller will never lead to the set point being achieved, as shortly before this point the setpoint is only just sufficient to compensate for the attrition, but to reach the set point. The I-part of the PI controller ensures that the setpoint is increased above that calculated by the P controller, should the set point not be reached within the reset time T_n .
- PD controller: - The PD controller compensates the inertia that occurs in the reaction to rapidly varying ratios. To do this, the controller determines the current speed of variation of the reading, and from this calculates the value that would result upon expiry of the derivative time T_v . The PD controller immediately sets the setpoint that the P controller would calculate from this future value.
- PID controller: - The PID controller combines all three functions.

Additive basic load

The set value is added to the setpoint calculated by the PID controller.

Additive basic load

PID controller calculates an setpoint of 75 %.

With a basic load of 10 % the system will show a total setpoint of 85 %.



The reader is referred to the relevant literature on controllers.

10.5.6 Gas Flow mode (optional)

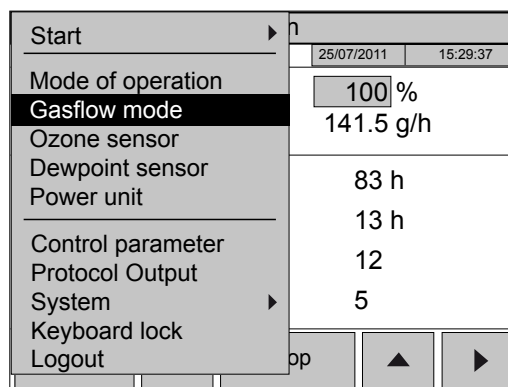


Fig. 33: Gas Flow mode (control valve)

The following operating modes can be selected for the control valve:

- 1 - 'Off'
- 2 - 'On' 'Operating mode' 'Manual'
- 3 - 'On' 'Operating mode' 'Flow'
- 4 - 'On' 'Operating mode' 'Concentration'

The process flow chart indicates the operating mode with pictograms:

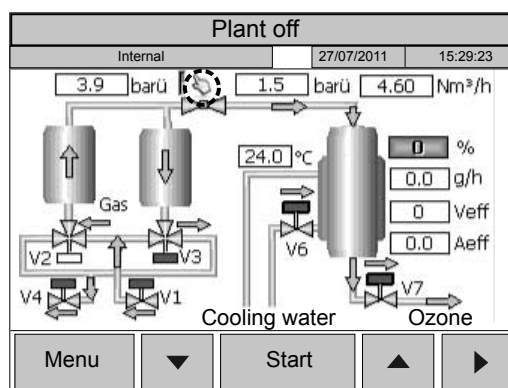
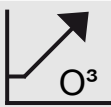


Fig. 34: Process flow chart with pictogram (in broken line circle) for the Manual operating mode. The vertical bar on the left indicates how widely the control valve is open.

Pictogram	Operating mode
	'Off'
	'On' 'Operating mode' 'Manual'
	'On' 'Operating mode' 'Flow'

Pictogram	Operating mode
	'On' 'Operating mode' 'Concentration'

The 'EXPERT' user can select all 4 operating modes by using the following menu window.

10.5.6.1 Off

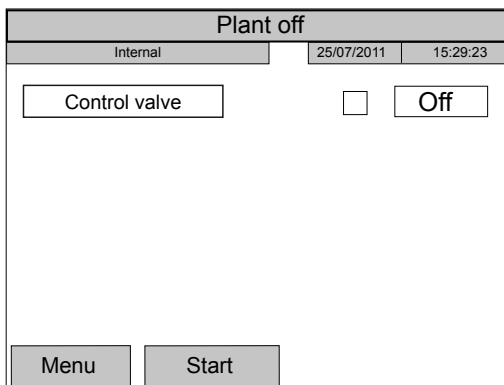


Fig. 35

The control valve is not operating and is closed – the gas flow is not controlled.

The gas flow can be adjusted with the needle valve, which is parallel to the control valve. This makes sense for testing purposes, or if the control valve is non-functional.

10.5.6.2 On, Operating mode Manual

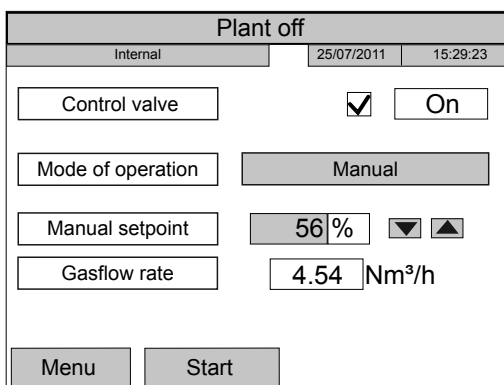


Fig. 36

The control valve is operating and can be manually adjusted via the control – the gas flow is not controlled.

The setpoint for the gas flow can be entered in the 'Manual setpoint' field. The 'Gas flow' field indicates the current gas flow.



The value must lie between 0 and 100% and relates to the position of the control valve and not to the gas flow.

10.5.6.3 On, Operating mode Flow

Plant off		
Internal	25/07/2011	15:29:23
Control valve	☒	On
Operating mode	Flow	
Gasflow rate setpoint	5.0 Nm ³ /h	
Gasflow rate	6.65 Nm ³ /h	
Menu Start		

Fig. 37

The control valve is operating – the gas flow is controlled.

The setpoint for the gas flow can be entered in the '*Gas flow setpoint*' field. The '*Gas flow*' field indicates the current gas flow in Nm³/h (standard cubic metres per hour).

Operation with a largely constant gas flow is possible in this operating mode. In this way, pressure changes in the raw water, which modify the gas flow in normal operation, can be largely corrected.



The value range for the possible inputs depends on the system type.

10.5.6.4 On, O3 Concentration operating mode

Plant off		
Internal	25/07/2011	15:29:23
Control valve	☒	On
Mode of operation	Concentration	
Concentration setpoint	25.0 g/Nm ³	
Gasflow rate	4.41 Nm ³ /h	
Setpoint	3.10 Nm ³ /h	
Menu Start		

Fig. 38

The control valve is operating – the O₃ concentration is controlled.

The setpoint for the ozone concentration can be entered in the '*Concentration setpoint*' field. The system control calculates the required setpoint for the '*Gas flow*' and displays it in the '*Setpoint*' field in g/Nm³ (grams per standard cubic metre).

The system control can set the desired ozone concentration so long as this is possible for the required ozone volume and the calculated gas flow is in the control range of the control valve. Otherwise the maximum ozone concentration under the existing conditions is set. @Fault message?



The value range for the possible inputs depends on the system type:

Oxygen systems OZMa_O_: 70 ... 150 g/Nm³

Air systems OZMa_A_: 18 ... 30 g/Nm³

In conventional operation without gas regulation, the output adjustment is achieved by reducing the ozone concentration at a constant gas flow.

Example of the benefits of gas regulation

Requirements:

The system type is OZMa 03A_ and is operated with air as the operating gas.

With the control variable 100%, the nominal ozone generation is 140 g/h.

At the nominal concentration of 20 g/Nm³ the gas flow must be 7 Nm³/h.

Operation without gas regulation:

For a control variable of 50% (70 g/h) and constant gas flow of 7 Nm³/h, the controller reduces the concentration from 20 g/Nm³ to 10 g/Nm³.

At this concentration, 1 bar of positive pressure and 20°C, the solubility limit of ozone in water is approx. 9.6 mg/l.

Under these conditions, the system requires **7 Nm³/h** for the ozone generation.

Operation with gas regulation:

The control reduces the gas flow via the control valve from 7 Nm³/h to 3.5 Nm³/h at a concentration setpoint of 20 g/Nm³.

At this concentration, 1 bar of positive pressure and 20°C, the solubility limit of ozone in water is approx. 19.2 mg/l.

Under these conditions, the system requires **3.5 Nm³/h** for the ozone generation.



If the ozone concentration deviates from the nominal concentration, then the maximum ozone volume that can be generated also deviates from the nominal generation.

10.5.7 Protocol Output

The protocol output can be configured from this menu.

10.5.8 System

10.5.8.1 Set time

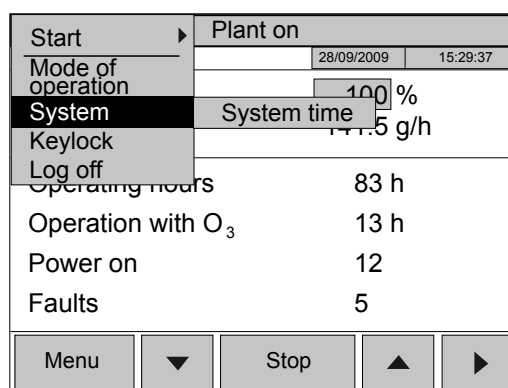


Fig. 39: "System Time" menu window

By using 'Menu → System → System time', the 'EXPERT' can set the 'Time'.

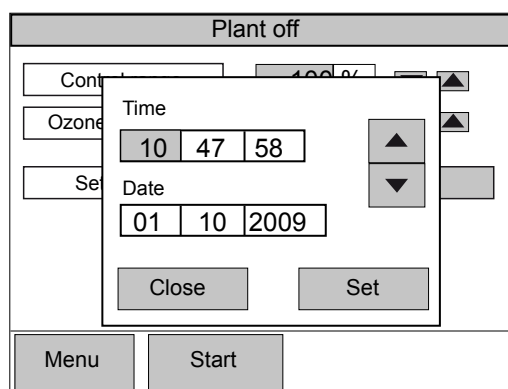


Fig. 40: Setting the Time

10.5.8.2 Record Data

The 'Record data (curr.)' menu contains the following:

Every morning, the touch panel control writes log data to the SD card which is inserted in it. If up-to-date log data is required for maintenance during the afternoon, then the user can trigger recording of the current data to the SD card by selecting 'Record data (curr.)'

10.5.9 Keyboard lock

The 'EXPERT' user can activate or deactivate the keyboard lock in this menu.

10.5.10 Info

Plant on		
Internal		24/06/2011 15:29:23
Type ☐ 01 ☒ 02 ☐ 03 ☐ 04 ☐ 05 ☐ 06	Interface Profibus ☐	Control ☐ 0 - Basis ☐ 1 - Ext. + Data logger ☐ 2 - Ext. + Save. + 2 AE + 1AA ☒ 3 - like 2 PID control
Gas type ☐ Air ☒ Oxygen		Additional options ☒ 0 - Without ☐ 1 - Dewpoint sensor ☐ 2 - Oxygen m. ☐ 3 - Dewp. and O2
Version 1.35 Date 04/10/2010 SN-TP 010586 SN-OZMa 4009800464		Energy options ☐ 0 - Without ☒ 1 - Gasflow rate ☐ 2 - Cooling water ☐ 3 - Gas + Cooling water
Menu Stop		

Fig. 41

This window shows the activated equipment of the OZMa and the versions for hardware and software.

10.5.11 Login - Logout

In this menu the operator can log in as an 'EXPERT' in order to make more low-level settings. Likewise he logs out from this menu, so that the adjustment options are again immediately blocked.

10.6 Functional Process

Once the system has been switched on for the first time by the main switch (1-23), the system is in 'System off' operating mode.

The system is ready for operation.

The system starts up operation with the [START] key if

- the 'PAUSE' mode has not been activated externally,
- the system has not been enabled by the existence of additional locking contacts (process water flow rate, gas detector)
- and there are no other faults.



When the system is commissioned for the first time, the required ozone volume ('Control variable' display) is pre-set to 0%.

If the system is now started by touching the [Start] key on the touch panel, then the system finds itself in normal operating mode, without the generation of ozone (high voltage switched off). The actuating variable must be at least 3% to switch on ozone generation.

10.7 Important System Statuses

10.7.1 "Start with Ozone Generation" Operating Status

The system is in 'Start with Ozone Generation' operating status, if

- it has not been switched by an external 'PAUSE' signal into the 'PAUSE' operating status,
- an actuating variable of greater than or equal to 3 % has been set,
- the system has not been stopped by touching the [STOP] key on the touch panel and
- there is no alert reporting a fault requiring acknowledgement displayed on the touch panel.

10.7.2 "Start without Ozone Generation" Operating Status

If a setpoint of less than 3 % has been set, the system operates in normal operating status:

- gas flow,
- cooling water flow
- and raw water flow are all present.
- The high voltage required for ozone generation is switched off, however, and no ozone is generated.
- In this operating status, the operating signal relay is not activated!

If the 'Setpoint' is increased to a display value of 3 % or more, then ozone generation will be switched on automatically without further action!

10.7.3 "Fault" Operating Status

Once a fault has occurred, the system will be switched to 'STOP' operating status by the control.

At the same time

- the gas inlet and outlet and
- the cooling water inlet will be closed by a solenoid valve and
- the high voltage required for ozone generation will be switched off.
- On the touch panel, a corresponding error message will appear in plain text - see  Chapter 12 'Troubleshooting' on page 82,
- The operating signal relay and the fault signal relay will be activated.

10.7.4 "Process Water Flow Rate Too Low" Operating Status

Should the system be locked by an external flow meter for process water and the flow rate of the process water be interrupted or fall below the minimum flow rate set on the meter, the control device switches the system to the operating status 'Stop'.

This status is a normal operating status. For this reason, the alarm signal relay will not be activated in this case, although the operating signal relay will drop out.

Once the process water flow rate is sufficiently high, the system will start up automatically without any further operation!

10.7.5 "Stop" Operating Status

The 'Stop' operating status can essentially be attained in two ways:

- A fault has occurred, which has stopped the system.
- The system has been stopped by touching the *[STOP]* key on the touch panel.

When the system switches to the 'Stop' operating status

- the gas inlet and outlet and
- the cooling water inlet are closed by a solenoid valve and
- the high voltage generation is switched off.

If the system was stopped by touching the *[STOP]* key, the following text is displayed in the touch panel status bar 'Plant off'.

If the 'STOP' operating status has been caused by a fault requiring acknowledgement, then an error message will appear in the status bar in plain text, the operating signal relay will be deactivated and the fault signal relay will be activated.

10.7.6 "Pause" Operating Status

The PAUSE contact input can be activated by a potential-free signal. In the 'Pause' operating status,

- the gas inlet and outlet,
- and the cooling water inlet of the system will be closed by a solenoid valve and
- the high voltage generation interrupted.

The status bar of the touch panel indicates 'PAUSE'. Once the PAUSE signal has been cleared, the system will run without further action in the operating status it was in before the PAUSE input was activated.

10.7.7 Behaviour Upon Switching on Power

The behaviour of the system when power is switched on is determined by the control (1-12). There are two options:

- The system wakes in "Stop" operating status and, once power has been switched on, has to be manually started by pressing the *[START]* key on the touch panel, independent of which operating status existed before mains power was switched on.
- The system wakes up in the mode that was active before power was switched on or before power failure. This means that the system control registers the current operating status, even in the event of a power failure. This affects
 - the preset 'actuating variable',
 - the status of the *[STOP]/[START]* key on the touch panel
 - and the fault status.

The system does not automatically start ozone generation, if, prior to mains power being switched off

- there was a fault requiring acknowledgement,
- the system was stopped by touching the *[STOP]* key on the touch panel.

Otherwise ozone generation will be automatically started with the preset setpoint as soon as power is switched on.

The system is preset by default to restart automatically when power is switched on.

If required, this can be changed in the system controller.

10.8 Display

10.8.1 Complete System

The following functions and displays can be seen in normal mode:

- The main system switch is set to ON,
- The fuse protection inside the system has not been triggered,
- The system primary pressure is within the permissible range,
- the pressure at the point of injection is within the permissible range,
- no faults are displayed on the touch panel.

10.9 Display Values on the Touch Panel

10.9.1 Control Variable in "Internal" Operating Mode

The required ozone volume can be set as a percentage using the actuating variable. In '*Internal*' operating mode, the value is set using the keys *[UP]* ▲ and *[DOWN]* ▼. A setting value of 100% corresponds to the maximum ozone volume (see Chapter 14 "Technical Data").

10.9.2 Setpoint in "External" Operating Mode (Option)

The setpoint is specified via a standard signal interface 0/4-20 mA. The type of interface, either 0-20 mA or 4-20 mA, can be selected.

10.9.3 Ozone Output

The display shows the approximate volume of ozone generated. The value displayed is calculated from the measured electrical values and is corrected to the value of the process air flow rate currently measured. There can be deviations between the displayed and actual value if

- the purity, dewpoint or temperature of the process gas is outside of the permissible range,
- the pressure in the ozone generators is outside the permissible range,
- the cooling water temperature or flow rate does not agree with the target values.

10.9.4 Gas flow rate

The gas flow rate currently measured through the ozone generator is displayed. The value in the display relates to standard conditions (air pressure 1013.25 mbar, temperature 0°C).

See chapter 14 "Technical Data" for the nominal system operating air flow rate.

10.9.5 Ozone generator pressure

The gas pressure for ozone generation is monitored by the pressure sensor (1-6) and displayed on the touch panel. The pressure relief valve (1-8) limits the pressure to non-critical values. The actual gas pressure in the ozone generator depends on the pressure of the process water at the point of injection, the back pressure of the pneumatic equipment (1-3, 1-5, 4-43) between the ozone inlet and the point of injection and the flow rate of the gas.

10.9.6 Cooling water

The display indicates the average temperature measured at the cooling water outlet of the ozone generator. The value is affected by the "setpoint", by the temperature at the cooling water inlet and by the cooling water flow rate.

10.9.7 Primary current

The display indicates the current flowing on the primary side of the high voltage transformer.

The displayed reading depends on the '*Control value*' set.

10.9.8 Primary voltage

The display indicates the voltage applied across the primary side of the high voltage transformer. The displayed measured value depends on the '*Control variable*' set and on the operating pressure displayed on the pressure sensor (1-6) in the system cabinet.

10.9.9 Status Page

The following values can be displayed here:

- Operating hours of the system with the main switch switched on,
- Operating hours with ozone generation,
- Number of mains power-ons,
- Number of error messages requiring acknowledgement.

10.9.10 Control range

The control range can be used to limit the ozone emission from the systems to lower levels or to influence the ozone range in external mode by external current signals.

Control range

In the 100% adjustment range, the ozone setting of 0 - 100% corresponds to the range 0 ... 140 g/h design.

In the 80% adjustment range, the ozone setting of 0 - 100% corresponds to the range 0 ... 112 g/h design.

The adjustment range can be set within a range of between 20% to 100%.

10.9.11 Ozone reduction in%

If the contact at the contact input for ozone reduction in the control is opened, the output of the system will be reduced by the percentage given in the ozone reduction field.

Ozone reduction in%

Ozone reduction 40%, setpoint 90%, ozone volume 140 g/l * 0.9 = 126 g/h, ozone reduction contact closed, generates an ozone volume of 126 g/h * (1.00 - 0.40) = 75.6 g/h when the contact is opened.

A timer can, for example, be connected to this input, with which night setback of the added ozone volume can be achieved.

10.9.12 "Internal" / "External" Operating Mode

The *[UP]* ▲ key and the *[DOWN]* ▼ key can be used to change the type of ozone generation rate setting here:

Internal - The ozone volume can be set in % steps in the '*Control variable*' display, as described above, using the keyboard.

External - The ozone volume is set using a normal signal interface connected to the 0-20 mA or 4-20 mA input.

A change of operating mode must be confirmed using the *[NEXT]* ► key.

If the operating mode is changed, the system changes automatically to '*STOP*' operating status and has to be restarted by the user.

10.9.13 0/4-20 mA

Should the ozone generation rate setting in the last display have been selected using a current interface, the type of the current interface can be set in this display

- 0-20 mA - current interface
- 4-20 mA - current interface

A change of operating mode must be confirmed using the *[NEXT]* ► key.

10.9.14 Language

Setting of another language in the pull-down menu can be carried out by customer service or the subsidiary:

- German
- English
- French
- Spanish
- Italian
- ... possible other languages

11 Maintenance



WARNING!

Only allow qualified personnel and personnel authorised by ProMinent to perform maintenance and repair work on the system.

Persons are deemed to be qualified, who have adequate knowledge in the field of ozone generation systems, owing to their technical training and experience, and who are sufficiently conversant with current occupational health and safety laws, accident prevention regulations, guidelines and general technical regulations of the relevant country, that they can correctly assess the condition of an ozone generation system in terms of safety.

All guarantee and liability claims on the part of the system operator will not be admitted following interference by unauthorised personnel.

11.1 Safety Guidelines for Maintenance and Repair

- Only allow service technicians to service or repair the system.
- Ensure that persons, who undertake maintenance and repair work on the system, have read and understood the operating instructions and in particular the chapter relating to "Safety".
- For reasons of safety, when the system is idle, ensure that the mains switch is switched off as a matter of principle if protection devices are opened. Ensure that appropriate measures are put in place to ensure that the system cannot be inadvertently switched on and operated in this state.

Even after the OZONFILT® OZMa has been switched off at the mains switch, parts of the electrical system inside the control cabinet are still live. Wait at least 5 minutes after the power supply to the OZONFILT® OZMa has been interrupted before undertaking any work inside the cabinet.

Should safety equipment have to be removed to perform adjustment, maintenance or repair work, ensure that it is refitted and check directly after completion of the work that this equipment is fulfilling its function properly.

- Ensure that pipes are at normal pressure and ozone-free before work can be undertaken on gas pipework. Ensure when depressurising oxygen carrying pipes that personnel are not endangered by the oxygen.
- Only use original spare parts for maintenance and repair.
- Regular inspection and maintenance is essential for the safe and proper operation of the system and prevents the system from malfunctioning.

11.2 Routine Inspection

The following table outlines recommended routine inspections, which OZONFILT® OZMa 1-6 systems should undergo. Keep a written account of all maintenance and inspection work undertaken. A template for this record can be found in the Appendix. Keep a logbook for the system.

OZMA display values	Value	Unit	Remark	Interval
Control variable (ozone)		%		daily
Ozone output (generation rate)		g/h		daily
Gas flow rate		l/h		daily
Cooling water (outlet temperature)		°C		daily
Control range (ozone)		%		daily
Mains voltage		V		daily
Mains current		A		daily
Primary voltage		V		daily
Primary current		A		daily
Operating hours		h		daily
Operating hours with ozone		h		daily
Power ons		-		daily
Error messages		-		daily
Other parameters				
Cooling water flow		l/h		daily
Pressure on drying unit		bar		daily
Ozone generator pressure	Less than 2.0	bar		daily
Miscellaneous checks				
Check the filter mats in the ozone cabinet		-	depending on ambient conditions	monthly
Inspection of the non-return valves (11, 37) at the ozone outlet		-	depending on raw water quality	monthly

**CAUTION!**

Blocked filter mats in the fan or in the outlet air filters can result in the control cabinet overheating, whereupon the control device will trigger the system to shut down with the fault alert "System temperature too high". In the worst case, overheating could damage components of the system.

11.3 Regular Maintenance

**WARNING!**

Observe the safety guidelines for maintenance - Chapter 11.1 'Safety Guidelines for Maintenance and Repair' on page 78.



CAUTION!

Service the OZONFILT® OZMa 1- 6 at least once per year to maintain the correct and proper operation of the system.

Standard maintenance measures for the OZONFILT® OZMa 1-6 are as follows:

Interval	Maintenance work
weekly*	Only with maintenance unit: Check the liquid level of the maintenance unit tanks - see 'Maintenance of the air-conditioning unit (optional)' on page 80.
	Only with maintenance unit: Check the filter elements of the maintenance unit - see 'Maintenance of the air-conditioning unit (optional)' on page 80.
every 3 months	Only with air-conditioning unit - see operating instructions for air-conditioning unit.
every 6 months	Only with air-conditioning unit - see operating instructions for air-conditioning unit.
at least annually	Check the pneumatic system (leaks, hoses)
	Check (leaks, deposits, hoses) and possibly clean the cooling water system
	Check the operation of the solenoid valves and pressure relief valves in the gas and cooling water system
	Replace the non-return valves (1-11, 4-37) at the ozone outlet
	Replace the solenoid valve (1-5) at the ozone outlet
	Replace the PTFE hoses at the outlets of the ozone generators
	Check the operation of the electrical system (locks, system parameters etc.)
	Replace the filter mats in the ozone cabinet



CAUTION!

Inspect fan filter mats and air outlet filters monthly and replace them at least once per year and more often under unfavourable conditions.

Maintenance of the air-conditioning unit (optional)



CAUTION!

The system can be seriously damaged if condensate occurs in the connecting hose between the maintenance unit and the system internals.

- Immediately stop the system and shut it down.
- Call Service or expert personnel authorised by ProMinent.



CAUTION!

Read the operating instructions for the maintenance unit.

The maintenance unit is on the outside of the OZONFILT®.

If there is condensate in a maintenance unit tank, then empty the tank manually.

Replace the maintenance unit filter elements if they are seriously dirty (visible from outside).

Maintenance of the air-conditioning unit (optional)

Read the operating instructions for the air-conditioning unit with identity code design "System design"-"C".

12 Troubleshooting



WARNING!

- Disconnect the system from the supply voltage before beginning work on the OZONFILT® OZMa for troubleshooting or to remedy faults.
- Wait at least 5 minutes after the system has been disconnected from the mains/power supply before touching components inside the cabinet. Ensure that the system cannot accidentally be reconnected to the mains while work on the system is being carried out.



WARNING!

- For safety reasons, only allow appropriately qualified technical personnel to inspect this system.
- Prior to working on the OZONFILT® OZMa, always read the safety notes in the "Safety" chapter.



WARNING!

Should the ozone gas system have to be opened, extract the ozone safely from the gas pipes.

- Either wait for 24 hours until the ozone has decomposed naturally
- Run the system with "Production" "0" for 10 minutes so that the ozone is forced out - do not forget the ozone in the external piping!
- Or pressurise the ozone out of the system using compressed air applied to the gas inlet. Once again here, do not forget the ozone in the external piping!

The faults listed in the table -  *Table on page 84* - will lead to the system being switched off.

The time delay between detection of the fault and shut-down of the system, will depend on the type of fault. During this delay period, the associated fault alert will flash at the bottom. The system will shut down in stages:

- 1 - The high voltage section is switched off first. The system will continue to run for some time without ozone being generated. During this period, residual ozone will be transported out of the generator.
- 2 - Thereafter solenoid valves will isolate the system pneumatically and hydraulically (gas inlet, gas outlet, cooling water inlet) from the remaining system.
- 3 - The touch panel will display a fault alert giving the cause of the fault.

The control monitors every analogue measured variable within the system at different stages. There is generally a warning threshold and a switching-off threshold.

If a 'warning threshold' is transgressed, the controller displays a warning message on the touch panel - the system continues to run.

If a *'switching-off threshold'* is transgressed, the controller displays a fault alert on the touch panel and switches the system off.

With digital variables, it switches the system off when the limit value set on the sensor is transgressed.

The "alarm delay" is the time period between a fault being detected and the system being switched off. It is based on the type of limit value transgression. Once the system has been switched off, the fault indicating relay will be activated and the operating signal relay will be deactivated.

Once the system has been switched on or started, all faults will be ignored for a certain time - for the duration of the so-called *'switch-on delay'*. The switch-on delay is also based on the type of fault.

Following the so-called *'Restart delay'*, the system tries to automatically restart the system with certain variables once a fault has been detected. This status is displayed by the controller on the touch panel with *'Restart in xxx sec'*. In doing so it activates the fault indicating relay for this period. Once the system has attempted to switch itself on again, it deactivates the fault indicating relay during the switch-on delay and alarm delay. Should the fault still exist after the programmed number of restart attempts, then the system will finally switch off and the fault indicating relay will remain activated. Otherwise the system will automatically restart.

The control archives all faults with their date and time in a file on the memory card in the touch panel.

It also updates the counter on the status page accordingly.

To acknowledge a fault, press *[STOP]* / *[Start]*.

To restart the system press this key again.

Following a fault, the control shuts down the system in stages:

- 1 - The high voltage is switched off.
The system continues to run for some time without ozone being generated, removing residual ozone from the system.
- 2 - All the solenoid valves on the pneumatic branch close.
- 3 - After a post-rinse period, the solenoid valve on the cooling water inlet also closes.
- 4 - The relevant fault alert appears on the touch panel.

Error no.*	Error message	Switch-off due to...	Cause	Remedy
1	Gas flow too low	Gas flow sensor	The operating gas flow through the ozone generator is too low.	Check the system priming pressure and increase if necessary. Check for too high back pressure in the ozone generator, if necessary, reduce the process water pressure. Check the solenoid valves in the gas branch for correct operation. Correct the gas flow at the needle valve (6).
1	Gas flow too high	Gas flow sensor	The operating gas flow through the ozone generator is too high.	Check the system priming pressure and reduce if necessary. Check for too low back pressure in the ozone generator, if necessary, increase the process water pressure. Correct the gas flow at the needle valve (6).
2	Ozone pressure too low	Operating pressure sensor on ozone generator	The ozone generator operating pressure is too low.	Increase the pressure in the process water or install a back pressure valve at the ozone outlet.
2	Ozone pressure too high	Operating pressure sensor on ozone generator	The ozone generator operating pressure is too high.	Check the gas system for blockages. Set the pressure of the process water so that the maximum pressure at the outlet of the ozone generator does not exceed 2.0 bar.
3	System priming pressure too low	Gas preparation unit operating pressure sensor	The operating pressure at the system inlet is too low.	Increase the system priming pressure at the pressure regulating valve (27). Clean the filter unit in the compressed air system, if necessary replace the filter cartridges.
3	System priming pressure too high	Gas preparation unit operating pressure sensor	The operating pressure at the system inlet is too high.	Reduce the system priming pressure at the pressure regulating valve (27).
4	Cooling water temperature too low	Temperature sensor at cooling water outlet	Cooling water temperature below 5 °C	Increase the water temperature at the cooling water inlet.
4	Cooling water temperature too high	Temperature sensor at cooling water outlet	Cooling water temperature higher than 45 °C	Reduce the water temperature at the cooling water inlet or increase the flow rate.
5	Primary current too low	Measurement of the primary current at the power unit	The current through the primary coil of the HV transformer is too low.	Check the supply voltage to the power unit. Check the connection between the HV transformer and the power unit.
5	Primary current too high	Measurement of the primary current at the power unit	The current through the primary coil of the HV transformer is too high.	Check the power unit, the HV transformer and the ozone generator.

Error no.*	Error message	Switch-off due to...	Cause	Remedy
6, 32	Primary voltage too low or dynamic primary voltage too low	Measurement of the primary voltage at the power unit	The voltage drop across the primary coil of the HV transformer is too low.	Check the connections between the power unit output and the primary side of the HV transformer for breaks. Increase the pressure in the process water. Clear any defects which may exist in the ozone generator or the HV transformer.
6, 32	Primary voltage too high or dynamic primary voltage too high	Primary voltage measurement	The voltage drop across the primary coil of the HV transformer is too high.	The process water pressure is too high. Set the pressure so that the maximum pressure at the outlet of the ozone generator does not exceed 2.0 bar.
7	Mains voltage too low	Measurement of the mains voltage at the power unit	Mains voltage too low	The circuit breaker (1-53) has tripped - reset the circuit breaker, increase the mains voltage if necessary.
7	Mains voltage too high	Measurement of the mains voltage at the power unit	Mains voltage too high	Reduce the mains voltage value using suitable measures.
8	Dewpoint too high	Dewpoint sensor (option)	Operating gas too moist or too hot	Check the operating gas temperature and the ambient temperature. OZMa A only: Arrange for Service to check the drying system.
9	Oxygen content too low	Oxygen sensor (optional)	Oxygen content too low	Check oxygen generator operation.
11	System temperature too high	Temperature sensors in the control cabinet	The temperature in the control cabinet or the HV transformer temperature is too high.	Check the control cabinet fan for correct operation. Clean the fan filter. Lower the ambient temperature, e.g. by fitting an air-conditioning system. Set a lower ozone output. Only with air-conditioning unit: Check that the air-conditioning unit is operating correctly.
12	Cooling water flow rate too low	Cooling water flow meter	Cooling water flow is below the minimum level	Check the cooling water priming pressure and increase if necessary. Check the cooling system pipes outside and within the cabinet for deposits which could be leading to blockages - clear if necessary. Raise the cooling water flow at the angle valve (9) and check the solenoid valve on the cooling water inlet for correct operation. Install a pressure regulator with filter upstream of the cooling water inlet outside the control cabinet.

Error no.*	Error message	Switch-off due to...	Cause	Remedy
13	Ozone alarm!!	Ozone detector	Ozone gas leak	Read the safety information before entering the room. Under no circumstance restart the system before the cause of the ozone alarm has been located and eliminated. Locate and seal the ozone gas leak.
14	Water flow rate too low	Raw water flow meter	Process water flow is below the minimum level	If a flow detector is installed, the system automatically restarts as soon as the process water flow increases above the set lower limit value. The alarm relay is not activated!
19	Control deviation, control valve too high	-	Gas flow deviates too greatly from the set-point.	Check the ozone gas line and fittings for flow. Check the control valve and its control.
21	Power unit: PFC voltage too low or power unit:PFC voltage too high	DC voltage control at the power unit	The link DC voltage from the power unit falls outside its limit values	Stabilise the system's mains voltage. If necessary, replace the power unit.
25	Power unit: Temperature too high	Temperature measurement at the power unit	The temperature of some components on the power unit is too high.	Check the control cabinet fan for correct operation. Clean the fan filter. Lower the ambient temperature, e.g. by fitting an air-conditioning system. Set a lower ozone output.
27	Power unit without voltage	Voltage monitoring at the power unit	The power supply to the power unit is broken.	The circuit breaker (1-53) has tripped - reset the circuit breaker, increase the mains voltage if necessary. The connection between the communication PCB and the power unit is broken. Check the connection and replace the connection elements as necessary.
28	Control 24 V supply has failed	Control supply voltage monitoring unit	The supply voltage to the control inputs has been lost.	Check the micro fuses on the communication PCB and replace as necessary. Replace the communication PCB.
31	Cabinet door open!!	Door switch monitoring mechanism	The contact in the door switch has triggered	Close the control cabinet door.
33	Check the drying unit pressure sensor	Drying unit pressure sensor	Sensors are not connected or are emitting an implausible analogue signal.	Check the sensor connection cable, check the analogue signals, if necessary replace the connection cable or the sensors.
34	Check the O3 generator pressure sensor	Ozone pressure sensor		
35	Check the flow sensor!!	Gas flow sensor		

*) program-internal numbering

13 Technical Data



WARNING!

Risk of personal injuries

Please observe the "Supplement for modified version" at the end of the chapter!

It replaces and supplements the technical data!

13.1 Complete System

Ambient parameters

Data	Value	Unit
Max. temperature	40	°C
Relative humidity, max *	85	%

* non-condensing

Air quality: dust-free, non-corrosive

OZMa 1-3 A (air as operating gas)

Ozone generation systems	Unit	OZMa 1 A	OZMa 2 A	OZMa 3 A
Ozone generation systems				
Number of generation modules	-	1	1	1
Ozone output measured according to DIN standards for air: 20°C, Cooling water: 15°C	g/h	70	105	140
Air requirement (only ozone generation)	Nm ³ /h,	3.5	5.25	7.0
Ozone concentration in the gas phase based on standard conditions	g/Nm ³ *)	20	20	20
Specific energy requirement at nominal power	Wh/g	16.5	16.5	16.5
Min. power factor at full capacity	cos φ	> 0.95	> 0.95	> 0.95
Ozone connection		G 3/8" internal thread	G 3/8" internal thread	G 3/8" internal thread
Max. sound pressure level		less than 70 dB (A)	less than 70 dB (A)	less than 70 dB (A)
Electrical connections				
Mains connected load	V / Hz / A	230 / 50; 60 / 10	230 / 50; 60 / 16	230 / 50; 60 / 16
Degree of protection				
without air-conditioning		IP 54	IP 54	IP 54
with air-conditioning		To the inside: IP 54 To the outside: IP 34	To the inside: IP 54 To the outside: IP 34	To the inside: IP 54 To the outside: IP 34

Technical Data

Ozone generation systems	Unit	OZMa 1 A	OZMa 2 A	OZMa 3 A
Overall dimensions (without mixing unit)				
Width	mm	1114	1114	1114
Height	mm	1961	1961	1961
Depth	mm	400	400	400
Weight				
Weight approx.	kg	270	280	300
Ozone mixing unit				
Max. raw water temperature	°C	35	35	35
Permissible pressure at ozone outlet	bar	0.8 - 2.0	0.8 - 2.0	0.8 - 2.0
Air supply				
Max. required air volume	l/min	73	110	147
Air quality	Residual oil content < 0.01 mg/m³, dust-free – max. particle size < 0.01 µm, non-corrosive, constant priming pressure of 4 - 10 bar **			
Cooling water				
Cooling water requirement (15°C)	l/h	90	135	180
Cooling water requirement (30°C)	l/h	125	190	250
Cooling water inlet pressure***	bar	2 - 5	2 - 5	2 - 5
Cooling water inlet, PE pressure hose	mm	8 x 5	8 x 5	12 x 9
Cooling water drain, free flow	mm	8 x 5	8 x 5	12 x 9
Cooling water quality	No tendency to form lime scale, no corrosive components; sedimentation substances: less than 0.1 ml; iron: less than 0.2 mg/l; manganese: less than 0.05 mg/l; conductivity: greater than 100 µS/cm; chloride: less than 250 mg/l			

*) Nm³ = m³ under normal conditions (p = 1.013 x 10⁵ Pa, T = 273 K)

**) attainable using maintenance unit (option)

***) 2 bar only with a free outlet directly at the system

OZMa 4-6 A (air as operating gas)

Ozone generation systems	Unit	OZMa 4 A	OZMa 5 A	OZMa 6 A
Ozone generation systems				
Number of generation modules	-	2	2	3
Ozone output measured according to DIN standards for air: 20°C, Cooling water: 15°C	g/h	210	280	420
Air requirement (only ozone generation)	Nm ³ /h,	10.50	14.00	21.00

Ozone generation systems	Unit	OZMa 4 A	OZMa 5 A	OZMa 6 A
Ozone concentration in the gas phase based on standard conditions	g/Nm ³ *)	20	20	20
Specific energy requirement at nominal power	Wh/g	16.5	16.5	16.5
Min. power factor at full capacity	cos φ	> 0.95	> 0.95	> 0.95
Ozone connection		G 3/8" internal thread	G 3/8" internal thread	G 3/8" internal thread
Max. sound pressure level		less than 70 dB (A)	less than 70 dB (A)	less than 70 dB (A)
Electrical connections				
Mains connected load	V / Hz / A	400 / 50; 60 / 16	400 / 50; 60 / 16	400 / 50; 60 / 16
Degree of protection				
without air-conditioning		IP 54	IP 54	IP 54
with air-conditioning		To the inside: IP 54 To the outside: IP 34	To the inside: IP 54 To the outside: IP 34	To the inside: IP 54 To the outside: IP 34
Overall dimensions (without mixing unit)				
Width	mm	1314	1314	1606
Height	mm	1961	1961	1961
Depth	mm	600	600	600
Weight				
Weight approx.	kg	420	445	580
Ozone mixing unit				
Max. raw water temperature	°C	35	35	35
Permissible pressure at ozone outlet	bar	0.8 - 2.0	0.8 - 2.0	0.8 - 2.0
Air supply				
Max. required air volume	l/min	220	293	440
Air quality	Residual oil content < 0.01 mg/m ³ , dust-free – max. particle size < 0.01 μm, non-corrosive, constant priming pressure of 4.5 - 10 bar **			
Cooling water				
Cooling water requirement (15°C)	l/h	270	360	540
Cooling water requirement (30°C)	l/h	300	400	600
Cooling water inlet pressure***	bar	2 - 5	2 - 5	2 - 5
Cooling water inlet, PE pressure hose	mm	12 x 9	12 x 9	12 x 9

Technical Data

Ozone generation systems	Unit	OZMa 4 A	OZMa 5 A	OZMa 6 A
Cooling water drain, free flow	mm	12 x 9	12 x 9	12 x 9
Cooling water quality	No tendency to form lime scale, no corrosive components; sedimentation substances: less than 0.1 ml; iron: less than 0.2 mg/l; manganese: less than 0.05 mg/l; conductivity: greater than 100 µS/cm; chloride: less than 250 mg/l			

*) Nm³ = m³ under normal conditions (p = 1.013 x 10⁵ Pa, T = 273 K)

**) attainable using maintenance unit (option)

***) 2 bar only with a free outlet directly at the system

OZMa 1-3 O (oxygen as operating gas)

Ozone generation systems	Unit	OZMa 1 O	OZMa 2 O	OZMa 3 O
Ozone generation systems				
Number of generation modules	-	1	1	1
Nominal power at 100 g/Nm ^{3**} and cooling water: 15°C	g/h	105	158	210
Ozone output at 150 g/Nm ^{3*}	g/h	60	90	120
Ozone output at 80 g/Nm ³	g/h	123	184	245
Specific energy requirement at nominal power	Wh/g	9	9	9
Min. power factor at full capacity	cos φ	> 0.95	> 0.95	> 0.95
Ozone connection		G 3/8" internal thread	G 3/8" internal thread	G 3/8" internal thread
Max. sound pressure level		less than 70 dB (A)	less than 70 dB (A)	less than 70 dB (A)
Electrical connections				
Mains connected load	V / Hz / A	230 / 50; 60 / 10	230 / 50; 60 / 16	230 / 50; 60 / 16
Degree of protection				
without air-conditioning		IP 54	IP 54	IP 54
with air-conditioning		To the inside: IP 54 To the outside: IP 34	To the inside: IP 54 To the outside: IP 34	To the inside: IP 54 To the outside: IP 34
Overall dimensions (without mixing unit)				
Width	mm	1114	1114	1114
Height	mm	1961	1961	1961
Depth	mm	400	400	400
Weight				
Weight approx.	kg	220	230	250
Ozone mixing unit				

Ozone generation systems	Unit	OZMa 1 O	OZMa 2 O	OZMa 3 O
Max. raw water temperature	°C	35	35	35
Permissible pressure at ozone outlet	bar	0.8 - 2.0	0.8 - 2.0	0.8 - 2.0
Specification of operating gas - oxygen				
Gas volume at nominal power 100 g/Nm ³	Nl ³ /h	1050	1580	2100
Gas volume at 150 g/Nm ³ output	Nl ³ /h	400*	600*	800*
Gas volume at 80 g/Nm ³ output	Nl ³ /h	1540	2300	3100
Concentration min.	vol%	90	90	90
Max. dewpoint	°C	-50	-50	-50
Pressure	bar	3 ... 6	3 ... 6	3 ... 6
Max. particles	µm	5	5	5
Max. hydrocarbons	ppm	20	20	20
Temperature	°C	5 ... 30	5 ... 30	5 ... 30
Cooling water				
Cooling water requirement (15°C)	l/h	70	105	140
Cooling water requirement (30°C)	l/h	115	175	230
Cooling water inlet pressure***	bar	2 ... 5	2 ... 5	2 ... 5
Cooling water inlet, PE pressure hose	mm	8 x 5	8 x 5	12 x 9
Cooling water drain, free flow	mm	8 x 5	8 x 5	12 x 9
Cooling water quality	No tendency to form lime scale, no corrosive components; sedimentation substances: less than 0.1 ml; iron: less than 0.2 mg/l; manganese: less than 0.05 mg/l; conductivity: greater than 100 µS/cm; chloride: less than 250 mg/l			

*) Output of 150 g/Nm³ must be factory configured as a non-standard design

*) Nm³ = m³ under normal [standard] conditions (p = 1.013 x 10⁵ Pa, T = 273 K)

***) 2 bar only with a free outlet directly at the system

OZMa 4-6 O (oxygen as operating gas)

Ozone generation systems	Unit	OZMa 4 O	OZMa 5 O	OZMa 6 O
Ozone generation systems				
Number of generation modules	-	2	2	3

Technical Data

Ozone generation systems	Unit	OZMa 4 O	OZMa 5 O	OZMa 6 O
Nominal power at 100 g/ Nm ³ ** and cooling water: 15°C	g/h	320	420	630
Ozone output at 150 g/Nm ³ *	g/h	180	240	360
Ozone output at 80 g/Nm ³	g/h	370	490	735
Specific energy requirement at nominal power	Wh/g	9	9	9
Min. power factor at full capacity	cos φ	> 0.95	> 0.95	> 0.95
Ozone connection		G 3/8" internal thread	G 3/8" internal thread	G 3/8" internal thread
Max. sound pressure level		less than 70 dB (A)	less than 70 dB (A)	less than 70 dB (A)
Electrical connections				
Mains connected load	V / Hz / A	400 / 50; 60 / 16	400 / 50; 60 / 16	400 / 50; 60 / 16
Degree of protection				
without air-conditioning		IP 54	IP 54	IP 54
with air-conditioning		To the inside: IP 54 To the outside: IP 34	To the inside: IP 54 To the outside: IP 34	To the inside: IP 54 To the outside: IP 34
Overall dimensions (without mixing unit)				
Width	mm	1314	1314	1314
Height	mm	1961	1961	1961
Depth	mm	600	600	600
Weight				
Weight approx.	kg	320	345	415
Ozone mixing unit				
Max. raw water temperature	°C	35	35	35
Permissible pressure at ozone outlet	bar	0.5 - 2.0	0.5 - 2.0	0.5 - 2.0
Specification of operating gas - oxygen				
Gas volume at nominal power 100 g/Nm ³	NI ³ /h	3200	4200	6300
Gas volume at 150 g/Nm ³ output	NI ³ /h	1200*	1600*	2400*
Gas volume at 80 g/Nm ³ output	NI ³ /h	4630	6130	9190
Concentration min.	vol%	90	90	90
Max. dewpoint	°C	-50	-50	-50
Pressure	bar	3 ... 6	3 ... 6	3 ... 6
Max. particles	µm	5	5	5
Max. hydrocarbons	ppm	20	20	20

Ozone generation systems	Unit	OZMa 4 O	OZMa 5 O	OZMa 6 O
Temperature	°C	5 ... 30	5 ... 30	5 ... 30
Cooling water				
Cooling water requirement (15°C)	l/h	200	280	420
Cooling water requirement (30°C)	l/h	300	400	600
Cooling water inlet pressure***	bar	2 ... 5	2 ... 5	2 ... 5
Cooling water inlet, PE pressure hose	mm	12 x 9	12 x 9	12 x 9
Cooling water drain, free flow	mm	12 x 9	12 x 9	12 x 9
Cooling water quality	No tendency to form lime scale, no corrosive components; sedimentation substances: less than 0.1 ml; iron: less than 0.2 mg/l; manganese: less than 0.05 mg/l; conductivity: greater than 100 µS/cm; chloride: less than 250 mg/l			

*) Output of 150 g/Nm³ must be factory configured as a non-standard design

*) Nm³ = m³ under normal [standard] conditions (p = 1.013 x 10⁵ Pa, T = 273 K)

***) 2 bar only with a free outlet directly at the system

13.2 OZMa Electrical Inputs and Outputs

Power supply to the system

OZMa 1-3

Data	Value	Unit
Mains supply frequency	50/60	Hz
Nominal voltage*	230	V _{eff}

Connection to L1, N, PE

* +/- 10%

OZMa 4-6

Data	Value	Unit
Mains supply frequency	50/60	Hz
Nominal voltage*	400	V _{eff}

Connection to L1, L2, L3, N, PE

* +/- 10%

Fuses

Communication circuit board (1-14): Micro fuse 5 x 20 mm

Description	Type	Supplied . .	Terminals	Order no.
F1	3.15 ATT	Relay outputs for solenoid valves	X5: 1-12, X6: 1-10	712069
F2	0.63 AT	Communication PCB, internal	-	712030
F3	0.63 AT	Power supply for the control inputs and outputs	-	712030

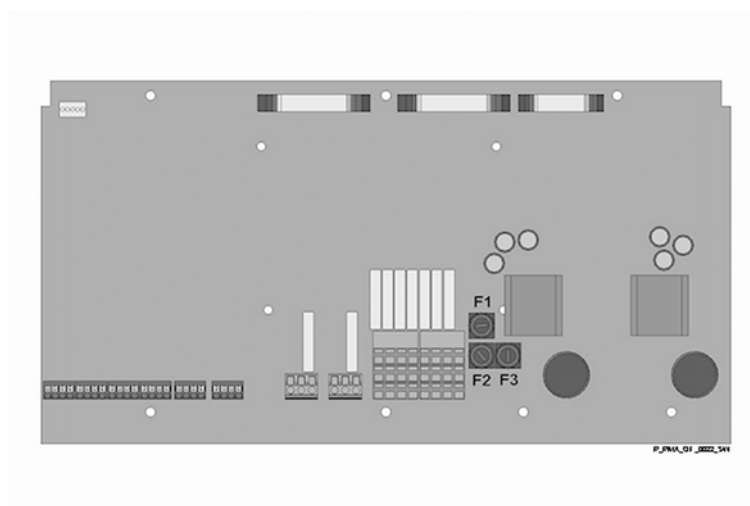


Fig. 42: Position of fuses on the communication circuit board

Mains/power supply PCB (1-16): Micro fuse 5 x 20 mm

Description	Type	Supplied . .	Terminals	Order no.
F4	0.63 AT	Main supply to control	-	712030
F5	0.63 AT	Touch panel and external sensors	-	712030

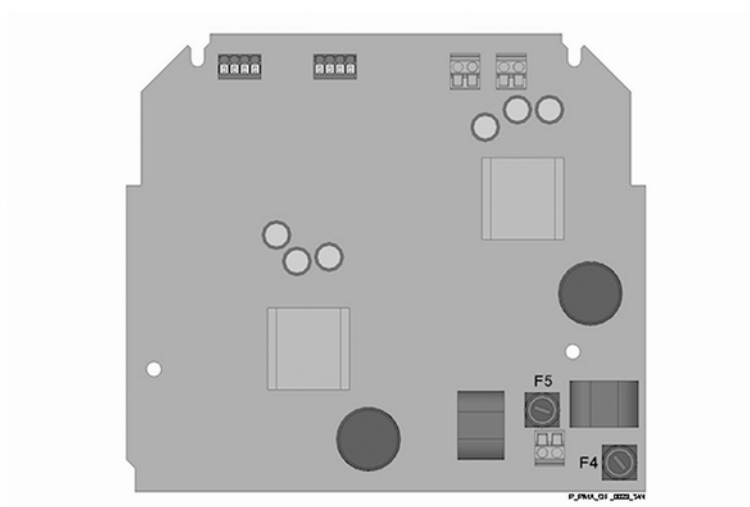


Fig. 43: Position of fuses on the mains/power supply PCB

Inputs

Contact inputs

Pause (X3: 7,8), Power reduction (X3: 9.10):

Data	Value	Unit
Open circuit voltage*	12	V
Short circuit current	6	mA

* +/- 1 V

Contact open

Data	Value	Unit
Resistance R	> 50	kΩ

Contact closed

Data	Value	Unit
Resistance R	< 1	kΩ

Ozone warning device (X3: 13.14), Raw water flow monitor (X4: 10.11):

Data	Value	Unit
Open circuit voltage*	24	V
Short circuit current	6	mA

* +/- 2 V

Contact open

Data	Value	Unit
Resistance R	> 50	kΩ

Contact closed

Data	Value	Unit
Resistance R	< 1	kΩ

Standard signal inputs (mA):

Standard signal input 1 (control variable or ozone sensor, X3: 15,16,17)

Standard signal input 2 (interference variable or external setpoint, X3: 20,21,22)

Data	Value	Unit
Current range**	0/4 ... 20	mA
Supply voltage* for passive sensors	24	V
Current for passive sensors, max.	30	mA
Load	< 150	Ω

* +/- 2 V

** isolated from system ground

Outputs**Relay**

Collective alarm (X4: 1,2,3), Ozone operating status (X4: 4,5,6),
Ozone limit value (X4: 7,8,9)

Type of contact: Changeover contact

Data	Value	Unit
Load capacity*	100	VA

* at 250 V_{eff} / 3 A

Ozone limit value (X4: 7,8,9)

Type of contact: Changeover contact

Data	Value	Unit
Load capacity*	100	VA

* at 250 V_{eff} / 3 A

Standard signal output (mA)

Protocol output (X3: 25.26)

Data	Value	Unit
Current range**	0/4 ... 20	mA
Load	< 500	Ω
Precision	+/- 0.8	%
Destruction limit against externally applied voltage	16	V

** isolated from system ground

13.3 Supplementary information for modified designs

(With identity code specification "Design": "M - modified")

Technical Data

The technical data for modified system designs can deviate from that of standard systems. It can be found in the document folder supplied.

Spare parts

With a modified design, the ordering information for spare and wear parts can be found in the documentation folder supplied.

14 Accessories

14.1 Classification

Compulsory accessories

- Ozone detector

Recommended accessories (available on request)

- Oxygen detector
- Mixing unit with non-return valve
- Residual ozone destruction unit
- Oxygen Supply
 - System for enriching oxygen from ambient air and compressor or
 - Oxygen bottles or
 - Evaporation system for liquid oxygen
- Reaction chamber with air vent

14.2 Description

Ozone detector

The ozone detectors type GMA 36 Ozone are designed as compact measuring and switching units for monitoring the ambient air for hazardous concentrations of ozone.

Accessories	Order no.
Gas detector type GMA 36 ozone	1023155
Replacement sensor for chlorine, chlorine dioxide, ozone	1023314

Oxygen detector

The oxygen detectors type GMA 36 Oxygen are designed as compact measuring and switching units for monitoring the ambient air for hazardous concentrations of oxygen.

Accessories	Order no.
Gas detector type GMA 36 (oxygen)	1023971
Replacement sensor for oxygen	1023851

Mixing equipment

The static helical mixers made of PVC or stainless steel are designed for intensive mixing of gas with liquid flows. 4 helical blades ensure optimum mixing of the ozone with minimal pressure loss (0.1 bar per blade at maximum flow rate). The specified flow range of the static helical mixer should be observed to achieve optimum mixing results.

Design with loose flanges in line with DIN 2501 and an integral stainless steel injection point with a threaded connector for stainless steel pipe Ø12 mm or PTFE tube 12/9 mm using stainless steel support sleeves. The injection point should also be fitted with a non-return valve to protect the ozone system from back flowing water. The mixers are delivered in a grease-free state and are thus also suitable for use with types OZMa 1-3 O. The stainless steel version has a G 1/4" manometer connection at the mixing point of the ozone.

Tab. 2: Material PVC-U

Flow	Length	Connector	Order no.
m ³ /h	mm		
5 – 10	718	DN40	1024324
10 – 15	718	DN50	1024325
15 – 25	718	DN65	1024326
25 – 35	1100	DN80	1024327
35 – 50	1100	DN100	1024328
50 – 90	1300	DN125	1034641
90 – 160	1700	DN150	1034640

Tab. 3: Material 1.4404

Flow	Length	Connector	Order no.
m ³ /h	mm		
5 – 10	718	DN40	1022503
10 – 15	718	DN50	1022514
15 – 25	718	DN65	1022515
25 – 35	1100	DN80	1022516
35 – 50	1100	DN100	1024154

Other sizes on request

Connectors for the gas piping	Order no.
Stainless steel pipe 12/10 mm, sold by the metre	015743
Stainless steel pipe 12/10 mm, grease-free, 1.4 m	1022463
PTFE tube 12/9 mm, grease-free, per metre	037428
Stainless steel back pressure valve, adjustable pressure range 0.07 – 2 bar, connection size: 1/4" NPT, 2 additional inputs for connecting 2 pressure gauges; for OZMa 1 – 3 O	1029032
Stainless steel back pressure valve for OZMa 1 – 3 A and OZMa 4 – 6 O, adjustable pressure range 0.5 – 10 bar, connector G 3/4" external thread, grease-free	1039408
Spare parts kit for back pressure valve order no. 1039408	1039410
Stainless steel back pressure valve for OZMa 4 – 6 A, adjustable pressure range 0.5 – 10 bar, connector G 1 1/4" external thread, grease-free	1039409
Spare parts kit for back pressure valve. order no. 1039409	1039411

Residual ozone gas destructor

The residual ozone gas destructor is used to remove traces of ozone in the exhaust air coming from the reaction chamber. As the exhaust air from the reaction chamber still contains water, provision must be made by means of appropriate pipework for a drainage line on the inlet side.

As the exhaust air downstream of the residual ozone gas destructor is still 100% saturated with water vapour and small fluctuations in temperature can also result in condensation flowing back at the outlet side, a drain connection should also be provided here.

The exhaust air from a filter system possibly fitted downstream can also pass through this residual ozone gas destructor.

Tab. 4: PVC version

Type	Ozone volume (g/h)	Order no.
Residual ozone gas destructor 3 l	10	879022
Residual ozone gas destructor 14 l	40	1004267
Residual ozone gas destructor 30 l	100	879019
Residual ozone gas destructor 60 l	200	879018

Active carbon granulate-based residual ozone gas destructor in a PVC housing.



The stated ozone quantities refer to quantities added to the raw water. The residual ozone gas destructor is designed for residual ozone concentrations found in swimming pool applications. It may only be used in systems, which use air as the process gas and a maximum quantity to be added of 1.5 g ozone/m³ of treated water.

Tab. 5: Stainless steel version

Max. gas flow	Heating power	Dimensions	Connector	Order no.
m ³ /h	W	H x W x D mm		
1.5	100	700 x 110 x 180	Rp 1/2"	1018440
8	100	735 x 110 x 235	Rp 1/2"	1018406
18	140	1154 x 275 x 240	DN 25	1019155
28	140	1154 x 300 x 259	DN 25	1021037
40	500	1156 x 330 x 264	DN 25	1026335

Max. gas flow	Heating power	Dimensions	Connector	Order no.
m ³ /h	W	H x W x D mm		
73	500	1158 x 400 x 320	DN 32	1019971
110	500	1160 x 450 x 375	DN 40	1027238

Residual ozone gas destructor based on a maintenance-free MnO catalyst in a stainless steel housing (1.4571) with integral heating 230 V, 50 - 60 Hz. Connectors Rp 1/2" or flange in compliance with DIN 2642, PN10. Types 18 to 110 m³/h additionally with ball valve Rp 1/2" as a condensation drain.



The catalytic residual ozone gas destructor should only be used in chlorine-free gas flows.

The PVC version should therefore be used with swimming pool applications.

Potassium iodide starch paper

Roll with 4.8 m test strip for detecting leaks in pipework carrying ozone gas.

Accessories	Order no.
Potassium iodide starch paper	1025575

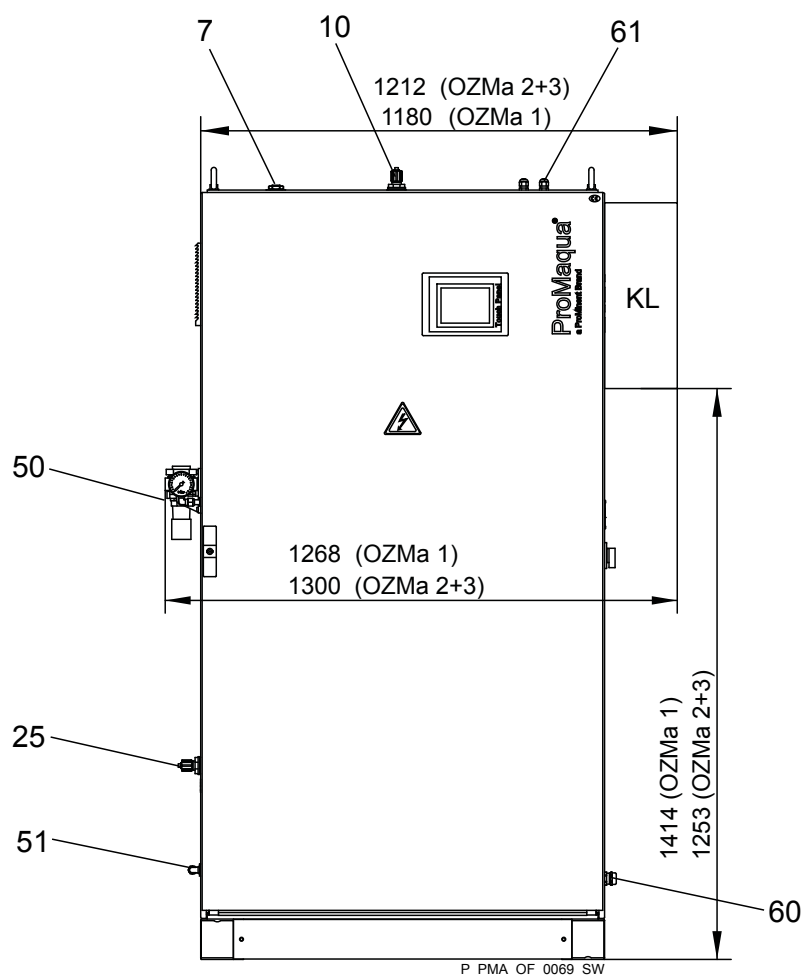


Fig. 45: Dimensional drawing (front view) of the OZMa 1-3 system with air-conditioning unit

Item	Connector
7	Ozone outlet Rp 3/8"
10	Cooling water outlet Ø 12/9
25	Cooling water inlet Ø 12/9
50	Gas inlet Rp 1/4"
51	Regeneration air output (only OZMa A)
60	Power supply input Ø 9 - Ø 17
61	Signal inputs/outputs

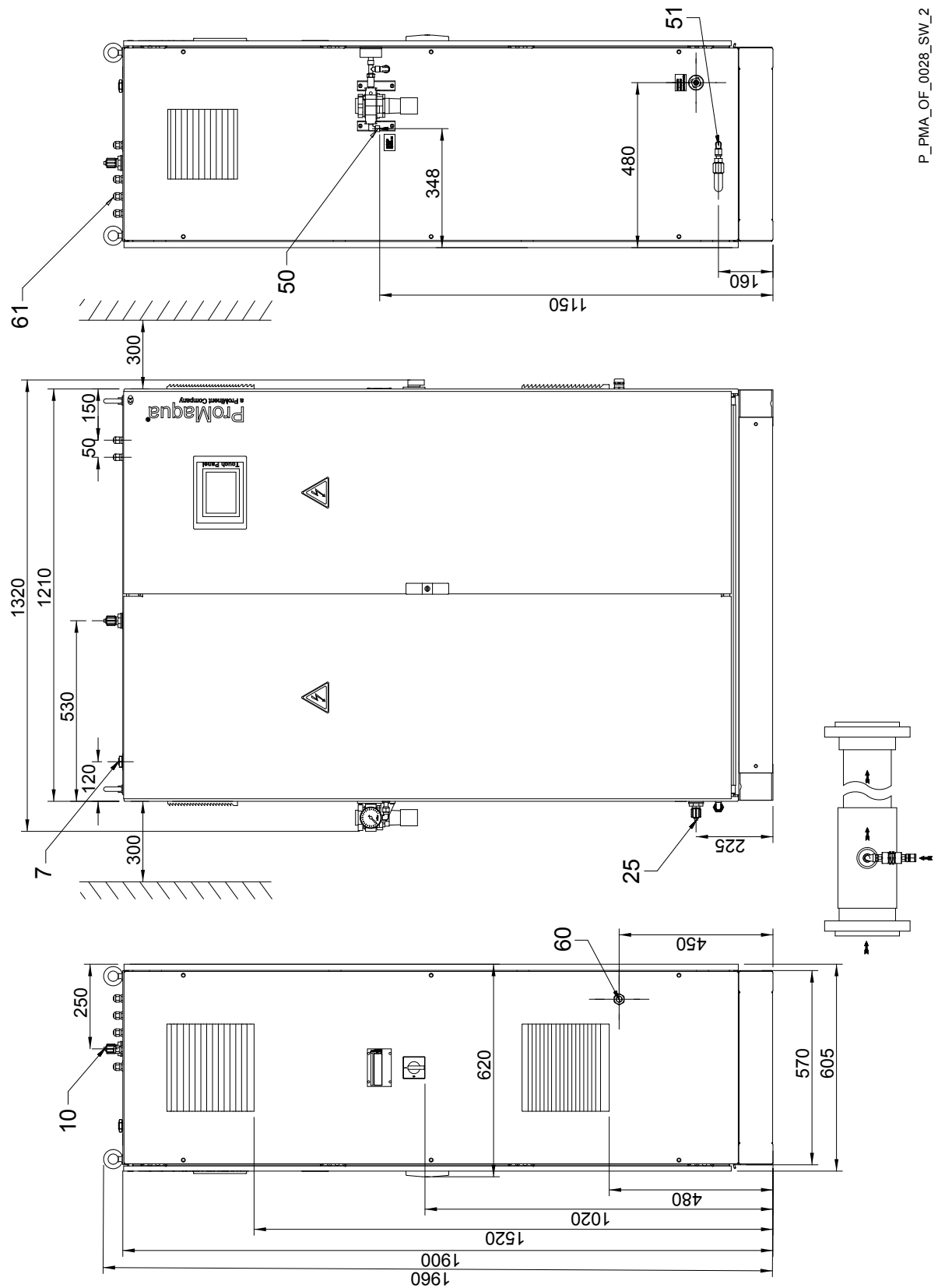


Fig. 46: Dimensional drawing of the OZMa 4 A/O, 5 A/O and 6 O system

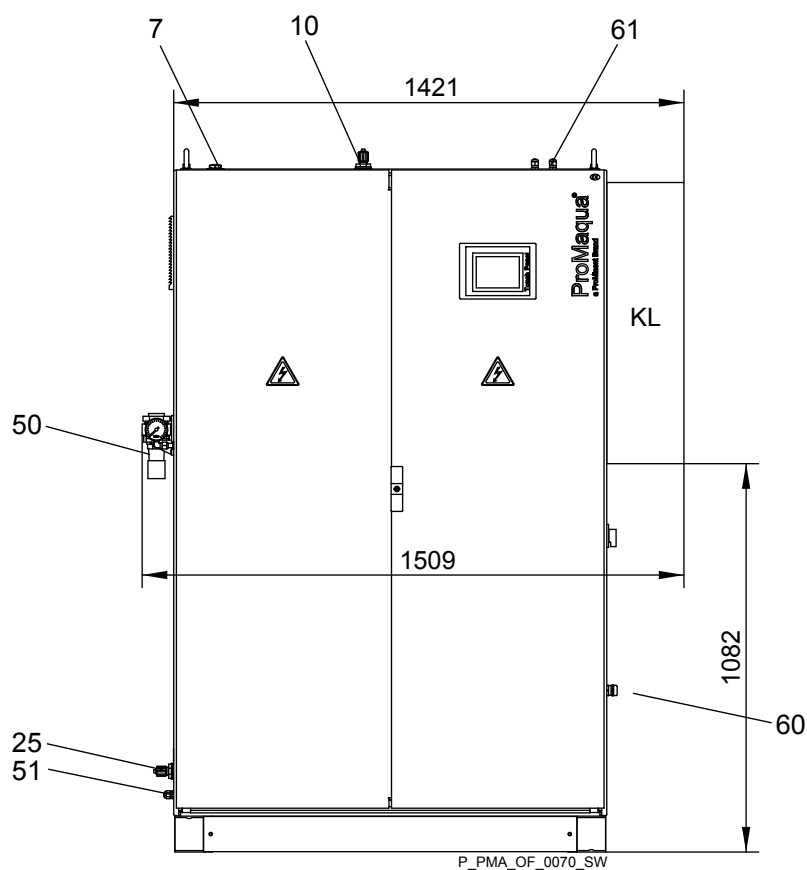


Fig. 47: Dimensional drawing (front view) of the OZMa 4 A/O, 5 A/O and 6 O system with air-conditioning unit

Item	Connector
7	Ozone outlet Rp 3/8"
10	Cooling water outlet Ø 12/9
25	Cooling water inlet Ø 12/9
50	Gas inlet Rp 1/4"
51	Regeneration air output (only OZMa A)
60	Power supply input Ø 9 - Ø 17
61	Signal inputs/outputs

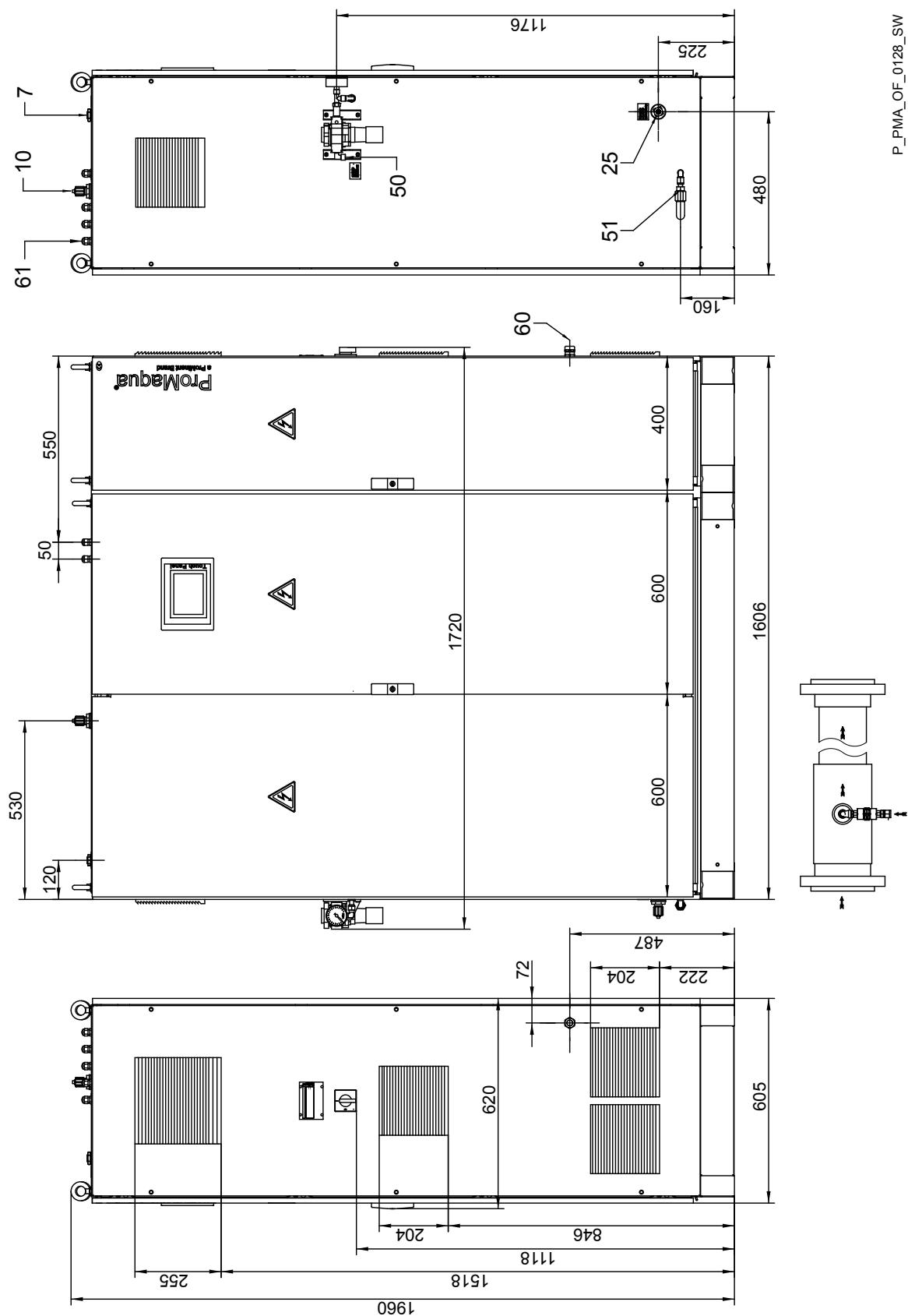


Fig. 48: Dimensional drawing of the OZMa 6 A system

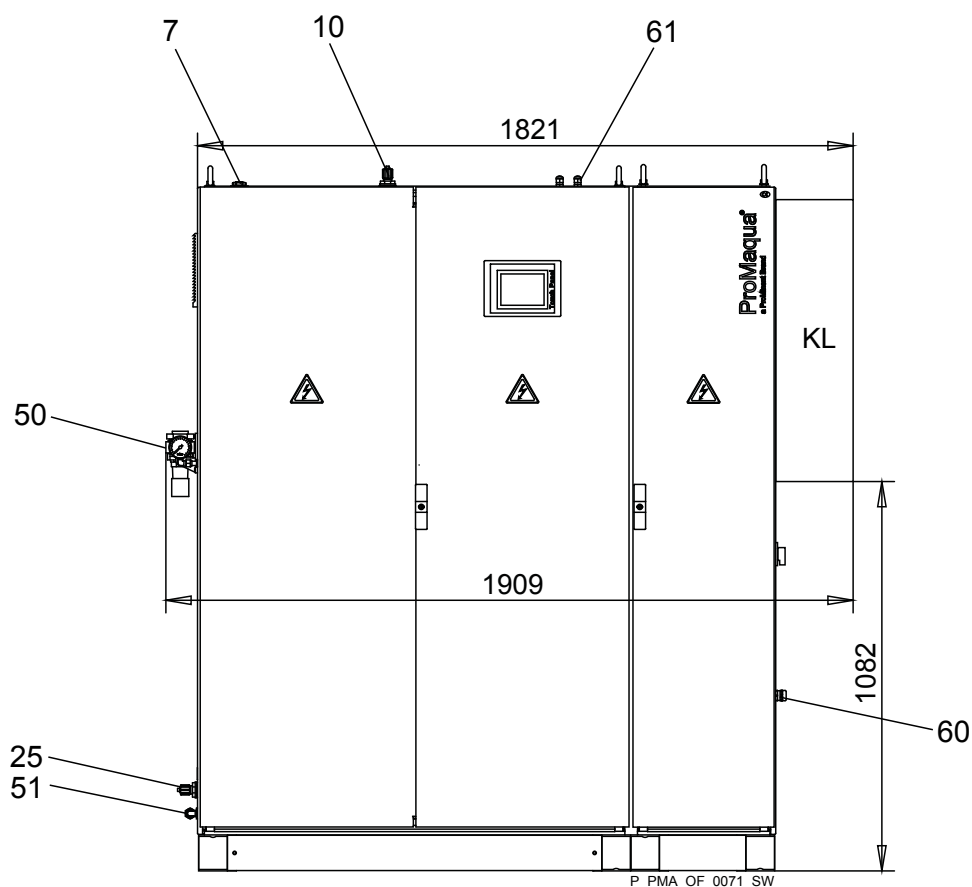


Fig. 49: Dimensional drawing (front view) of the OZMa 6 A system with air-conditioning unit

Item	Connector
7	Ozone outlet Rp 3/8"
10	Cooling water outlet Ø 12/9
25	Cooling water inlet Ø 12/9
50	Gas inlet Rp 1/4"
51	Regeneration air output (only OZMa A)
60	Power supply input Ø 9 - Ø 17
61	Signal inputs/outputs

17 Wiring Diagram

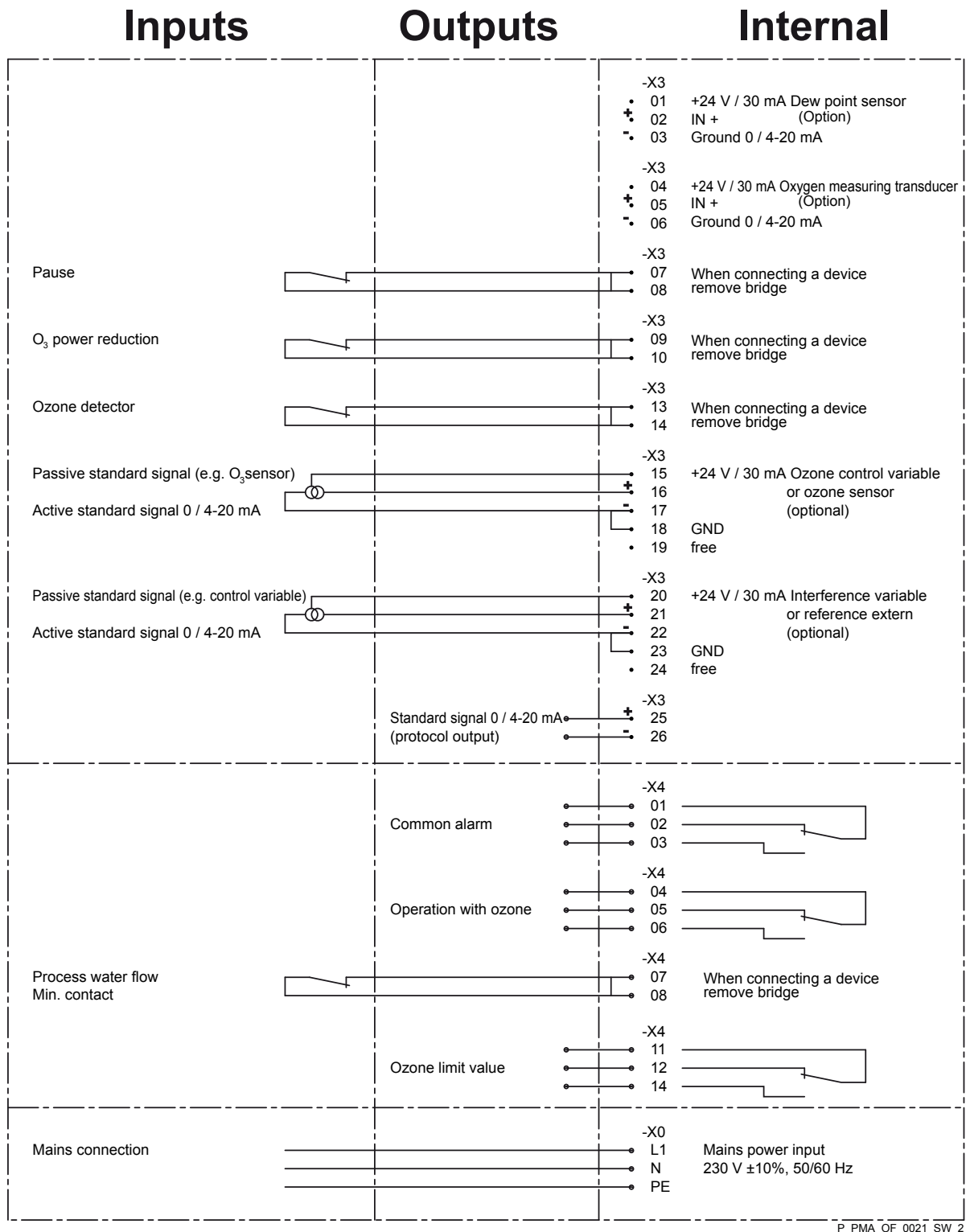


Fig. 51

18 EC Declaration of Conformity

We,

- ProMinent GmbH
- Im Schuhmachergewann 5 - 11
- D - 69123 Heidelberg,

hereby declare that the product specified in the following, complies with the relevant basic health and safety requirements of the EC Directive, on the basis of its functional concept and design and in the version distributed by us.

Any modification to the product not approved by us will invalidate this declaration.

Tab. 6: Extract from the EC Declaration of Conformity

Designation of the product:	Ozonfilt® ozone generation system
Product type:	OZMa...
Serial number:	see nameplate on the device
Relevant EC directives:	EC Low Voltage Directive (2006/95/EC) EC EMC Directive (2004/108/EC) EC Pressurised Equipment Directive (97/23/EC)
Harmonised standards applied, in particular:	EN 60204-1 EN 61010-1 EN 60529 EN 61000-3-2/3 EN 61000-6-2/4 EN 60664-1
Date:	02/01/2013

The EC Declaration of Conformity is available to download on our homepage.

19 Information on the legally compliant use of ozone

Anyone who manufactures or uses chemicals is subject to various legal regulations, under which the so-called Biocide Regulation (EU) No. 528/2012 and the REACH Regulation (EC) No. 1907/2006 (REACH = **R**egistration, **E**valuation, **A**uthorization and **R**estriction of **C**hemicals). An authorization or registration process, respectively, must be completed, without which legally compliant operation of an ozone system is not possible. If ozone is used for biocidal purposes, i.e. for disinfection, it is subject to the Biocide Regulation. In all other cases (e.g. oxidation of water constituents), registration must be obtained under the REACH Regulation. Violations of the two regulations can be classified as criminal offences and can be punished with fines or even imprisonment.

Who is responsible for authorization and registration?

In principle, any party in the chain of manufacturer, seller and user can apply for an authorization according to the Biocide Regulation. In the non-profit organization EurO₃zon izvw, we have joined forces with other manufacturers of ozone systems in order to achieve the very time-consuming and expensive authorization jointly on behalf of all parties involved. So anyone who purchases, re-sells or operates an ozone system manufactured by a EurO₃zon member for biocidal purposes can use this authorization. For more information, please contact: www.euro3zon.org.

A registration according to REACH has to be made by each user, a takeover by the equipment manufacturer is not possible. However, EurO₃zon, together with a member also acting as a user, has organized a joint registration dossier, which other users can join as a co-registrant, in return for a contribution to the costs. Unlike the Biocide Regulation, the REACH Regulation staggers the scope of registration, and the associated costs, according to the annual production volume of the chemical concerned. Below a production volume of 1 t/year (= 114 g/h continuous output), no registration is required. For further information, please contact EurO₃zon at: www.euro3zon.org/LoA/IndexReach.

ProMinent GmbH, member of EurO₃zon izvw

20 Index

1, 2, 3 ...

0/4-20 mA 77

A

Accessories 97

Acknowledgeable error messages 76

Additional information 51

Additive basic load 66

Adjustment Options 57, 58

Adjustment range 57, 58

Air 87

Air quality 87

Alarm delay 82

Appendix 107

Applied harmonised standards 109

Assembly 34, 38

Authorisation Scheme 53

B

Behaviour Upon Switching on Power 74

Block circuit diagram 29

C

Calibrating the ozone sensor 62

Calibration 62

Collective alarm 41

Commissioning 44

Complete System 75

Configuring mA input 2 59

Configuring the ozone sensor 62

Connectors 101

Contact inputs 95

Control 57, 58

Control information 51

Control operating mode 59

Control parameter 59, 61, 65

Control range 76

Control valve 67

Control valve operating modes 67

Control valve, concentration 69

Control valve, flow 69

Control valve, manual 68

Control valve, off 68

Control variable 75, 77

Control, operating mode 56, 59

Cooling water 76

Cooling Water Flow 29

Cooling water quality 87, 90

Cooling water temperature - outlet 50

D

Date 51

Deactivation of the keyboard lock 55

Dead zone 65

Definitions 60, 65

Designation of the product 109

Deviations, indicated ozone output 75

Dewpoint sensor 64

Dimensional Drawings 101

Display 75

Display Values on the Touch Panel 75

Disturbance 60

DOWN key 51

Drier operating pressure 50

E

Effects 61

Electric power 28

Electrical inputs and outputs 41, 93

Electrical Installation 41

Electrical operating data 54

Enter control variable 54, 57, 58

Equipment 72

Error 63, 73

Error messages 76

EXPERT 55, 56

EXPERT password 55

EXPERT User 56

External 56, 57, 58, 77

External setpoint 59

External Setpoint 60

F

Function 28

Fuses 93

G

Gas flow 47

Gas Flow mode 67

Gas flow rate 50, 75

Gas initial pressure	47	Operating gas - oxygen	90
Gas piping connectors	98	Operating gas flow	47
H		Operating Gas Flow	28
Hardware	72	Operating hours	76
Hysteresis	64	Operating keys	51
I		Operating mode	51, 56, 77
Identification of safety notes	9	Operating Modes and Settings	56
Identity code	7	Operating Principles	49
Important System Statuses	72	Operating Report	107
Information	110	Operating status	72, 73, 74
Installation	34	Operation	49
Installation place requirements	34	Operation of the Control for System Calibration	50
Installation, electrical	41	Operation with ozone	41
Interference variable	59, 60, 61, 65	OPERATOR	54
Internal	56, 57, 58, 77	OPERATOR User	54
Internal Setpoint	59	Oxygen	90
K		Oxygen detector	97
Keyboard lock	56, 71	Oxygen quality	90
L		Ozone detector	41, 97
Language	77	Ozone generator operating pressure	50
legally compliant use	110	Ozone generator pressure	76
Log data	71	Ozone limit value	41, 64, 96
Login	55, 72	Ozone measurement	62
Login window	55	Ozone Output	50, 75
Logout	56, 72	Ozone reduction	41, 57, 58, 77
M		P	
mA input 2	60, 65	P controller	66
Machine settings	54	Pause	41, 74
Maintenance	78	PD controller	66
Measured Value Checkout Time	62	Photometric measurements	63
Measurements, photometric	63	PI controller	66
Measuring range	60	PID controller	66
MENU key	51	Pneumatic operating data	54
Mixing equipment	97	Potassium iodide starch paper	100
Mixing modules	36	Power ons	76
N		Preliminary tests	44
NEXT key	51	Primary current	50, 76
Night setback	57, 58, 77	Primary voltage	50, 76
O		Process flowchart	50, 52, 54
Off delay	64	Process Flowchart Displays	52
Operating gas - air	87	Process water flow rate	41
		Process water flow rate too low	73
		Protocol Output	70

R

Raw Water Flow	29
Reaction section	37
Reaction vessel	37
Read out information	72
Record data (curr.)	71
Regular maintenance	79
Relay	96
Relay output	41
Relevant EC directives	109
Report	41
Requirements Relating to System Components	36
Residual ozone destruction unit	37
Residual ozone gas destructor	99
Restart delay	82
Routine Inspection	78

S

Safety guidelines	34
Schematic diagram	30
SD card	71
Sensor	60
Serial number	109
Set time	71
Setpoint	59, 60
Setpoint input field	50
Shut-down level	82
Software	72
Standard signal inputs	95
Standard signal output	41, 96
START key	51
Start with Ozone Generation	72
Start without Ozone Generation	73
Status	51
Status bar	49
Status Page	54, 76
Stop	74
STOP key	51
Switch-on delay	64, 82
System	71
System statuses	72
System time	71

T

Technical Data	87
Time	51

Timer	57, 58, 77
Tn	65
Touch panel	49
Troubleshooting	82
Tv	65
Types of controller	66

U

UP key	51
use	110
User	55

V

Values changing	49
Values fixed	49
Version	72

W

Warning symbol	9
Warning threshold	82
Wiring Diagram	108

X

xp	65
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