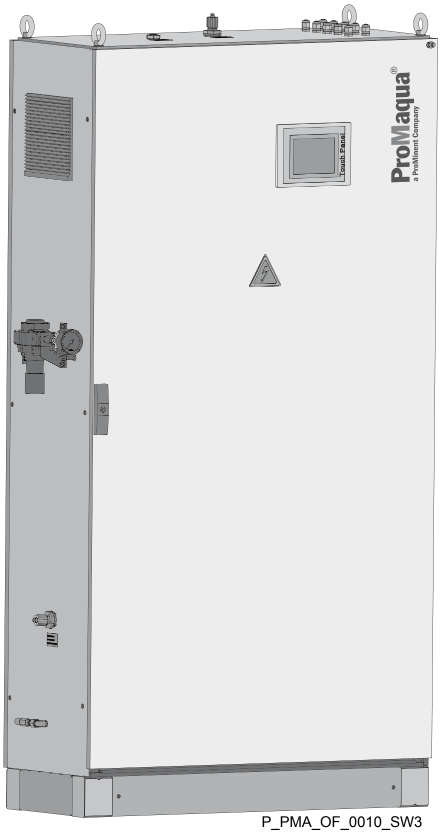
# Operating instructions

## Ozone Generation System

## OZONFILT® Type OZMa 1 - 6 A/O



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!
Technical changes reserved.

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## Supplementary information

Read the following supplementary information in its entirety! Should you already know this information, you have an even greater need of the Operating Instructions.

The following are highlighted separately in the document:

- Enumerated lists

→ Operating instructions

Keys: Key *[UP]*.

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

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

### Information

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

### Safety information

Safety information is identified by pictograms - see "Safety Chapter".

### Note for the system operator

This document includes notes and citations from German guidelines relating to the system operator's scope of responsibility. This information does not discharge operators from their responsibility as an operator and is intended only to remind them or make them 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.

## General non-discriminatory approach

In order to make it easier to read, this document uses the male form in grammatical structures but with an implied neutral sense. It is aimed equally at both men and women. We kindly ask female readers for their understanding in this simplification of the text.

# Table of contents

# 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 ProMaqua, 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 Safety

Thanks to the latest technology, the OZONFILT® OZMa system provides the ultimate in operational safety and functional reliability. The following chapter explains all of the safety measures and safety equipment.

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

The operating instructions contain general remarks and advice about oxygen and ozone. They do not discharge the operator in anyway from their responsibility of obtaining information about the dangers arising from oxygen and ozone and writing a user's guide. 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.

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

## 2.1 Explanation of the safety instructions

**Explanation of the Safety Information**

The following signal words are used in these operating instructions to denote different severities of a hazard:

| Signal word | Meaning |
|---|---|
| DANGER | Denotes a possibly hazardous situation. If this is disregarded, it will result in fatal or very serious injuries. |
| WARNING | Denotes a possibly hazardous situation. If this is disregarded, you are in a life-threatening situation and this can result in serious injuries. |
| CAUTION | Denotes a possibly hazardous situation. If this is disregarded, it could result in slight or minor injuries or material damage. |

## 2.2 Warning signs denoting different types of danger

**Warning signs denoting different types of danger**

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

| Warning signs | Type of danger |
|---|---|
|  | Warning – high-voltage. |

| Warning signs | Type of danger |
|---|---|
|  | Warning – toxic substances. |
|  | Warning – danger zone. |

## 2.3 Correct and proper 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 ProMaqua 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).
- You are obliged to 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 at every phase of the system's service life.

## 2.4 Personnel qualification

| Activity | Qualification level |
|---|---|
| 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**

Customer service refers to service technicians who have received certificated training and have been authorised by ProMaqua® to work on the system.

## 2.5 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.

## 2.6 Safety Equipment

The safety equipment is described in Chapter 4.3 "Safety Equipment".

## 2.7 Notes for the System Operator

Before commissioning the system, the operator must:

- obtain the latest safety data sheets for compressed oxygen from the chemical suppler (only for system type "O").
- Obtain the latest safety information concerning ozone and ozone containing water.

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 must create the legal framework for safe operation of the system.

The operator is for example obliged to write a "handling ozone" user's guide (including instructions on danger prevention, alarm plan, ...) and (only for system type "O") a "handling oxygen" guide.

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)

## 2.8 Guidelines on Working with Ozone

### 2.8.1 Safety Information on Ozone

Ozone consists of three oxygen atoms and has a molar mass of ~48 g/mol. Under standard conditions (0 °C and 1.013 bar (abs)), ozone has a density of 2.15 kg/$m^3$. The chemical symbol is $O_3$.

Ozone is heavier than air!

At standard pressure, ozone is a colourless to bluish gas with a boiling point of -112 °C. Below this temperature it condenses to form a blue liquid.

Depending on its concentration, ozone has the odour of carnations or hay or an odour similar to chlorine. The odour threshold is ~0.02 mg/$m^3$ (~0.01 $ppm_v$ ), the maximum allowable concentration (MAC) (MAK in Germany) is 0.2 mg/$m^3$ (~0.1 $ppm_v$) or 0.1 ml/$m^3$.

Ozone is not combustible but assists combustion processes so that spontaneous explosive reactions are possible.

Ozone oxidises almost all metals and inorganic and organic materials (with the exception of gold, platinum, stainless steel, glass and ceramic).

The highly oxidising effect of ozone is used for disinfection purposes (ozone is extremely harmful to lower organisms, such as bacteria and fungi) and for the oxidation of organic and inorganic substances, such as COD removal and AOX removal. The organic components are oxidised by the ozone and can be broken down into carbon dioxide and water.

### 2.8.2 Health Risks due to Ozone

Ozone is an irritant gas and in particular causes irritation to the mucous membranes of the eyes, nose and lungs. If breathed in, ozone can produce the symptoms of poisoning. Physical exercise and high temperatures increase the toxic effects of ozone with the result that otherwise harmless concentrations can become hazardous. The toxicity of ozone doubles with a rise in temperature of 8 °C in a room.

Remaining for longer periods in an environment in which the concentration of ozone is greater than 0.2 mg/$m^3$ (~0.1 $ppm_v$) leads to irritation of the throat.

Concentrations of higher than 1.0 mg/$m^3$ (~0.5 $ppm_v$) lead to irritation of the eyes and mucous membranes in the air ways. After a few minutes the person will suffer serious bouts of coughing and a numbing of the sense of smell. The person will experience breathing discomfort, with symptoms of a pulmonary oedema.

At concentrations greater than 2.0 mg/$m^3$ (~1.0 $ppm_v$), the person will experience tightening of the chest, drowsiness and headaches. Higher concentrations will lead to circulatory troubles and sialosis. People, who are exposed regularly or for longer periods of time to lower concentrations of ozone, can suffer from chronic bronchial problems.

Ozone concentrations of greater than 20 mg/$m^3$ (~10 $ppm_v$) will lead, after longer periods of exposure, to unconsciousness, pulmonary haemorrhaging and death. Breathing in of ozone concentrations of greater than 10,000 mg/$m^3$ (~5,000 $ppm_v$) will cause death within minutes.

### 2.8.3 Recommended Protective Measures for Use with Ozone

Ozone generation systems must be housed in sealed, lockable rooms. Permanent work places my not be located in rooms, in which ozone generation systems are situated.

Should it not be possible to locate the system separately from a work place, for process engineering reasons,the concentration of ozone in the room air then has to be monitored.

In this case the applicable MAC figure is 0.2 mg/$m^3$ (~0.1 $ppm_v$).

Rooms in which ozone can be released by accident, must be effectively monitored with visual and acoustic gas detectors.

This type of room may be a room in which an ozone generation system is located or a room in which ozone pipes with removable fittings are run.

The monitoring devices (sensors) should be fitted where the ozone concentration would be expected to be at its highest in the event of an accident.

If arranged in this way, the switch-off level can be set at 1.0 mg/m$^3$ (~0.5 ppm$_v$) and the alarm threshold at 0.6 mg/m$^3$ (~0.3 ppm$_v$).

Rooms in which ozone generation systems are located must, in accordance with DIN 19627, be identified by the following warning signs:

| Warning label | Meaning |
| --- | --- |
|  | Warning of toxic substances |
| <br>Ozone system<br>Access only for trained personnel<br> | Ozone generation system! Access only for trained personnel. Fire, naked lights and smoking prohibited |
|  | No admission for persons with heart pacemakers |

The signs must be durable and easily visible at the entrance to the plant room.

Rooms, in which an ozone generation system is located, should be provided with mechanical ventilation, by means of which it is possible to ensure that the room air can be changed at least three times per hour in the event of a gas alarm. A suction ventilation system is needed directly above the floor, which switches on as soon as the gas detector is triggered.

Rooms, in which an ozone leak has been established or presumed, may only be entered to rescue injured persons or to prevent an immediately threatening danger and then only with breathing apparatus.

Do not keep breathing apparatus in rooms, in which parts of the ozone generation system are located.

Ozone-resistant full masks with effective filters can be used as breathing apparatus. A mask identified by the person's name should be available for every user.

Repairs to ozone generation systems may only be performed by people who meet the following requirements:

- Persons with adequate knowledge of working with ozone generation systems, due to their technical training and experience,
- and who are fully conversant with relevant statutory occupational health and safety and accident prevention regulations, locally applicable standards and the principles and regulations relating to electrical engineering, to the extent that they can assess the state and condition of the ozone generation system from an occupational health and safety point of view.

Parts, which come into contact with ozone or oxygen, must be kept free from oil and grease. Ozoniferous exhaust gas must be diverted into the open air through an effective residual ozone destructor.

The operator is obliged to make readily available a copy of the "Working with Ozone" instruction manual to all employees on the operating site.

## 2.9 Directives for Handling Oxygen

### 2.9.1 Oxygen Safety Instructions

Oxygen consists of two oxygen atoms and has a molar mass of ~32 g/mol. Under standard conditions (0 °C and 1.013 bar (abs)), oxygen has a density of 1.43 kg/m$^3$. The chemical symbol is $O_2$.

Oxygen is heavier than air!

Under normal pressure, oxygen is a colourless and odourless gas. At standard pressure, oxygen condenses below -183 °C to form a blue liquid. Oxygen forms blue crystals below -219 °C.

Oxygen itself is not combustible but promotes and aids combustion. No combustion is possible in the absence of oxygen, i.e. a burning flame will be extinguished if there is no more oxygen available for the combustion process.

The proportion of oxygen in the air is approximately 21 percent by volume.

If the oxygen content of breathable air falls below 17 percent by volume, it can lead to health problems.

Oxygen concentrations in excess of 23 percent by volume significantly accelerate the combustion process. Moreover, safety-related properties, such as the rate of pressure rise, ignition and glowing temperature, explosion pressure and flame temperature, also change.

Oxygen can cause oil or lubricating grease to ignite spontaneously. The same relates to clothing with specks of oil or grease.

Oxygen binds to almost all other elements. The majority of substances react so powerfully with oxygen that they either burn upon ignition or even spontaneously ignite.

### 2.9.2 Risks due to Oxygen

At standard pressure, concentrations of oxygen of lower than ~50 percent by volume can be regarded as non-hazardous to health even after lengthy exposure.

Inhaling pure oxygen over a longer period of time can result in damage to the lungs and disorders of the vegetative nervous system.

The lung damage can result in a toxic pulmonary oedema.

Inhaling pure oxygen at high pressure (> 3 bar) will very quickly lead to symptoms of poisoning, such as drowsiness, nausea, impaired vision, impaired hearing, dizziness, cramps, unconsciousness and even death.

Slight breathing difficulties, after inhaling high concentrations of oxygen for short periods of time, will quickly subside in the fresh air.

With oxygen concentrations of 23 percent by volume and higher, there is a risk due to the fire-accelerating effects of the gas. Oxygen can become stubbornly lodged in clothing and even after the oxygen-enriched environment has been left, can lead to hazardous burning of clothing.

Accumulation of oxygen, such as this, is dangerous because there are no perceptible signs of the increased concentration of oxygen. It is essential that the following is prevented:

- oxygen penetrating into clothing,
- a combustion process being promoted by too much oxygen,
- ignition being triggered.

Therefore, never

- ventilate with oxygen,
- use oxygen to clean clothing,
- wear clothing contaminated with oil and grease,
- work on pipes carrying oxygen with hands covered in grease or oil,
- smoke in areas presumed to contain oxygen.

### 2.9.3 Recommended Protective Measures with Oxygen

Owing to the risk of ignition, all parts of the system, which come into contact with oxygen, must be kept immaculately clean, meaning that they have to be kept free, at all times, of free particles, or particles that could possibly be released during operation, such as ash, welding residue and swarf or chippings, and also as free of oil, grease and solvents as possible. To meet this requirement, the stainless steel parts can be pickled with acid after welding.

Only use fittings, seals and measuring devices, which are specifically recommended for use with oxygen and keep them free of grease and oil.

Do not touch parts, which could come into contact with oxygen or ozone, with oily cloths or greasy fingers.

Oily and greasy substances can ignite spontaneously when they come into contact with oxygen or ozone. Leakage tests should only be performed by persons, who have experience of working with oxygen. Pipes which carry oxygen should be appropriately identified by coloured signs or symbols.

Rooms, in which oxygen may be released during operation, must be ventilated, so that oxygen cannot accumulate in the air.

If natural ventilation is insufficient, mechanical ventilation should be provided for.

A possible accumulation of oxygen in the ambient air should be monitored by a gas detector, which indicates when a level of 23 percent by volume is exceeded.

Floors and walls in areas, in which liquid oxygen could be released, must not be combustible.

Fire, naked lights and smoking is prohibited in rooms in which people are working with oxygen!

Inform your employees about the dangers of oxygen and about the requisite protective measures.

The operator is obliged to make readily available a copy of the "Working with Oxygen" and "Working with Ozone" instruction manuals to all employees on the operating site.

# 3 Interesting Facts about Ozone

## 3.1 What is Ozone?

Under normal environmental conditions, oxygen is a molecule consisting of two atoms. These two atoms are linked by a double bond. The symbolic language of chemistry designates this molecule as $O_2$.

If energy is supplied to this molecule, one of these bonds breaks. A further oxygen atom can now latch onto this gap. This produces a molecule consisting of three oxygen atoms - ozone.

The ozone molecule attempts to reach a lower energy level. It decomposes again after a short time. This produces oxygen and heat. This short life span prevents ozone from being produced in high concentrations and stored. Ozone has to be produced on site.

In its concentrated form, ozone is a colourless gas, which is around 1.5 times heavier than air. Thus if ozone escapes it can accumulate at floor level. The characteristic odour of ozone gives it its name (the Greek ozein = smell). This odour can still be noticed at a concentration of 1:500,000. Occasionally it occurs during storms with serious lightning discharge or adjacent to frequently used copiers. The odour threshold of ozone is approximately 0.04 $mg/m^3$. Ozone gas is poisonous and kills germs. In relatively low concentrations, people can experience severe irritation to the mucous membranes of the nose and eyes. Furthermore, even very low, non-hazardous concentrations of ozone can be recognised by their characteristic odour. This means that people in potential danger receive an early warning, long before high concentrations, which could be hazardous to health, are reached.

Ozone is technically the strongest oxidising agent. This property is the fundamental reason for the use of ozone in the treatment and disinfection of potable water, process water, bathing water and waste water. Undesirable substances are oxidised into easily removable substances. The major advantage of ozone is that is decomposes again into oxygen after use, which in any case is already present in the water.

## 3.2 Use of Ozone in Water Treatment

The technical use of ozone was only possible following the invention of ozone tubes by Werner v. Siemens in 1857. Only when Fox discovered the germ-killing effects of ozone in 1873 were the first tests performed with the aim of using ozone as a disinfectant in water treatment.

Around the turn of the century, ozone was used for the first time in waterworks (Berlin, Wiesbaden, Paderborn). In 1906 and 1909 the first large-scale waterworks to use the ozone process, were built in Nice and Paris.

In the 1920's the use of ozone fell into disuse. It was replaced by chlorination, which was more cost-effective and technically simpler. In the 1950's new endeavours were made and finally ozone was no longer used only as a disinfectant but also as an oxidising agent in water treatment processes, In addition to its use in the treatment of potable water, ozone is used today in the treatment of swimming pool water,as a disinfectant in the food industry, for the removal of iron in table water, as a bleaching agent in paper and textile production, for flue gas cleaning in large-scale combustion plants and in waste water treatment.

## 3.3 Production Process

Ozone is generated by the reaction of an oxygen molecule with an oxygen atom. The only economical method for this is the principle of silent electric discharge. In this process, an oxygen containing gas (generally air or pure oxygen) is passed through an electric field between two electrodes. It must be ensured beforehand that the gas is dry and does not contain any particles of dust.

The oxygen is converted into ozone in the electric field. The resulting ozoniferous gas flow is directly conveyed to where it is needed (e.g. to mixing equipment to be dissolved in water).

## 3.4 Definition of Terms Used in Ozone Technology

**Ozone generation system**

Section of the system, which is used for the actual generation of ozone.

It includes the drying unit to dry the air process gas, the ozone generator and the electrical control.

**Ozone generation element**

Electrode system, in which the process gas (air or pure oxygen) is exposed to a silent electric discharge to form ozone.

**Ozone generator**

Term for the ozone generation elements as a whole.

**Mixing equipment**

Part of the system, in which the ozoniferous gas coming from the ozone generation elements is mixed with the water to be treated.

It consists of an ozone feed system with a downstream mixing section.

**Reaction vessel (reaction section)**

The reaction vessel is downstream of the ozone mixer.

This is where the ozone reacts with the constituents of the water and the undissolved gas is separated.

**Residual ozone gas removal system**

Section of the plant, in which the ozone not used in the reaction is decomposed.

# 4 Components of the System and Their Role

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

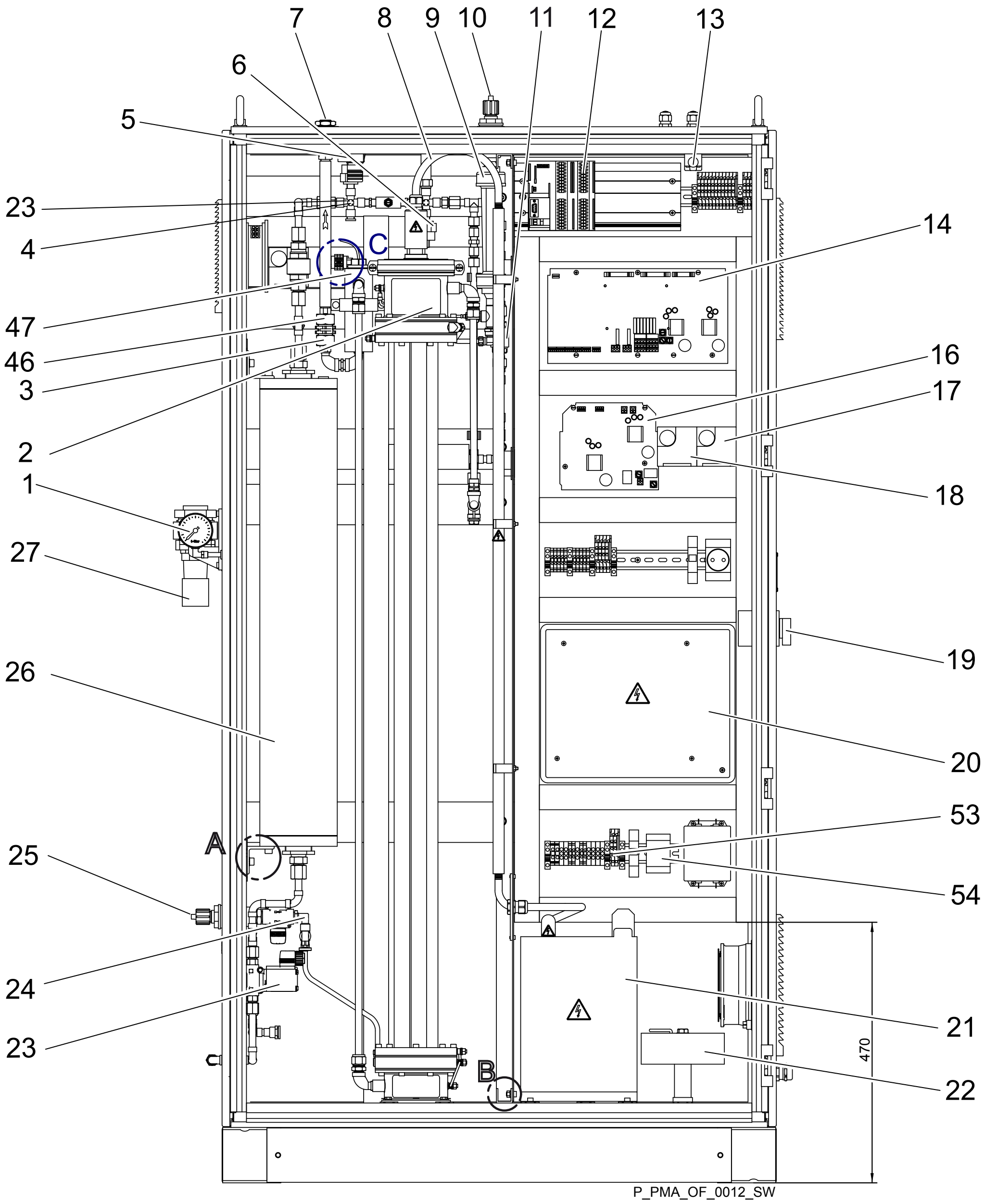



*Fig. 1: Ozone generation system OZONFILT® OZMa 1-6 A - without door*

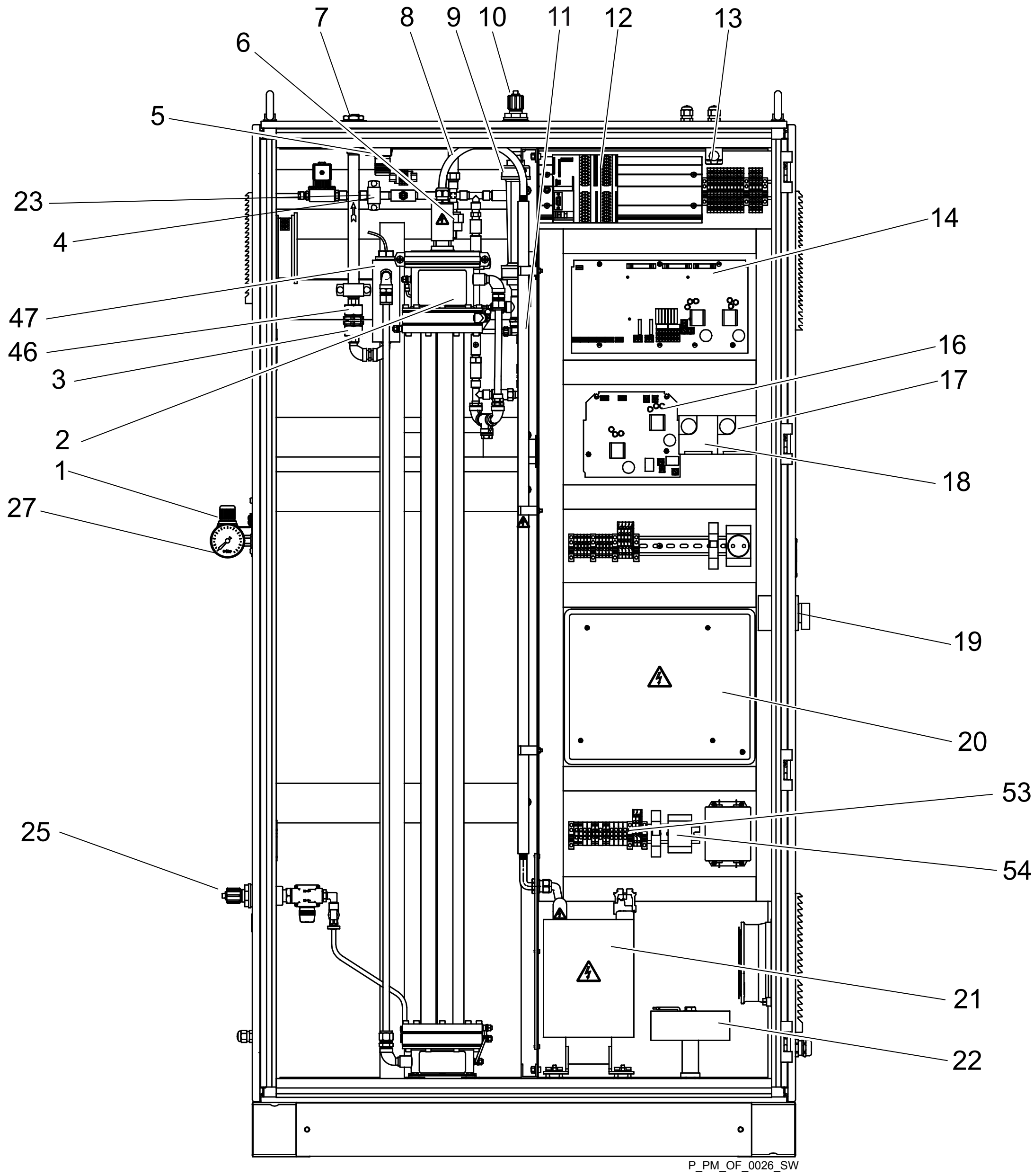



*Fig. 2: Ozone generation system OZONFILT® OZMa 1-6 O - without door*

| No. | Component | Function |
|---|---|---|
| 1 | Pressure regulating valve with pressure sensor | Unit for adjustment and display of the primary pressure of the system. |
| 2 | Ozone generator | A proportion 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. |
| 4 | Adjustable operating gas throttle valve | The flow of operating gas for ozone generation can be adjusted using the throttle valve. |
| 5 | Ozone outlet solenoid valve | The solenoid valve at the ozone outlet serves as a shut-off device when the system is idle |
| 6 | Operating pressure sensor | The pressure sensor displays and monitors the operating pressure in the ozone generator. |

| No. | Component | Function |
| --- | --- | --- |
| 7 | Ozone outlet | - |
| 8 | Ozone generator pressure relief valve | The pressure relief valve limits the operating pressure in the ozone generator. |
| 9 | Flow meter with minimum contact | Serves 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) | The control (PLC) serves to control and monitor the entire system. |
| 13 | Door switch | The door switch stops the generation of ozone as soon as the door of the control cabinet 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 serves to actuate the control cabinet fan according to the temperature. |
| 18 | Control cabinet temperature monitor | The temperature monitor monitors the temperature in the control cabinet. |
| 19 | Main switch | The main switch connects or disconnects the system from the 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 serve to adjust the profile of the electrical signals on the primary side of the high-voltage transformer. |
| 23 | Solenoid valve block - drying unit | Serves to control the gas flows in the drying unit of the system, should one be 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 | Vessel for drying unit | The vessels 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) serves as an interface between the system and the operating personnel. |

| No. | Component | Function |
|---|---|---|
| 30 | Water mixed with ozone | - |
| 31 | Mixing section (accessory) | Mixes the ozoniferous gas with the process water. |
| 32 | Point of injection non-return valve | Must be fitted vertically downwards. |
| 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 the 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 serves to display and monitor the temperature of the cooling water at the cooling water outlet of the system. |
| 43 | Drying unit operating pressure sensor | The pressure sensor is used to display and monitor the pressure at the output of the drying unit as well as for its control. |
| 44 | Silencer for regeneration gas | The silencer provides controlled pressure relief for the vessels of the drying unit. |
| 45 | Filter unit (optional accessory) | The filter unit filters particles and separates oil and water from the compressed ambient air. |
| 46 | Water trap with level sensor | The water trap plug protects the ozone generator against the backflow of process water The level sensor is processed by the system control. |
| 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 | - |

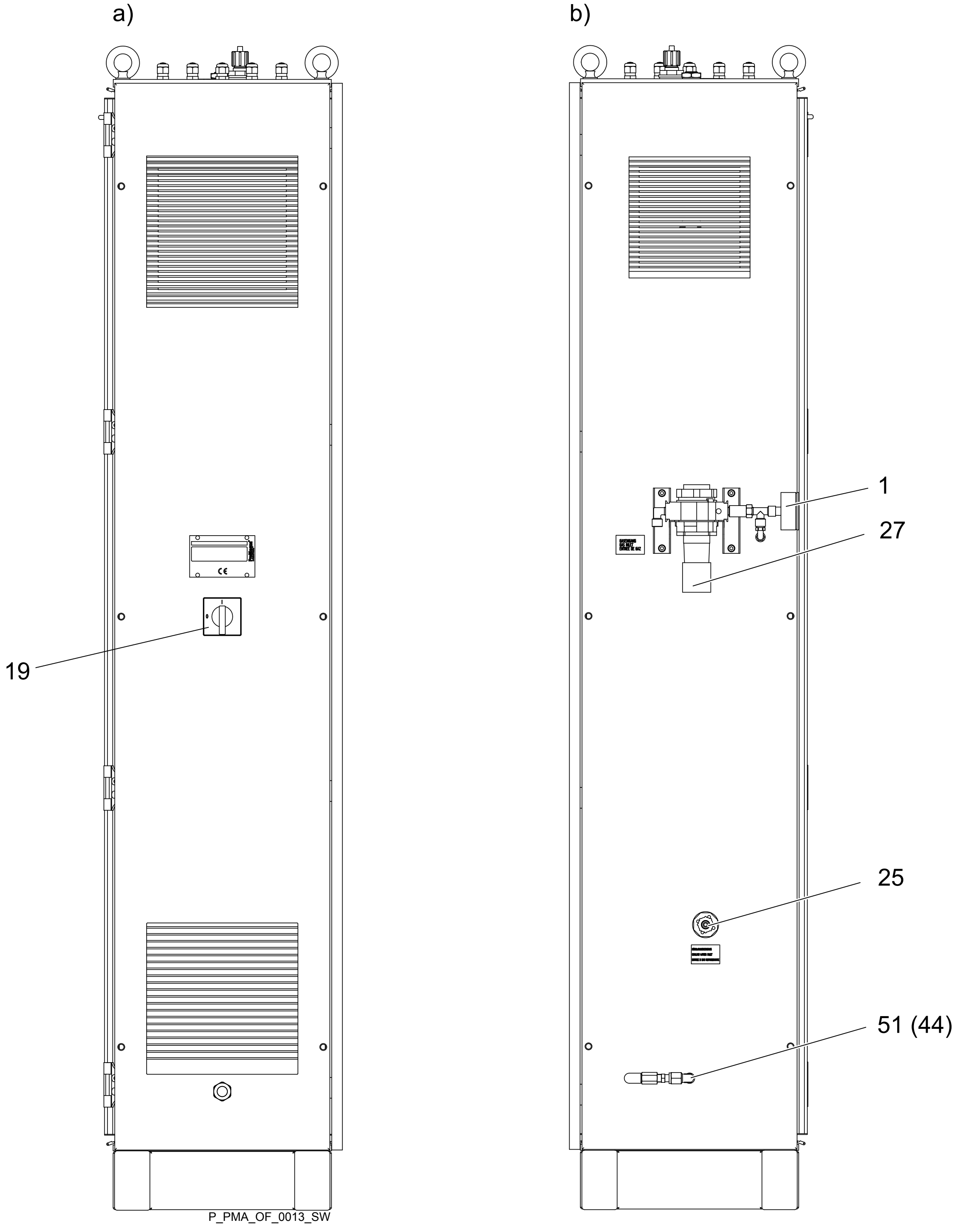



*Fig. 3: OZMa Ozone generation system; view of the right and left side*

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 outlet (only OZMa 1-6 A)

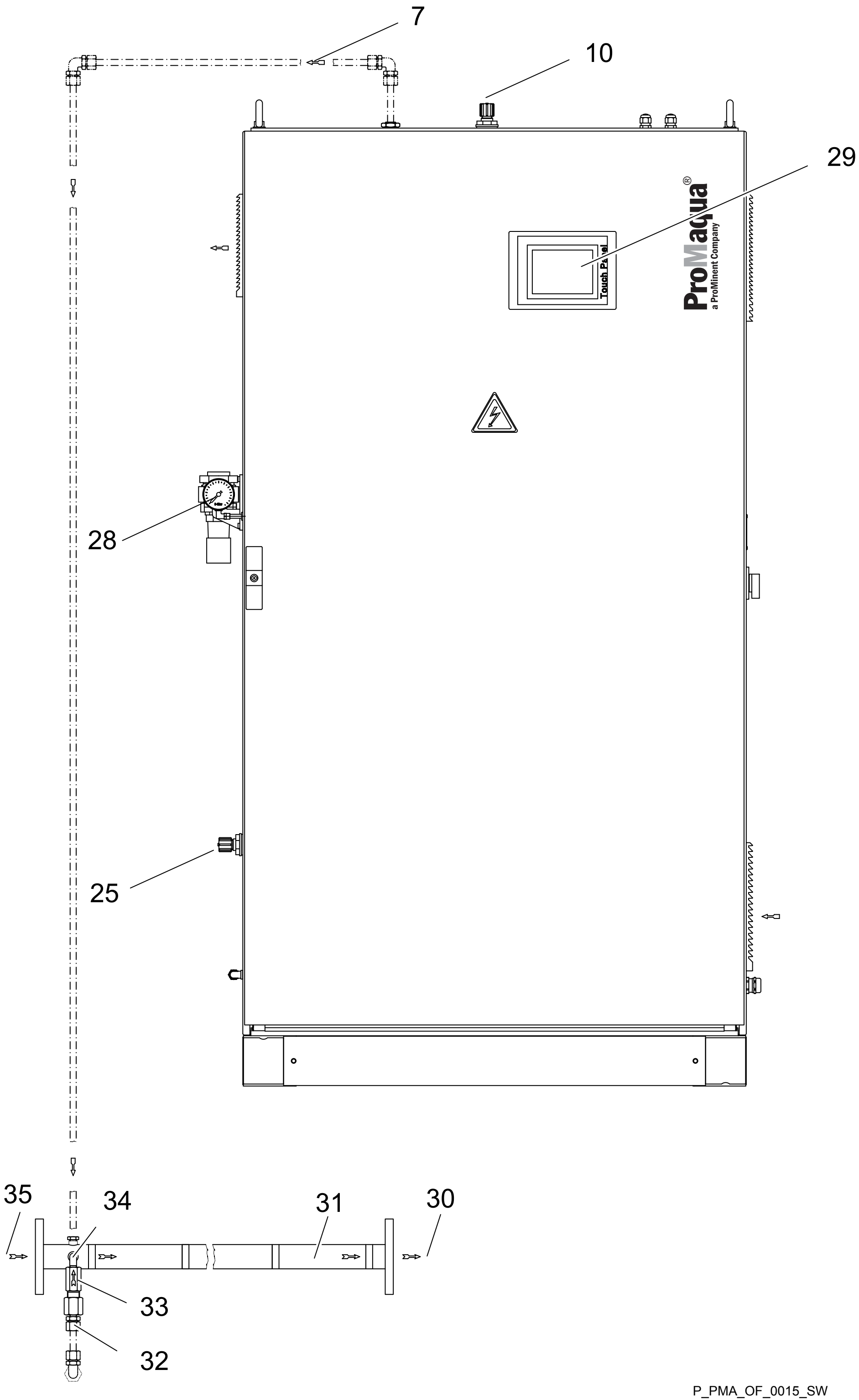



*Fig. 4: OZMa ozone generation system with mixing equipment*

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

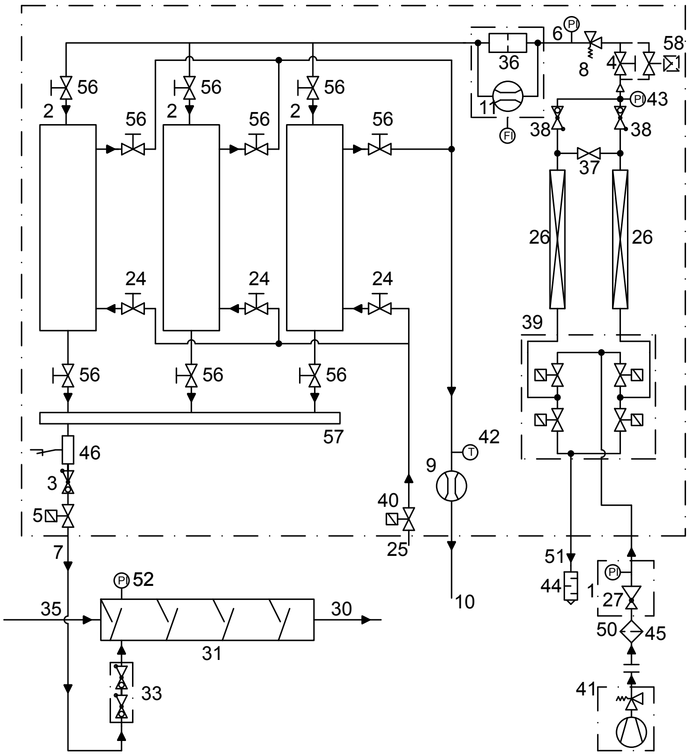



*Fig. 5: Schematic pneumatic and hydraulic flow in the OZMa 1-6 A ozone generation systems with drying unit for use with air as an operating gas*

1 Pressure regulating valve with pressure sensor
2 Ozone generator #
3 Ozone outlet non-return valve
4 Adjustable operating gas throttle valve
5 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
26 Vessel 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)
46 Water trap with level sensor
50 Compressed air inlet
51 Regeneration air outlet

52 Raw water pressure sensor (accessory)
56 Stopcock
57 Ozone collector
58 Control valve (optional)

# 2 ozone generators for OZMa 4 A and OZMa 5 A

3 ozone generators for OZMa 6 A

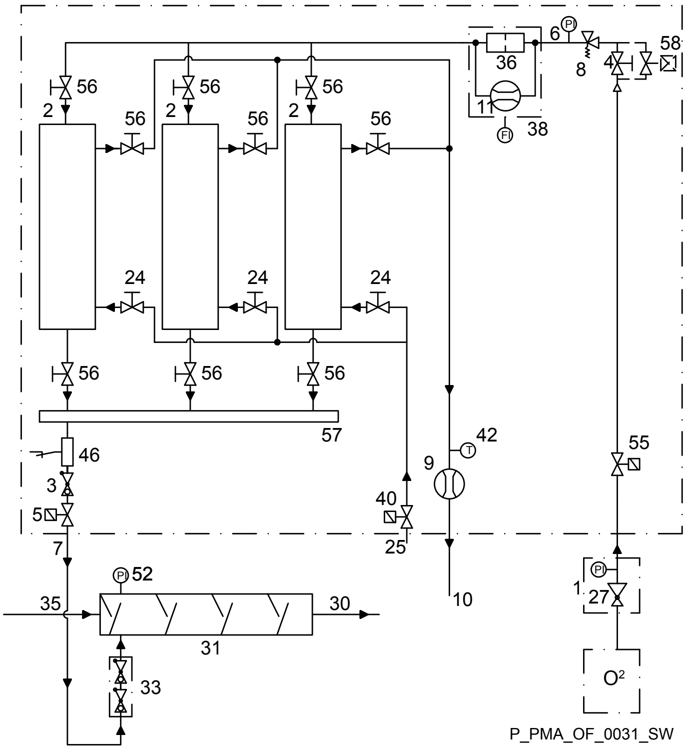



*Fig. 6: Schematic pneumatic and hydraulic flow in the OZMa 1-6 O ozone generation systems with drying unit for use with oxygen as an operating gas*

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
46 Water trap with level sensor
50 Compressed air inlet
52 Raw water pressure sensor (accessory)
55 Oxygen inlet shut-off valve
56 Stopcock
57 Ozone collector
58 Control valve (optional)

# 2 ozone generators for OZMa 4 O and OZMa 5 O

3 ozone generators for OZMa 6 O

## 4.2 Description of the OZONFILT® OZMa ozone generation system

The OZMa ozone generation systems 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 The OZONFILT® OZMa 1-6 A Drying Unit

The system requires compressed, deoiled or oil-free pressurised air at the inlet of the pressure regulating valve (1-27). A detailed description relating to the pressure range, quality of pressurised air and temperature can be found in Chapter 14.1 "Technical Data". When using pressurised air systems, which are fed by oil-greased compressors, a filter assembly with automatic condensation drainage has to be fitted between the pressurised air system and the inlet of the pressure regulating valve. 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 possibly de-oiled pressurised air passes through the pressure regulating valve with pressure sensor (1-1) to the inlet of the solenoid valve block (4-39). There must be a constant primary system pressure set on the pressure regulating valve (1-27). The system pre-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 adsorption unit integrated within the system to a dewpoint of approx. –60 °C. The gas flows for the pressure swing adsorption unit are controlled by the solenoid valve block (4-29). This is provided with the relevant electrical signals by the control (1-31) and the communication circuit board (1-14).

The vessels (1-26) of the pressure swing adsorption unit are filled with a drying agent that draws out the residual moisture from the compressed air. The two dryers (1-26) respectively alternate between a drying and 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 vessel (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 vessel. 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 output (1-51) via a silencer (1-44).

The pressure swing adsorption unit 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 pressurised air system and the volume of gas currently set. This is what differentiates the drying process in the Ozonfilt OZMa from conventional pressure swing adsorption units, 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 vessels (26) is designed in such a way that the drying process produces dew-points of approx. –60 °C even at low system pre-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 volume of gas required for ozone generation can either be set using the throttle valve (1-4), or in the case of systems with automatic gas control the flow volume is set using 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).

### 4.2.2 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 vol.-%).
- Oxygen in bottles
- Evaporation of liquid oxygen

### 4.2.3 The OZONFILT® OZMa 1-6 O gas system

The OZONFILT® OZMa 1-6 O ozone generation system 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 task 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 gas system of the OZONFILT® OZMa 1-6 O. The volume of gas required for ozone generation can either be set at the throttle valve (1-4) or at the control if a control valve (1-58) is available.

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).

### 4.2.4 The Ozone Generator

The ozone generator includes, depending on the model of the OZMa several ozone generation elements (2-4). 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 electric discharge is enabled by a medium range frequency alternating high voltage signal fitted between the high voltage electrode and outer pipe, and causes a proportion 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.

### 4.2.5 The ozone gas transfer equipment

From the output of the ozone generators, the ozone gas mixture passes via the water trap (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 generators. 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).

### 4.2.6 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. For optimum incorporation of the ozone into the process water, the mixing equipment has to be appropriately configured to the process water throughput. There cannot be optimum mixing if the throughput is too low.

### 4.2.7 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 in order to maintain the excellent ozone output and to protect the inner components of the ozone generator.

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

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

### 4.2.8 Electrical System Components

#### 4.2.8.1 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 transformers (1-21),
- measures and monitors the primary current of the HV transformers (1-21),
- measures and monitors the frequency during high voltage generation,
- measures and monitors the gas flow through the ozone generators,
- 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 generators, electronic power units),
- controls the solenoid valves at the cooling water inlet, gas inlet and gas output 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 output (accessory)
- enables the connection of a DULCOTEST® OZE ozone sensor for measuring of the metered ozone output and regulate ozone generation via the integral PID controller (option).

#### 4.2.8.2 Electronic power units

Each electronic power unit (1-20) supplies an 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 technique 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)

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

A flow meter 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 must also be locked by the circulating pump of the water treatment system via the Pause input on the control (1-12).

The system starts up automatically with the preset "Ozone output setpoint" if

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

### 4.3.2 Door Safety Switch

To ensure that no live pats 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 bridged, 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 electrical system of the plant can still be at mains voltage.

- Bridging the door safety switch is prohibited!
- Disconnect the system from the mains power supply to ensure that there can be no unauthorised intervention into the system cabinet and ensure that it cannot be reconnected (e.g. padlock on the main switch).
- The system cabinet must only be opened 5 minutes after the system has been disconnected from the mains.

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

In accordance with the safety guidelines ZH 1/474 and GUV 18.13, it must be possible to switch off ozone generation systems using an emergency switch (emergency command device). This emergency stop switch must be installed in an easily accessible, invulnerable position in the vicinity of the door of the installation room of the ozone generation system and must be labelled 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 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 against overloading.

### 4.3.6 Non-return Valves

The non-return valve (1-3) at 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)

According to 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.

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

The alarm threshold of the gas detector should be set to an ozone concentration of 0.5 ppm.

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

In the case of 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 terminal wiring diagram (Appendix) - see also ↳ *Chapter 9.2 ‘System Electrical Inputs and Outputs’ on page 54*.

The applicable regulations and guidelines should be adhered to 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 the signals for the HV transformer (1-21). Each HV transformer (1-21) supplies the high voltage for silent electrical discharge in an 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 manometer. 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 vessel to atmospheric pressure. In this way the drying agent is regenerated in this vessel. Once the drying time has finished, the roles of the vessels are swapped by the corresponding actuation 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), which operates 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 then passes through the water trap (4-46), 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 output 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 manometer. The compressed gas then passes the solenoid valve (5-55), then through the needle valve (4-4) or the control valve (-58) in order to reach the gas flow meter (1-11), which operates 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 then passes through the water trap (4-46), 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 output are closed.

## 5.3 Cooling Water Flow

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

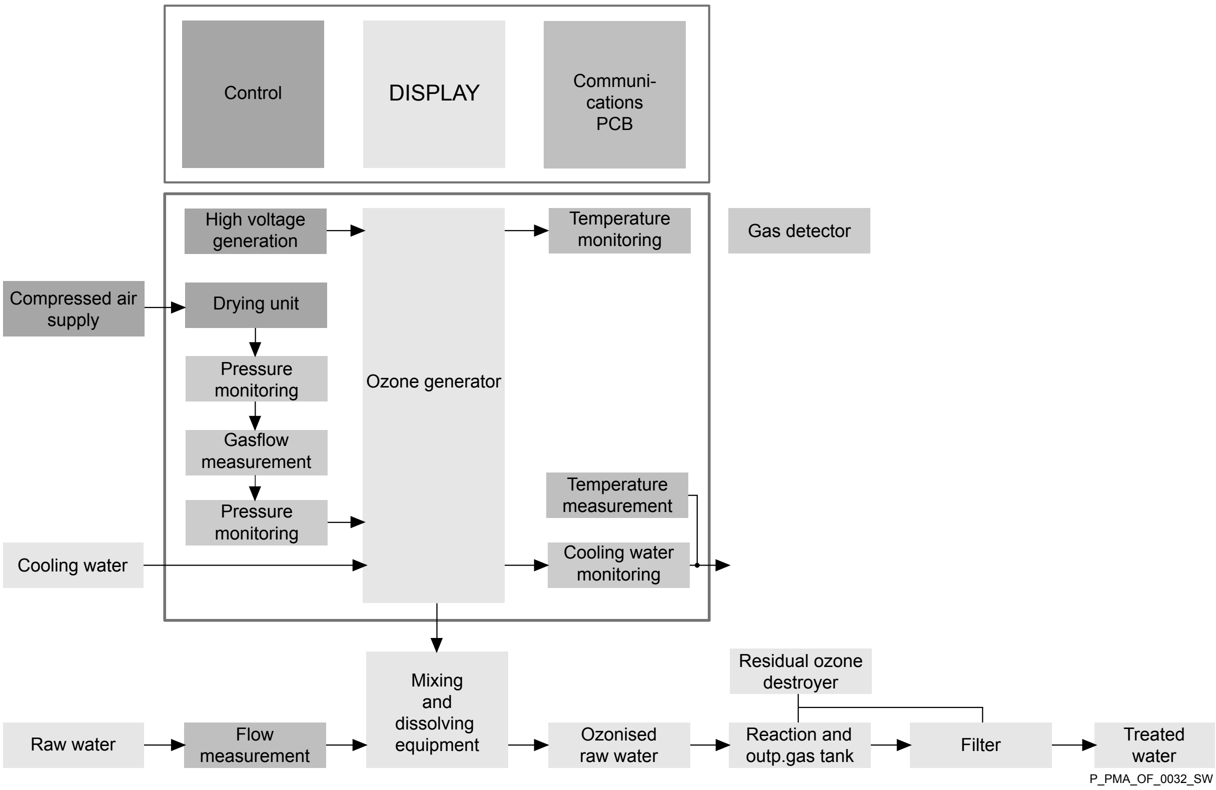



*Fig. 7: Block diagram of the OZONFILT® OZMa 1-6 A system*

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

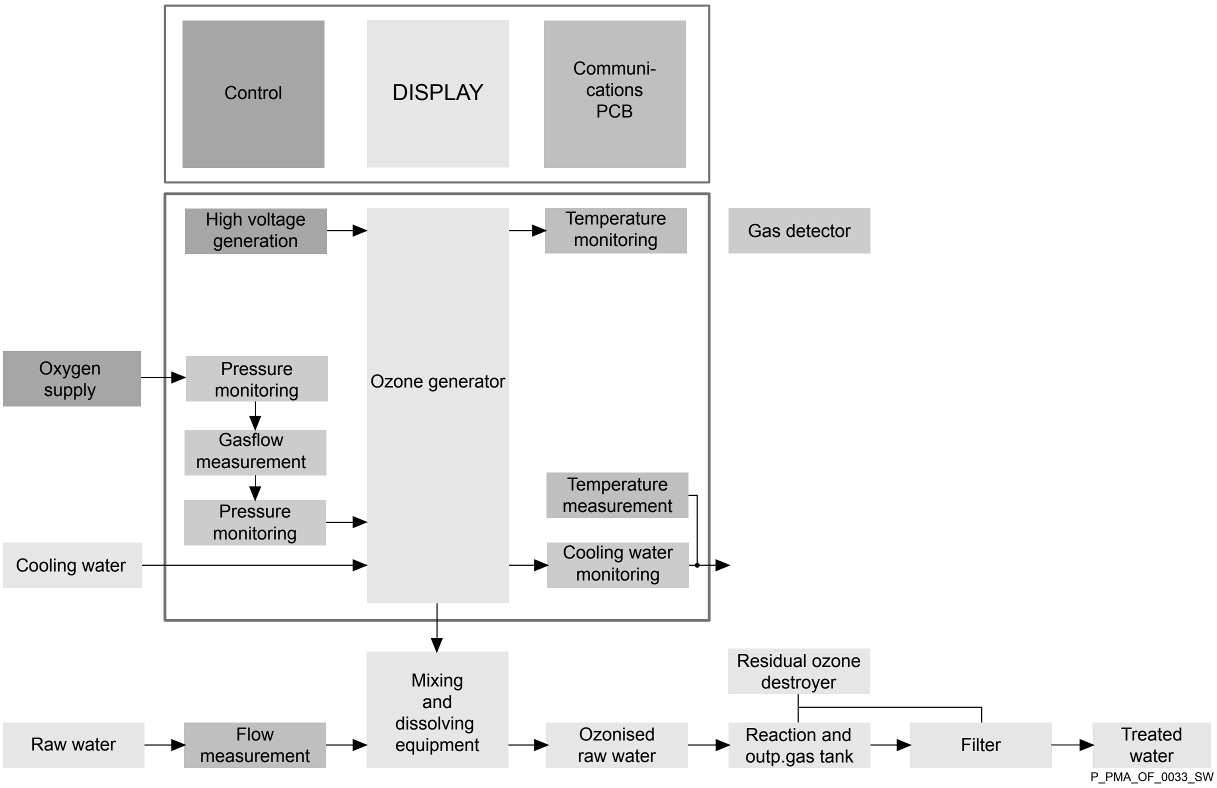



*Fig. 8: Block diagram of the OZONFILT® OZMa 1-6 O system*

# 6 Design and Integration of the OZONFILT ® OZMa System

## 6.1 System Design

The OZONFILT ® OZMa is intended solely to generate and meter an ozoniferous gas mixture from pressurised air or oxygen.

**CAUTION!**
The guidelines and safety regulations currently applicable must be adhered to.

**Note for the system operator**

In Germany DIN 19627 and the accident prevention regulations issued by the Commercial Professional Associations in particular must be adhered to (ZH 1/474 and GUV 18.13: Guidelines on the Use of Ozone in Water Treatment) in their current versions. We recommend reading these guidelines and designing and using the OZONFILT ® OZMa ozone generation system accordingly.

# 7 Scope of Delivery, Storage and Transport

## 7.1 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.

## 7.2 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.

## 7.3 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.

# 8 Mounting and installation

## 8.1 Safety Guidelines and General Requirements

WARNING!

Fatal injury by electrocution

The system produces high voltage.

– For safety reasons, this system may only be installed, operated and serviced by appropriately qualified technical personnel
– All technical personnel should be trained by the manufacturer about the specific system.

Handing 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/Nm$^3$), compressed (up to 2 bar) ozone gas from air or pure or enriched oxygen.

– For safety reasons, this system may only be installed, operated and serviced by appropriately qualified technical personnel
– All technical personnel should be trained by the manufacturer about the specific system.

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

## 8.2 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/m$^3$.
- The room in which the system is located must be monitored by an ozone warning device, which switches off the system 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 may 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 system control cabinet.
- 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.

### 8.2.1 Safety Signs

Rooms in which ozone generation systems are located must, in accordance with DIN 19627, be identified by the following warning signs:

| Warning label | Meaning |
|---|---|
|  | Warning of toxic substances |
|     | Ozone generation system! Access only for trained personnel. Fire, naked lights and smoking prohibited |
|  | No admission for persons with heart pacemakers |

The signs must be durable and easily visible at the entrance to the plant room.

## 8.3 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.

### 8.3.1 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 ProMaqua.

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 ProMaqua 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.

### 8.3.2 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.

## 8.4 Installation

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.
- All systems then have to be freely accessible for service and maintenance. For this reason and so that the cooling fans can work effectively, a gap of at least 30 cm must be left on the left-hand and right-hand side of the control cabinet. The entry of warm exhaust air from other units into the inlet openings of the OZONFILT® OZMa air filters should be avoided.

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

### 8.4.1 Raw Water Piping

All raw water piping

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

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.
- The sections of pipework should be as short as possible.

### 8.4.2 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 output of the oxygen supply to the OZONFILT® OZMa 1-6 O inlet must be approved to carry oxygen (>90 volume percent) and must 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.
- An expert must 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.

### 8.4.3 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 must be made of stainless steel or PTFE pipe.
- The pipework must be 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.
- An expert must 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 dimensioned drawing of the OZMa Fig. 9 shows the position of the inlet connection for ozone on the OZONFILT® OZMa.

### 8.4.4 Cooling Water System

1. The cooling water connections are joined with PE pipes and the connection to the system cabinet is made using a PVC connector kit - see the dimensioned drawing of the OZMa system - Fig. 9.
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 with 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 following dimensioned drawing of the OZMa shows the position of the inlet and outlet connections for refrigerant on the OZONFILT® OZMa.

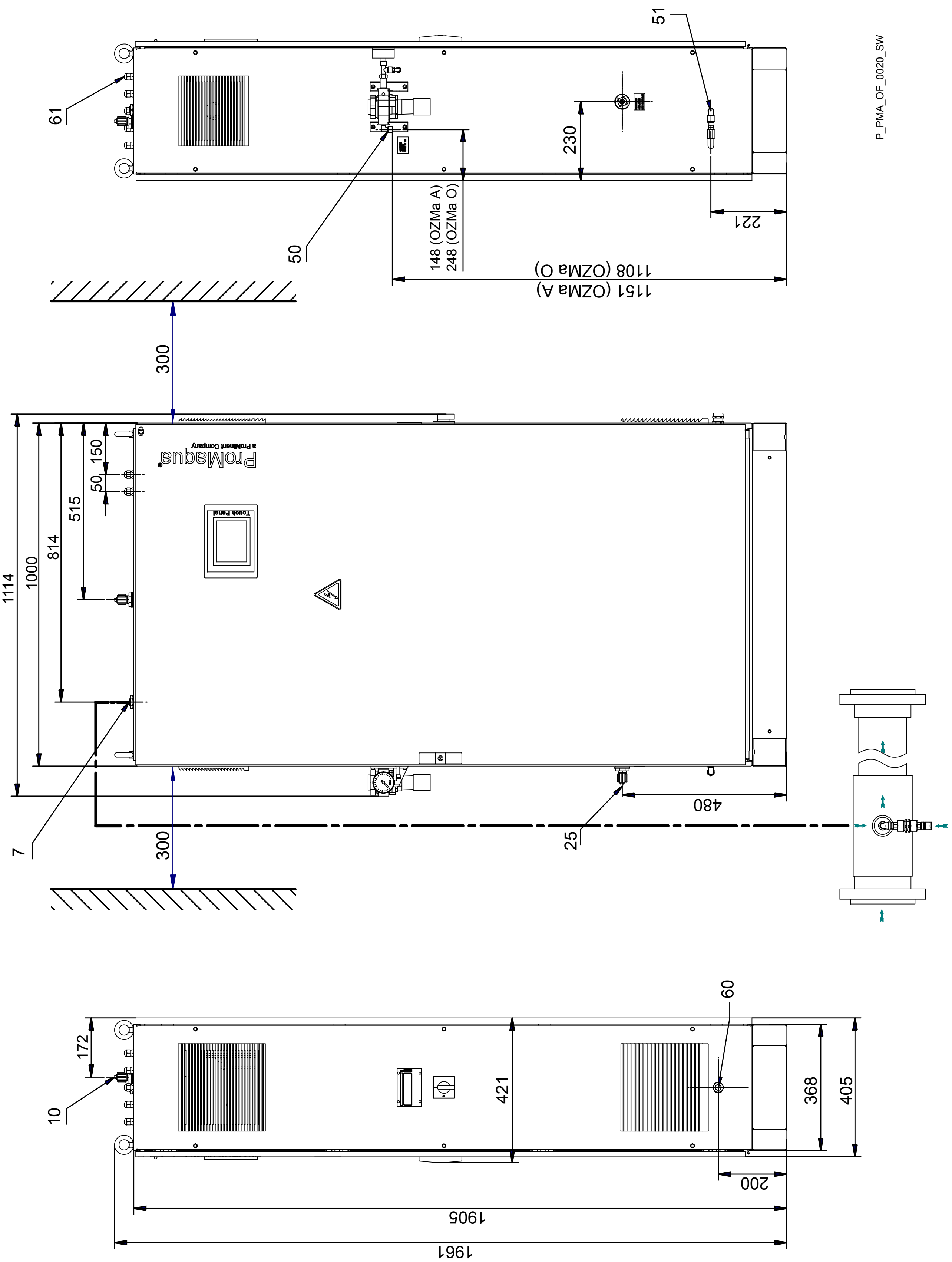



*Fig. 9: OZMa 1-3 system dimensioned drawing*

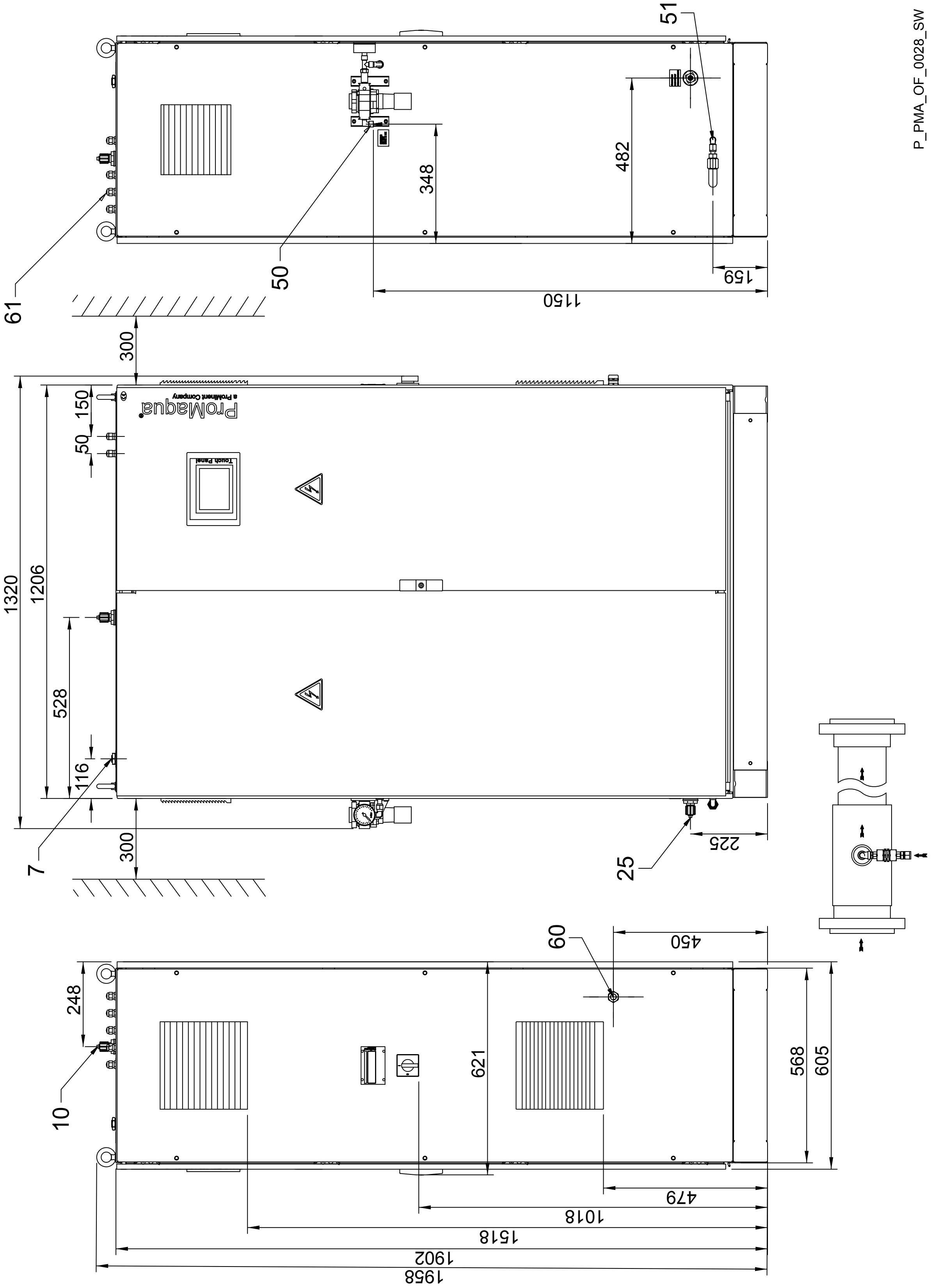


Fig. 10: OZMa 4-6 system dimensioned drawing

| Item | Connector |
|---|---|
| 7 | Ozone outlet Rp 3/8" |
| 10 | Cooling water outlet Ø 12/9 |

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

# 9 Electrical Installation

## 9.1 Information Relating to Electrical Connections

**CAUTION!**

**Warning of malfunctions 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 system must pass through the strain relief screw connections into the inside of the system.

The supply cables must be laid in the cable ducts provided there. Following installation, all of the threaded connectors must be tightened. All of the threaded connectors, which are not used, must be sealed tightly 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. It must be ensured that the live, neutral and protective earth conductors are connected correctly as per the wiring diagram.

The electrical installation of the system must be fixed. 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). This must be installed 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 by the Pause input on the control circuit board - *Chapter 9 'Electrical Installation' on page 54*.

2. The gas detector needed for system operation must have an isolated contact which is electrically connected to the terminals (see 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 wiring diagram in the appendix.

## 9.2 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 wiring 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" means 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" means that the PAUSE status is activated.
- **"Process water flow rate" contact input**

  This input can cause the system to be placed in PAUSE status by way of the minimum contact of the in-line probe housing flow meter. Such an in-line probe housing is employed when using an ozone sensor to the control the ozone concentration. If the sample water flow is too low, the system must be automatically shutdown to prevent incorrect metering.

  "Contact open" means that the PAUSE status is activated.
- **"Ozone warning device" contact input**

  The alarm output of an ozone warning device can be connected to this contact. The ozone warning device must have a potential-free alarm contact.

  "Contact open" means 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 an setpoint of 0 % and a current value of 20 mA corresponds to an setpoint of 100 %.
  - "Control" operating mode:

    In this operating mode, the standard signal input serves 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 either serves to issue an disturbance variable 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 4mA 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 generation" 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 shows 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.

# 10 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 ProMaqua 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 11.7.5 '"Stop" Operating Status' on page 89*.

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 11.7.2 '"Start without Ozone Generation" Operating Status' on page 88*.

   ⇨ 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 10.3 'Adjusting the Cooling Water Flow Rate' on page 61*.

> **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 10.1 'Adjusting the Initial Gas Pressure' on page 60*.

7. Set the desired operating gas flow - ↻ *Chapter 10.2 'Adjusting the Process Gas Flow' on page 60*.

> **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 11 'Operation' on page 62*.z

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.

## 10.1 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.

## 10.2 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.*

## 10.3 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.*

# 11 Operation

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

## 11.1 Touch Panel

The information contained in the touch panel (1-29), as well as the operating options, are shown in Fig. 11.

The touch panel can be used to

- start or stop the entire system,
- set the required ozone output,
- display the system variables measured and
- set various system parameters.

Further information is provided by ✎ *Chapter 11.9 'Display Values on the Touch Panel' on page 90*.

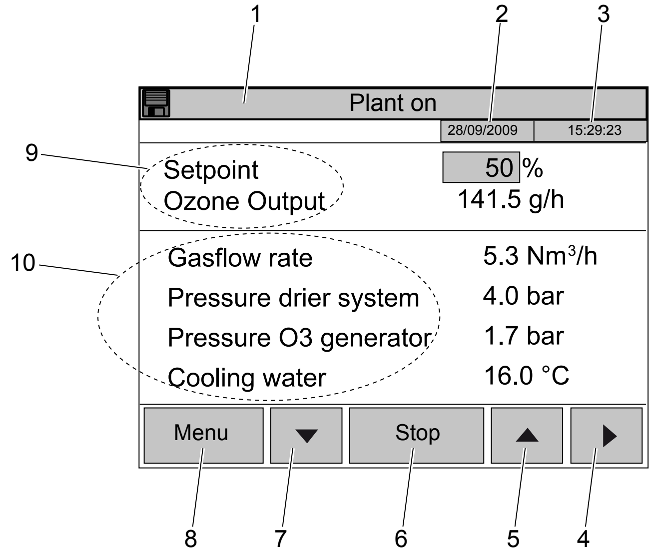



*Fig. 11: Touch panel layout*

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 (required state 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)

## 11.2 Operating Principles

Dependent on the system status ( *'Plant off'*, *'Plant on'*) values can be set via the touch panel.

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 can be displayed Fig. 12

- via *'Menu ➔ Start ➔ ...'*.
- Switch from window to window using 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 key *[UP]* and *[DOWN]* keys.

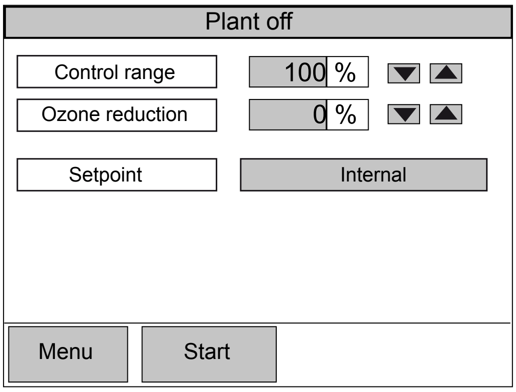



*Fig. 12: Two options for changing a value*

## 11.3 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 for system operation. Once the system has been switched on, a process image will be displayed, in which the key information for ozone generation is presented.

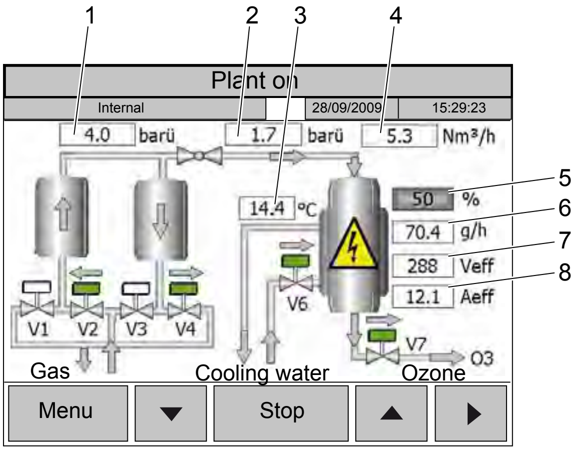



*Fig. 13: Values displayed in the process flowchart OZMa 1-6 A (here under "Plant On" status)*

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

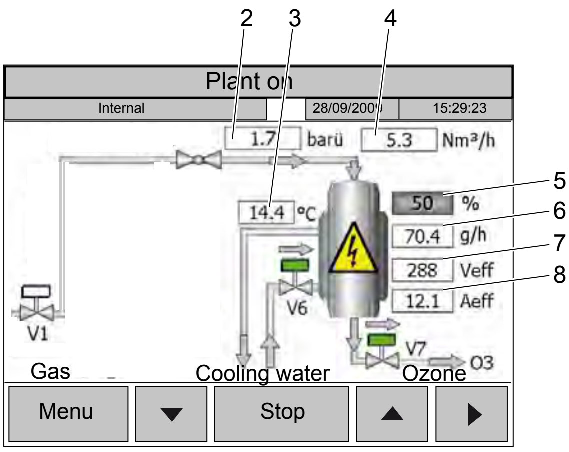



*Fig. 14: Values displayed in the process flowchart OZMa 1-6 O (here under "Plant on")*

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

## 11.3.1 Operating Keys and Control Information

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

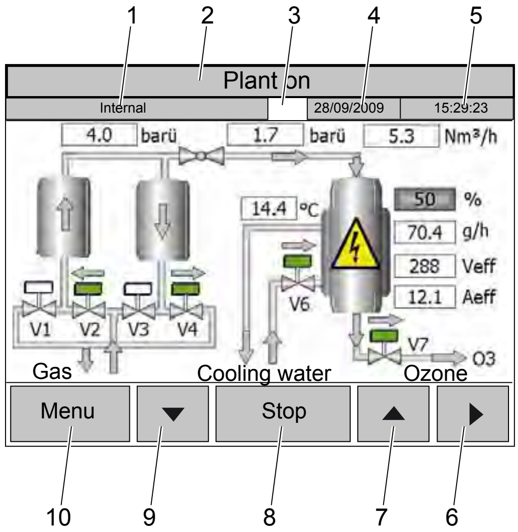



*Fig. 15: System information and operating keys (here: OZMa 1-6 A)*

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]* ▴ keys:
  These keys are used to lower (or better said reduce) or increase set values, e.g.: the setpoint. The operating keys *[DOWN]*▾ and *[UP]* ▴ influence grey highlighted operating fields, such as: the setpoint. 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, which 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)

## 11.3.2 Process flowchart displays

The touch panel displays the components which are involved in the process:

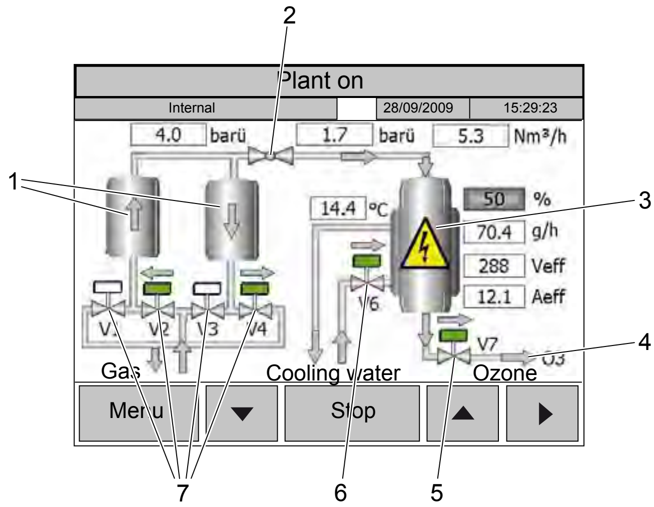



*Fig. 16: Pressure flowchart, here for OZMa 1-3 A*

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 valve (only OZMa 1-3 A)

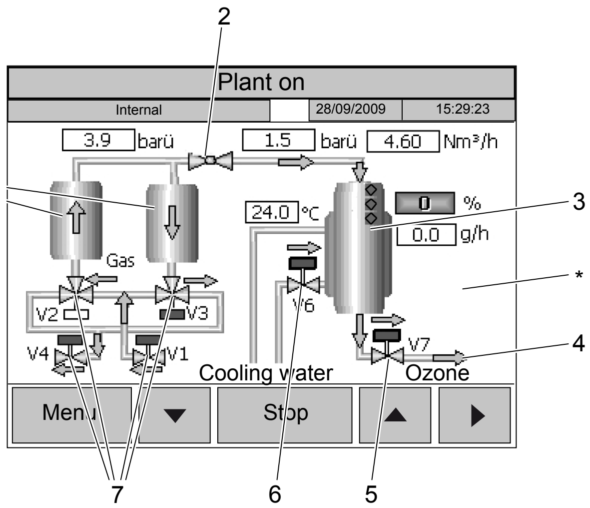



*Fig. 17: Pressure flowchart, here for OZMa 4-6 A*

3 Ozone generators (solid points indicate the number of operating ozone generators)
* Vrms primary voltage and Arms primary current can be read-off for each ozone generator individually in the menu window "Electrical data" - see *on page 67*

## 11.4 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 setpoint | - | 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:

### 11.4.1 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 key lock. This is only possible for the *'EXPERT'* user *'Login' on page 69*.

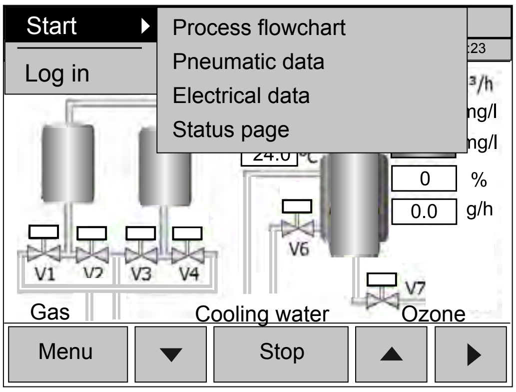



*Fig. 18: This menu selection is available to the OPERATOR user, without ozone sensor and without control.*

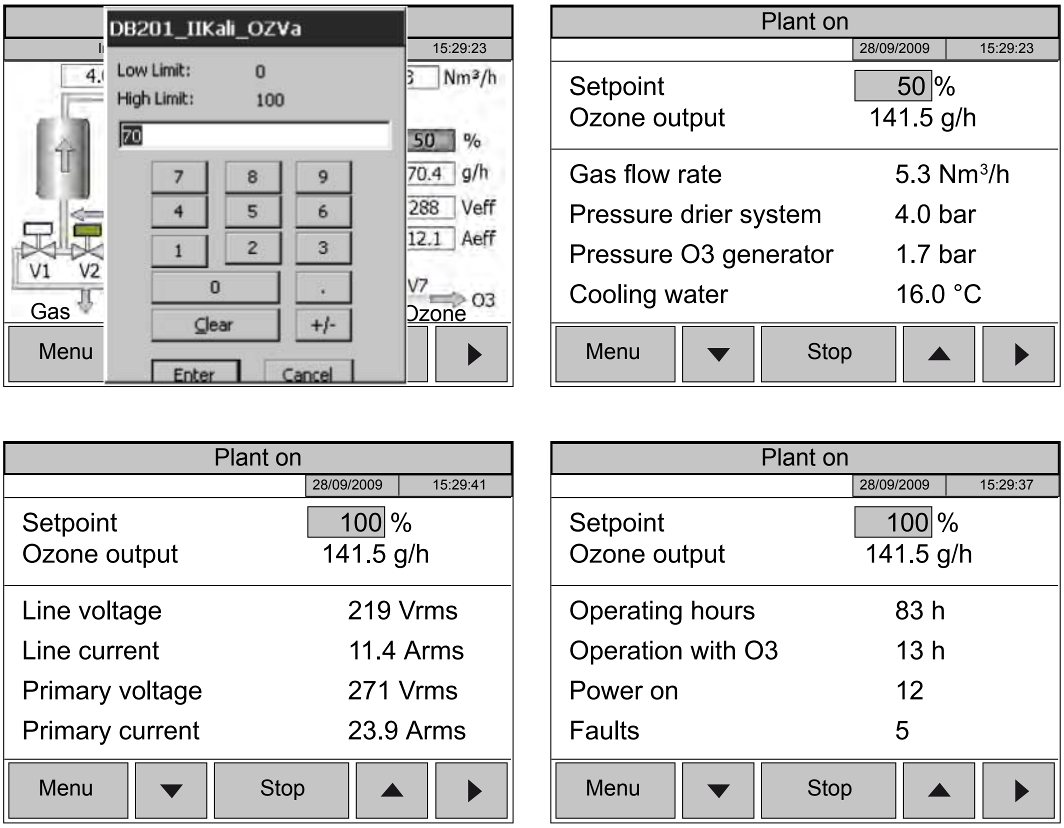



*Fig. 19: Menu window "Process flowchart" with setpoint input, "Pneumatic data", "Electrical data" and "Status page"*

In these sequentially occurring menu windows, the OPERATOR user can read-off the system parameters and set the actuating 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:

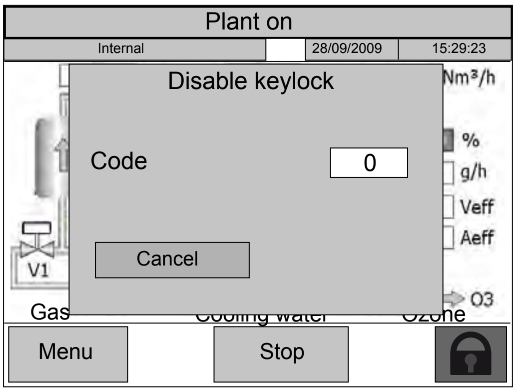



*Fig. 20: Code query when the keyboard lock is activated*

The *'EXPERT'* user must know the code.

### 11.4.2 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 control range,
- changes the value of ozone reduction,
- sets the system time.

**Login**

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


*Fig. 21: The EXPERT login window*

**Logout**

If the *'EXPERT'* user does not log off, the *'EXPERT'* user 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.

## 11.5 Operating Modes and Settings

### 11.5.1 Operating modes

The ozone system is equipped with the following operating modes:

1 - *'Internal'*

2 - *'External'*

3 - *'Automatic control'* (optional)

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

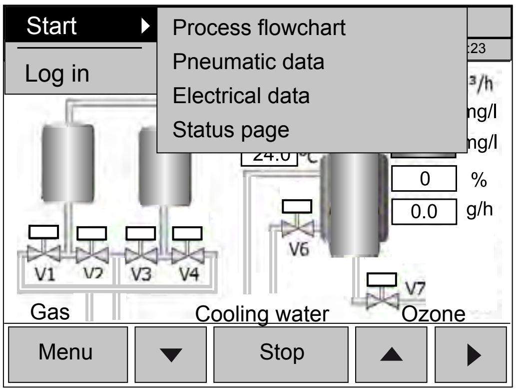



*Fig. 22: Menu selection in "Internal" and "External" operating modes*

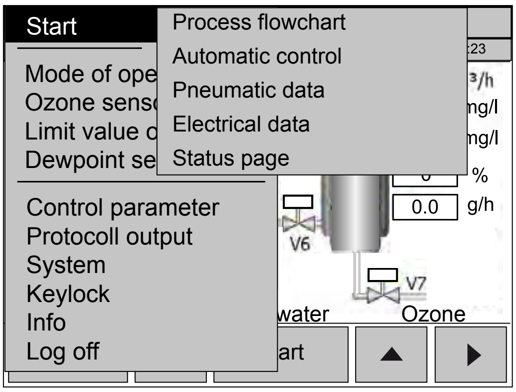



*Fig. 23: Complete menu selection in "Control" operating mode (option)*

#### 11.5.1.1 "Internal" Operating Mode

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

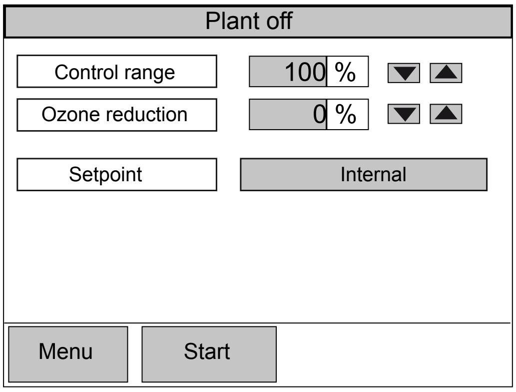



*Fig. 24*

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 %.<br>With an adjustment range of 80 %, a maximum of 0.8 * 140 g/h = 112 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 g/h * (100 - 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.

- *'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

### 11.5.1.2 "External" Operating Mode

In *'external'* operating mode, the actuating variable is specified via a standard signal interface 0/4-20mA. The type of 0-20mA or 4-20mA interface can be selected in the field below it. 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.

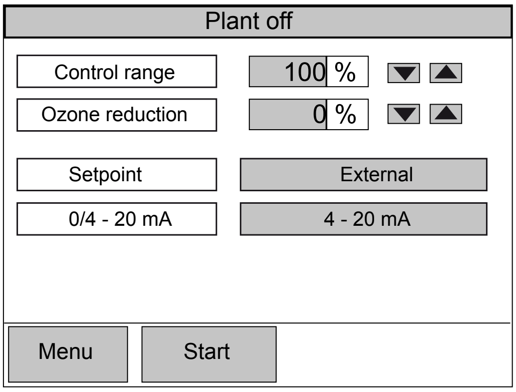



*Fig. 25*

**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 * 140 g/h = 112 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 g/h * (100 - 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.

- *'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

### 11.5.1.3 "Control" operating mode

#### 11.5.1.3.1 Activating the control

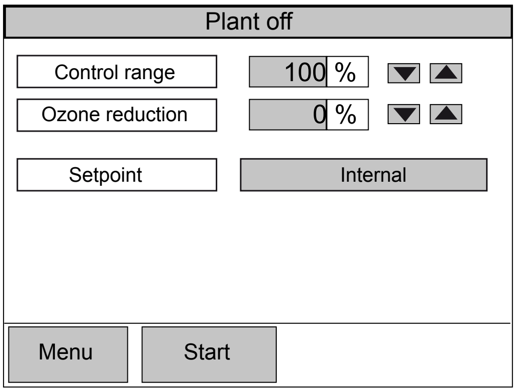



*Fig. 26*

→ in the main menu press *'Mode of operation'* and then press the field *'Internal'* in the menu that appears.

⇨ This then switches to *'Control'* and the field *'Control parameter'* becomes accessible in the main menu *Chapter 11.5.5 'Control parameter' on page 79*.

#### 11.5.1.3.2 Configuring mA input 2

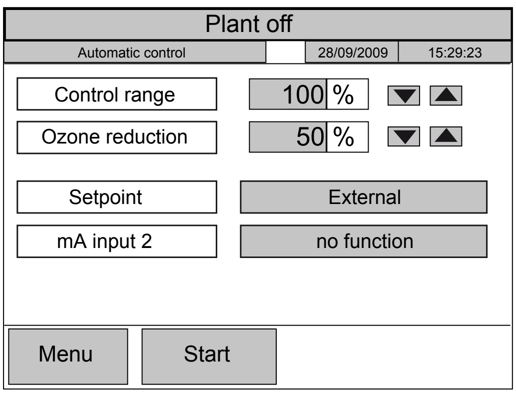



*Fig. 27*

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

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

### 11.5.1.3.3 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 flowchart'*.

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

**External Setpoint**

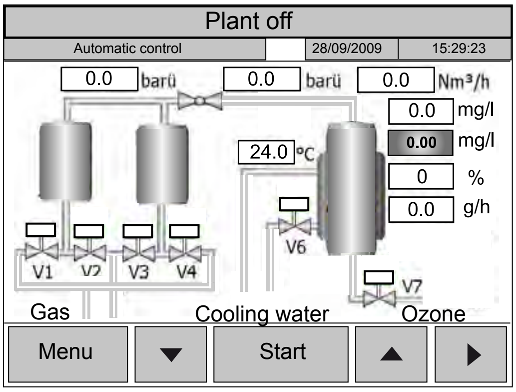



*Fig. 28*

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 corresponds to the measurement range of the sensor (e.g. 2 ppm = 2 mg/l),*

*0 or 4 mA corresponds to 0 mg/l.*

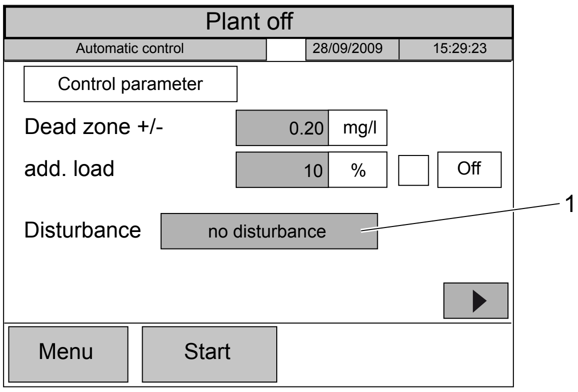



*Fig. 29*

1 Field 1

→ In field 1 select “no disturbance”, “Add. disturbance" or "mult. disturbance".

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 disturbance variables

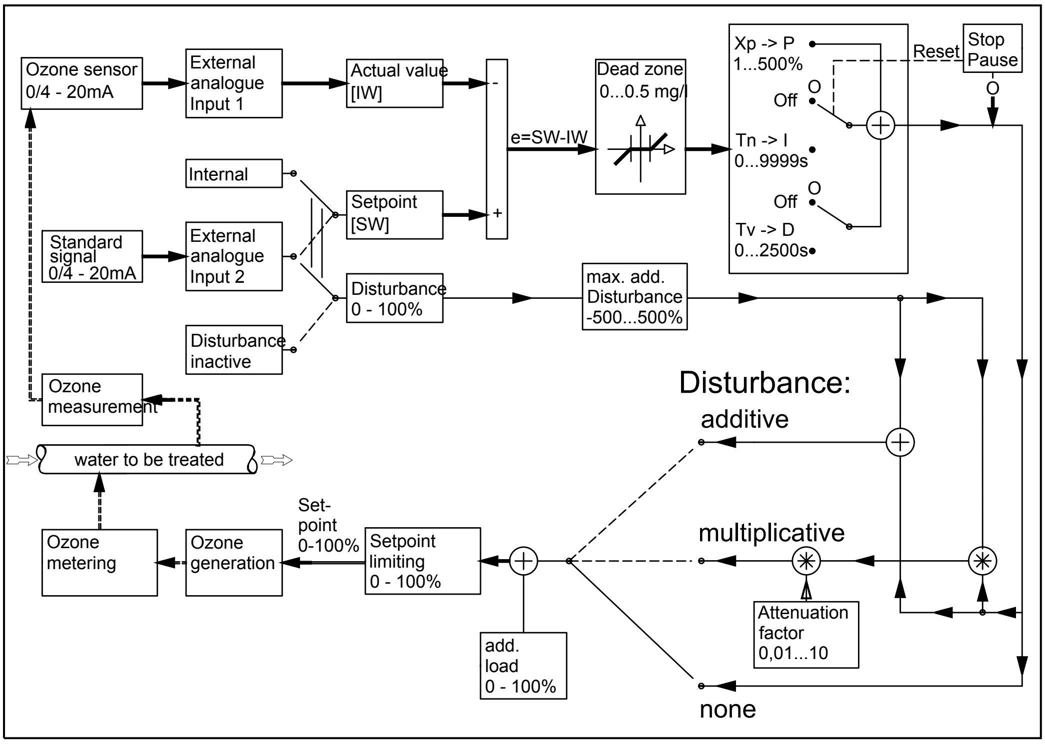



*Fig. 30*

## 11.5.2 Ozone sensor (only with Ozone sensor)

### 11.5.2.1 Configuring the ozone sensor

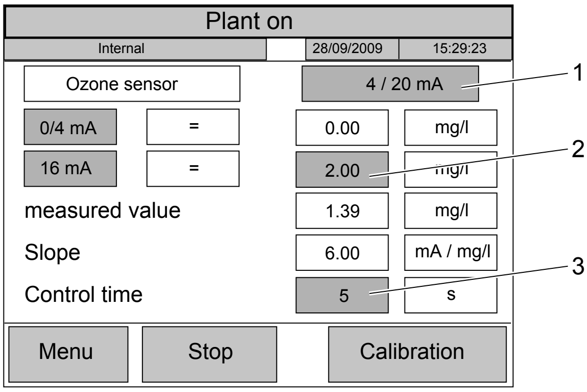



*Fig. 31*

1 Field 1
2 Field 2
3 Field 3

The menu *'Ozone measurement'* also appears in *'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. In the menu which opens select the signal range *'disabled'*, *'0-20 mA'* or *'4-20 mA'*.

3. Enter the ozone sensor measuring range in field 2.
4. Enter the value for the control time in field 3.

### 11.5.2.1.1 Measured Value Checkout Time

> **CAUTION!**
> This function must not be activated in applications where it can be assumed that the measured value will not change.

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

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

### 11.5.2.2 Calibrating the ozone sensor

- Pre the *[CALIBRATION]* key in Fig. 31 and enter the value measured by DPD for the calibration.
  - ⇨ The slope is then recalculated on the basis of the entered value.

If the slope reported is too low or too high, the DPD measurement and the ozone measuring 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 prediluting the sample with oxidant-free water.

## 11.5.3 Limit Value Ozone Sensor (only with Ozone Sensor)

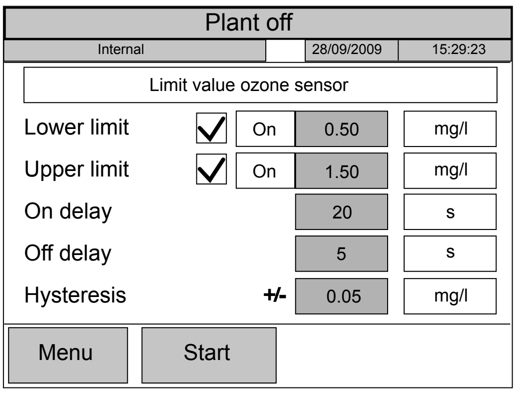



*Fig. 32*

This menu opens after pressing *'Limit value ozone sensor'* in the main menu. The limit values, switch-on and -off delays and hysteresis can be entered directly.

Adjustment Options

**Switch on delay:**

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

**Switch-off delay:**

The length of time within which a limit value transgression must occur before the limit value 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 value 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 *'Upper limit'* is only resolved when the measured value falls below 1.45 mg/l. A transgression of the *'Lower limit'* is only resolved when the measured value rises above 0.55 mg/l.

This lowers the limit value transgression switching rate.

## 11.5.4 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.

## 11.5.5 Control parameter

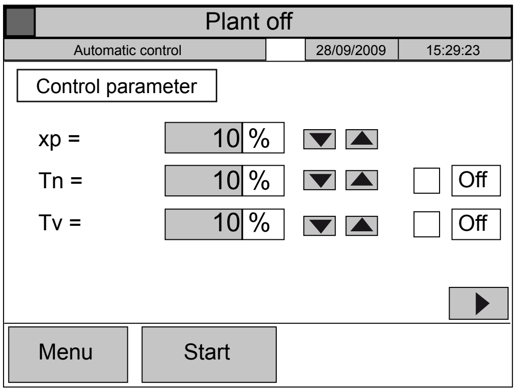



*Fig. 33*

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 "disturbance" opens, if "mA input 2" was configured accordingly.

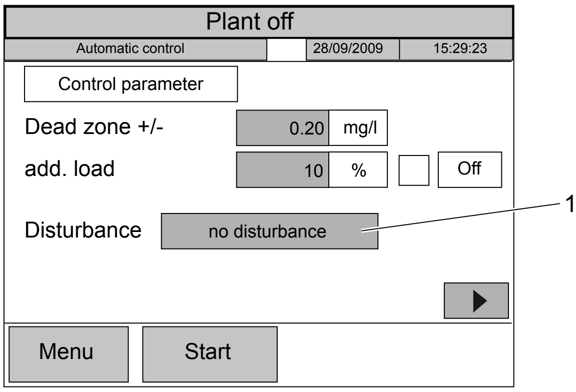



*Fig. 34*

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 Tn.

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 Tv. 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.*

## 11.5.6 Gasflow rate mode (optional)

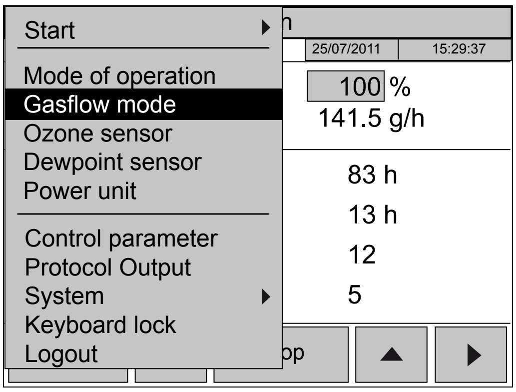



*Fig. 35: Gasflow mode (control valve)*

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

1 - *'Off'*

2 - "On" "Mode of operation" "Manual"

3 - "On" "Mode of operation" "Flow"

4 - "On" "Mode of operation" "Concentration"

The process flowchart shows the operating modes using pictograms:

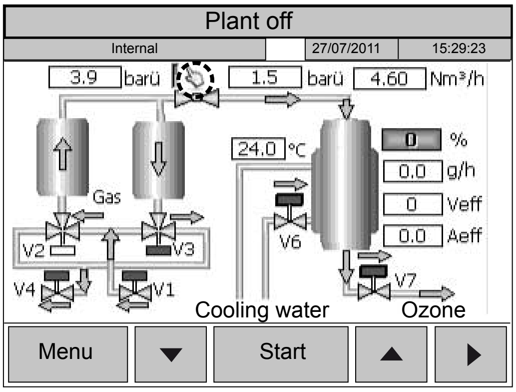
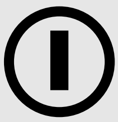
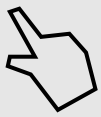
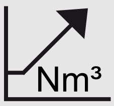
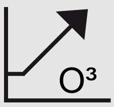



*Fig. 36: Process flowchart with pictogram for manual operating mode (in the dotted line circle). To the left of this the small vertical bar shows how far open the control valve is.*

| Pictogram | Operating mode |
|---|---|
|  | *'Off'* |
|  | "On" "Mode of operation" "Manual" |
|   | "On" "Mode of operation" "Flow" |
|   | "On" "Mode of operation" "Concentration" |

The "EXPERT" user can select all 4 operating modes displayed in the following menu window.

### 11.5.6.1 Off

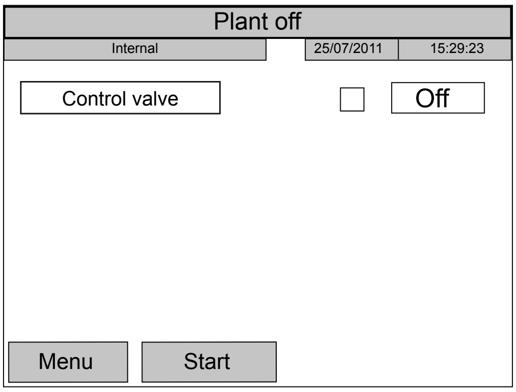



*Fig. 37*

The control valve is not in operation and closed - the gas flow is not regulated.

The gas flow can be adjusted at the needle valve which is positioned in parallel to the control valve. This makes sense for test purposes or if the control valve should not be operating.

### 11.5.6.2 On, manual operating mode

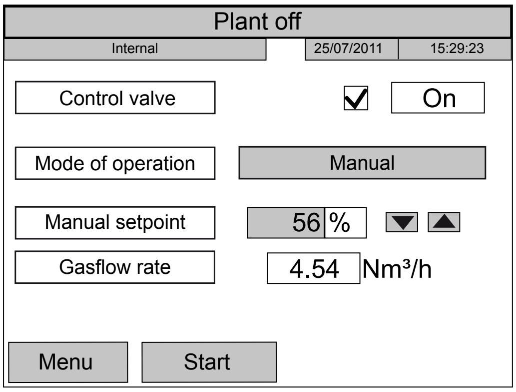



*Fig. 38*

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

The setpoint of the gas flow can be manually entered in the field "Setpoint manual" field. The current gas flow rate is shown by the field "Gasflow rate".

> *The value must be between 0 and 100 % and relates to the position of the control valve and not to the gas flow rate.*

### 11.5.6.3 On, flow operating mode

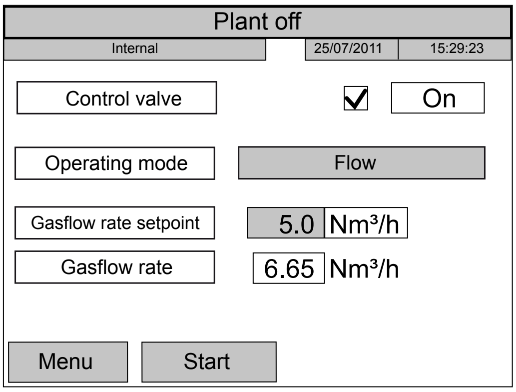



*Fig. 39*

The control valve is operating - the gas flow rate is regulated.

The setpoint of the gas flow rate can be set in the field "Setpoint Gasflow rate". The actual gas flow rate is shown in the field "Gasflow rate" in $Nm^3/h$ (normalised cubic metres / hour).

In this operating mode, operation with an effectively constant gas flow rate is possible. Thus for example pressure changes in the raw water, which in normal operation would change the gas flow, are largely regulated out.

*The value range of possible inputs depends on the system type.*

### 11.5.6.4 On, O3 concentration operating mode

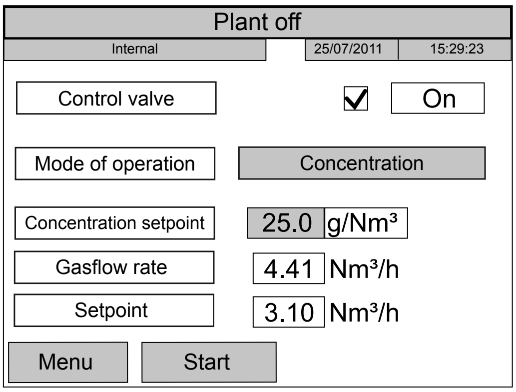



*Fig. 40*

The control valve is operating - the $O_3$ concentration is regulated.

The setpoint for the ozone concentration can be entered in the field "Setpoint concentration". The necessary setpoint for the "Gasflow rate" is calculated by the system control and displayed in the "Setpoint" field in $g/Nm^3$ (grams per normalised cubic meter).

The system control can adjust the desired ozone concentration, insofar as this is possible with the required ozone output and calculated gas flow rate in within the control range of the control valve. Otherwise the maximum possible ozone concentration is set under the pertaining conditions. @Error message?

*The value range of the possible entries depends on the system type:*

*Oxygen systems OZMa_ _O_: 70 ... 150 g/Nm³*

*Air systems OZMa A: 18 ... 30 g/Nm³*

During conventional operation without gas control, the capacity setting is influenced so that the ozone concentration reduces at constant gas flow rate.

Example of gas control advantage

Requirements:

Assume an OZMa 03A system type operating using air as the operating gas.

With a setpoint of 100%, the rated ozone generation is 140 g/h.

With a nominal concentration of 20 g/$Nm^3$, the gas flow rate must be 7 $Nm^3$/h.

**Operation without gas control:**

With a setpoint of 50 % (70 g/h) and a constant gas flow rate of 7 $Nm^3$/h, the control reduces the concentration from 20 g/$Nm^3$ to 10 g/$Nm^3$.

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

Under these conditions, the system requires **7 $Nm^3$/h** for ozone generation

**Operation with gas control:**

The control reduces the gas flow rate from 7 $Nm^3$/h to 3.5 $Nm^3$/h using the control valve at a concentration setpoint of 20 g/$Nm^3$.

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

Under these conditions, the system requires **3.5 $Nm^3$/h** for ozone generation

*If the ozone concentration deviates from the nominal ozone concentration, then the maximum produceable ozone output also deviates from the nominal ozone production.*

## 11.5.7 Protocol Output

The protocol output can be configured from this menu.

## 11.5.8 System

### 11.5.8.1 Setting the Time

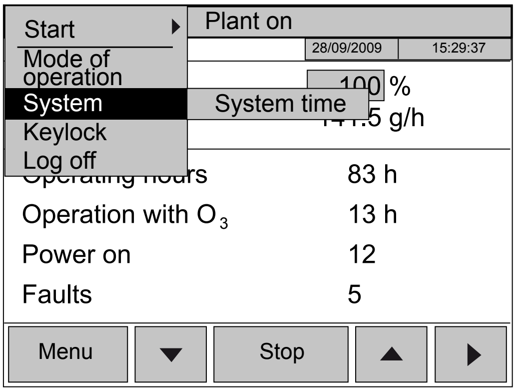



*Fig. 41: "System Time" menu window*

The *'EXPERT'* can set the *'Time'* via *'Menu ➔ System ➔ System time'*.

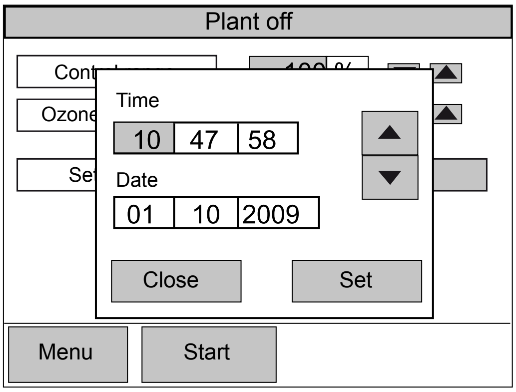



*Fig. 42: Setting the Time*

### 11.5.8.2 Record Data

The following are accessible from the menu "Save Logfile (Act)":

Every morning, the touch panel control writes log data to the SD card which is inserted in it. If up-to-date log data are now required for maintenance during the afternoon, then the user can trigger the writing of the current data to the SD card by selecting "Save Logfile (Act)".

## 11.5.9 Keyboard lock

The "EXPERT" user can activate or clear the keyboard lock from this menu.

### 11.5.10 Info

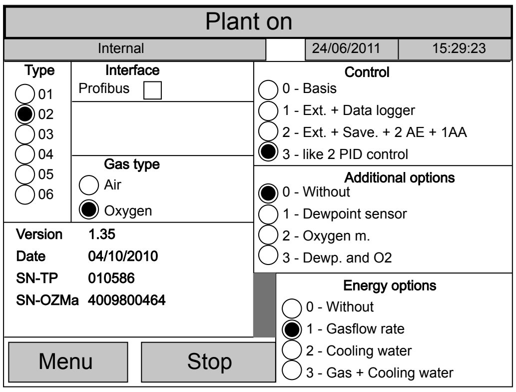



*Fig. 43*

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

### 11.5.11 Login - Logout

In this menu the operator can log in as an "EXPERT" user to make more advanced adjustments. Likewise he logs out from this menu, so that the adjustment options are again immediately blocked.

## 11.6 Functional Process

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

The system is ready for operation.

The system starts operation if the "START" key is pressed, if

- "PAUSE" mode has not been externally activated,
- 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, the required ozone output ( "setpoint" display) is preset 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 status, without the generation of ozone (high voltage switched off). The actuating variable must be at least 3 % to switch on ozone generation.*

## 11.7 Important System Statuses

### 11.7.1 "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.

### 11.7.2 "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!

### 11.7.3 "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 13 'Troubleshooting' on page 98*,
- The operating signal relay and the fault signal relay will be activated.

### 11.7.4 "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!

### 11.7.5 "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.

### 11.7.6 "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.

### 11.7.7 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.

## 11.8 Displays

### 11.8.1 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 pre-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.

## 11.9 Display Values on the Touch Panel

### 11.9.1 Actuating Variable in "Internal" Operating Mode

The required ozone output can be set as a percentage using the actuating variable. In "Internal" operating mode, the value is set using the "UP" "▴" or "DOWN" "▾" key. A setting value of 100 % corresponds to the maximum ozone output (see Chapter 14 "Technical Data").

### 11.9.2 Setpoint in "External" Operating Mode (Option)

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

### 11.9.3 Ozone output

The display shows the approximate ozone output 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 operating 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 setpoints.

## 11.9.4 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.

## 11.9.5 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.

## 11.9.6 Cooling water

The display indicates the average temperature, which is 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.

## 11.9.7 Primary current

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

The displayed measured value depends on the set "Setpoint".

## 11.9.8 Primary voltage

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

## 11.9.9 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 power ons,
- Number of error messages requiring acknowledgement.

## 11.9.10 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 % control range, the ozone setting of 0 - 100 % corresponds to the range 0 ... 140 g/h.<br>In the 80 % control range, the ozone setting of 0 - 100 % corresponds to the range 0 ... 112 g/h. |

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

## 11.9.11 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 output 140 g/l*0.9 = 126 g/h, ozone reduction contact closed, generates an ozone output 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 output can be achieved.

## 11.9.12 "Internal" / "External" operating mode

The "UP" "▲" and DOWN▼ keys can be used to change the type of ozone output setting:

internal - The ozone output, can be set in % steps in the "Setpoint" display, as described above using the keyboard.

external - The ozone output 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 operating status changes automatically to "STOP" operating mode and has to be restarted by the user.

## 11.9.13 0/4-20 mA

Should the ozone output 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.

## 11.9.14 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
- ... possibly further languages

# 12 Maintenance

WARNING!

Maintenance and repair may only be performed by qualified personnel and by personnel authorised by ProMaqua.

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.

## 12.1 Safety guidelines for maintenance and repair

- Only service technicians may service or repair the system.
- Persons, who undertake maintenance and repair work on the system, must have read and understood the operating instructions and in particular the chapter relating to "Safety".
- For reasons of safety, when the system is idle, the mains switch must be switched off as a matter of principle if protection devices are opened. Appropriate measures must be 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 that check directly after completion of the work that this equipment is fulfilling its function properly.
- Pipes must be 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.

## 12.2 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 | Remarks | Interval |
|---|---|---|---|---|
| setpoint (ozone) | | % | | daily |
| Ozone output (generation rate) | | g/h | | daily |
| Gas flow rate | | l/h | | daily |
| Cooling water (output 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 | | - | Dependent on ambient conditions | Monthly |
| Inspection of the non-return valves (11, 37) at the ozone outlet | | - | Dependent on raw water quality | Monthly |

**CAUTION!**
Blocked filter mats in the fan or in the output 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.

## 12.3 Regular Maintenance

WARNING!
Observe the safety guidelines for maintenance - ↪ *Chapter 12.1 'Safety guidelines for maintenance and repair' on page 94*.

CAUTION!
The OZONFILT® OZMa 1- 6 should be serviced at least once per year to maintain the system operability and safety.

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

| Interval | Maintenance work |
|---|---|
| weekly* | Only with maintenance unit: Checking of the liquid level of the maintenance unit storage tank - see ↪ *'Maintenance of the maintenance unit (optional)' on page 96*. |
| | Only with maintenance unit: Monitoring of the maintenance unit filter elements - see ↪ *'Maintenance of the maintenance unit (optional)' on page 96*. |
| At least yearly | Inspect the pneumatic system (leaks, tubes) |
| | Inspect (leakages, deposits, tubes) 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 tubes at the outputs of the ozone generators |
| | Check the operation of the electrical system (locks, system parameters etc.) |
| | Replace the filter mats in the ozone cabinet |

CAUTION!
Fan filter mats and air outlet filters should be inspected monthly and must be replaced at least once per year and more often under unfavourable conditions.

**Maintenance of the maintenance unit (optional)**

CAUTION!
In condensate arises in the hose between the maintenance unit and the system internals, the system can be seriously damaged.

– Stop the system immediately and place out of operation.
– Call customer service or a ProMaqua or ProMinent authorised person.

**CAUTION!**
Observe the maintenance unit operating instructions.

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

If there is condensate in a maintenance unit storage tank, empty the tank by hand.

If the filter elements of the maintenance unit are heavily contaminated (visible from the outside), replace them.

# 13 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 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, this system may only be examined by appropriately qualified technical personnel.
– Prior to working on the OZONFILT® OZMa, always read the safety information in the "Safety" chapter.

WARNING!

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

– Either wait for 24 h until the ozone has decomposed naturally
– or 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. Here also, do not forget the ozone in the external piping!

The faults listed in the table - *Table on page 100* below 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 output, cooling water inlet) from the remaining system.

3 - The touch panel will display an error message, which will give the cause of the fault.

The control monitors every analog measured variable within the system in several stages. There is generally a warning threshold and a switching off threshold.

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

If a "Shutdown level" 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 "On delay". The switch on delay is also based on the type of fault.

Following the so-called "Retry 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 switching 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 the *[STOP]* / *[Start]* key.

To restart the system press this key again.

Following a fault, the control will shut down the system in stages:

1 - The high voltage will be switched off.

    The system will continue to run for some time without ozone being generated. This will remove residual ozone from the system.

2 - All of the solenoid valves on the pneumatic branch will close.

3 - After a flush period, the solenoid valve on the cooling water inlet will also close.

4 - The relevant fault alert will appear on the touch panel.

| Error no.* | Fault 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 pre-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 pre-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.<br>Set the pressure of the process water so that the maximum pressure at the ozone generator output does not exceed 2.0 bar. |
| 3 | System pre-pressure too low | Gas preparation unit operating pressure pressure sensor | The operating pressure at the system inlet is too low. | Increase the system pre-pressure at the pressure regulating valve (27). Clean the filter unit in the compressed air system, if necessary replace the filter cartridges. |
| 3 | System pre-pressure too high | Gas preparation unit operating pressure pressure sensor | The operating pressure at the system inlet is too high. | Reduce the system pre-pressure at the pressure regulating valve (27). |
| 4 | Cooling water temperature too low | Temperature sensor at cooling water outlet | Cooling water temperature less than 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 greater 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.* | Fault 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 ozone generator output 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.<br>OZMa A only: arrange for customer service to check the drier system. |
| 9 | Oxygen content too low | Oxygen sensor (option) | 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. |
| 12 | Cooling water flow rate too low | Cooling water flow meter | Cooling water flow is below the minimum level | Check the cooling water pre-pressure and increase if necessary. Inspect the cooling system piping outside and within the cabinet for deposits which could be leading to blockages - clear if necessary. Increase the cooling water flow rate at the angle valve (9). Check the solenoid valve and cooling water inlet for correct operation. Install a pressure regulator with filter upstream of the cooling water inlet outside the control cabinet. |

| Error no.* | Fault message | Switch-off due to... | Cause | Remedy |
|---|---|---|---|---|
| 13 | Ozone alarm!! | Ozone warning device | Ozone gas leak | **Observe the safety information before entering the room. Under no circumstance must the system be restarted before the cause of the ozone alarm has been located and cleared. Locate and seal the ozone gas leak.** |
| 14 | Water flowrate 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 be activated!** |
| 15 | Gas system flooded!! Do not restart!! | Water trap | The contact in the water trap has triggered. | **Do not start the system under any circumstances, as process water may be present in the ozone generator. Check the gas system and the ozone generator for water ingress. If necessary, open the gas system and the ozone generator and dry completely. Check the non-return valves and the solenoid valve at the system ozone outlet and the point of injection for leak-tightness and replace as necessary.** |
| 19 | Control valve control deviation too high | - | Gas flow rate differs too greatly from the setpoint. | Check ozone gas pipework and valves are clear.<br>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 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. |

| Error no.* | Fault message | Switch-off due to... | Cause | Remedy |
|---|---|---|---|---|
| 31 | Cabinet door open!! | Monitoring of the door switch | The contact in the door switch has triggered | Close the control cabinet door. |
| 33 | Check the pressure sensor drier | Pressure sensor drier | Sensors are not connected or are outputting an implausible analog signal. | Check the sensor connection cable, check the analog signals, if necessary replace the connection cable or the sensors. |
| 34 | Check the pressure sensor O3 generator | Ozone pressure sensor | | |
| 35 | Check the gas flow sensor!! | Gas flow sensor | | |

*) program internal numbering

# 14 Decommissioning and disposal

## 14.1 Decommissioning

WARNING!

**Caution high voltage**

- Always disconnect the system from the power supply before beginning work on the OZONFILT® OZMa.
- Wait at least 5 minutes after the system has been disconnected from the mains 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!

**Toxic ozone gas**

Before opening the ozone gas system, the ozone must be extracted safely from the gas pipes.

- Either wait for 24 h until the ozone has decomposed naturally
- or 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. Here also, do not forget the ozone in the external piping!

## 14.2 Disposal

WARNING!

- First decommission the system according to the chapter "Decommissioning".

WARNING!

**Danger to persons and the environment**

Pay special attention to chemicals, control unit electronic waste and for the type A, the molecular sieve of the drier unit, upon disposal.

The molecular sieve can concentrate toxins contained in the ambient air.

- Observe the conditions which apply to your site.

# 15 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!

## 15.1 Complete System

Ambient parameters

| Data | Value | Unit |
|---|---|---|
| Max. temperature | 40 | °C |
| % rel. humidity, max * | 85 | % |

* non-condensing

Air quality: dust-free, non-corrosive

OZMa 1-3 A (air 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 capacity, measured as per DIN standards with air at 20 °C, cooling water at 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 referenced to standard conditions | $g/Nm^3$ *) | 20 | 20 | 20 |
| Specific energy requirement at nominal capacity | 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" inner | G 3/8" inner | G 3/8" inner |
| 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 | | IP 43 | IP 43 | IP 43 |
| Overall dimensions (without mixing unit) | | | | |
| Width | mm | 1114 | 1114 | 1114 |
| Height | mm | 1961 | 1961 | 1961 |

| Ozone generation systems | Unit | OZMa 1 A | OZMa 2 A | OZMa 3 A |
|---|---|---|---|---|
| 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 | Residue oil content < 0.01 mg/m³, dust-free - max. particle size < 0.01 µm, non-corrosive, constant primary pressure of 4 - 10 bar** | | | |
| **Cooling water** | | | | |
| Cooling water requirement (15 °C) | l/h | 90 | 135 | 180 |
| Cooling water requirement (30 °C) | l/h | 200 | 300 | 400 |
| Cooling water inlet pressure*** | bar | 2 - 5 | 2 - 5 | 2 - 5 |
| Cooling water inlet, PE pressure tube | 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 limescale, no corrosive components; settleable 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 | | | |

*) $Nm^3$ = $m^3$ at standard temperature and pressure (p = 1.013 x 105 Pa, T = 273 K)

** achievable using maintenance unit (optional)

***) 2 bar only with free output directly to the system

OZMa 4-6 A (air 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 capacity, measured as per DIN standards with air at 20 °C, cooling water at 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 referenced to standard conditions | g/Nm³ *) | 20 | 20 | 20 |
| Specific energy requirement at nominal capacity | 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" inner | G 3/8" inner | G 3/8" inner |
| 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 | | IP 43 | IP 43 | IP 43 |
| **Overall dimensions (without mixing unit)** | | | | |
| Width | mm | 1314 | 1314 | 1314 |
| 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 | Residue oil content < 0.01 mg/m³, dust-free - max. particle size < 0.01 µm, non-corrosive, constant primary 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 | 600 | 800 | 1200 |
| Cooling water inlet pressure*** | bar | 2 - 5 | 2 - 5 | 2 - 5 |
| Cooling water inlet, PE pressure tube | 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 limescale, no corrosive components; settleable 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 | | | |

*) $Nm^3$ = $m^3$ at standard temperature and pressure (p = 1.013 x 105 Pa, T = 273 K)

** achievable using maintenance unit (optional)

***) 2 bar only with free output directly to the system

OZMa 1-3 O (Oxygen Process 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 output 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 capacity | Wh/g | 9 | 9 | 9 |
| min. power factor at full capacity | cos φ | >0.95 | >0.95 | >0.95 |
| Ozone connection | | G 3/8" inner | G 3/8" inner | G 3/8" inner |
| 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 | | IP 43 | IP 43 | IP 43 |
| **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** | | | | |
| 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 capacity 100 g/$Nm^3$ | $Nl^3/h$ | 1050 | 1580 | 2100 |
| Gas volume at output 150 g/$Nm^3$ | $Nl^3/h$ | 400* | 600* | 800* |
| Gas volume at output 80 g/$Nm^3$ | $Nl^3/h$ | 1540 | 2300 | 3100 |

| Ozone generation systems | Unit | OZMa 1 O | OZMa 2 O | OZMa 3 O |
|---|---|---|---|---|
| Concentration min. | vol% | 90 | 90 | 90 |
| Max. dewpoint | °C | -50 | -50 | -50 |
| Pressure | bar | 3 ... 6 | 3 ... 6 | 3 ... 6 |
| Particles max. | µm | 5 | 5 | 5 |
| Hydrocarbons max. | ppm | 20 | 20 | 20 |
| Max. temperature | °C | 30 | 30 | 30 |
| **Cooling water** | | | | |
| Cooling water requirement (15 °C) | l/h | 120 | 180 | 240 |
| Cooling water requirement (30 °C) | l/h | 200 | 300 | 400 |
| Cooling water inlet pressure*** | bar | 1 ... 5 | 1 ... 5 | 1 ... 5 |
| Cooling water inlet, PE pressure tube | 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 limescale, no corrosive components; settleable 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 at standard temperature and pressure (p = 1.013 x 105 Pa, T = 273 K)

***) 2 bar only with free output directly to the system

OZMa 4-6 O (Oxygen Process Gas)

| Ozone generation systems | Unit | OZMa 4 O | OZMa 5 O | OZMa 6 O |
|---|---|---|---|---|
| **Ozone generation systems** | | | | |
| Number of generation modules | - | 2 | 2 | 3 |
| Nominal output at 100 g/Nm³ ** and cooling water: 15 °C | g/h | 320 | 420 | 630 |
| Ozone output at 150 g/Nm³* | g/h | 180 | 240 | 360 |
| Ozone output at 80 g/Nm³ | g/h | 370 | 490 | 735 |
| Specific energy requirement at nominal capacity | Wh/g | 9 | 9 | 9 |
| min. power factor at full capacity | cos φ | >0.95 | >0.95 | >0.95 |
| Ozone connection | | G 3/8" inner | G 3/8" inner | G 3/8" inner |
| Max. sound pressure level | | less than 70 dB (A) | less than 70 dB (A) | less than 70 dB (A) |

| Ozone generation systems | Unit | OZMa 4 O | OZMa 5 O | OZMa 6 O |
|---|---|---|---|---|
| **Electrical connections** | | | | |
| Mains connected load | V / Hz / A | 400 / 50; 60 / 16 | 400 / 50; 60 / 16 | 400 / 50; 60 / 16 |
| Degree of protection | | IP 43 | IP 43 | IP 43 |
| **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 capacity 100 g/Nm$^3$ | Nl$^3$/h | 3200 | 4200 | 6300 |
| Gas volume at output 150 g/Nm$^3$ | Nl$^3$/h | 1200* | 1600* | 2400* |
| Gas volume at output 80 g/Nm$^3$ | Nl$^3$/h | 4630 | 6130 | 9190 |
| Concentration min. | vol% | 90 | 90 | 90 |
| Max. dewpoint | °C | -50 | -50 | -50 |
| Pressure | bar | 3 ... 6 | 3 ... 6 | 3 ... 6 |
| Particles max. | µm | 5 | 5 | 5 |
| Hydrocarbons max. | ppm | 20 | 20 | 20 |
| Max. temperature | °C | 30 | 30 | 30 |
| **Cooling water** | | | | |
| Cooling water requirement (15 °C) | l/h | 200 | 280 | 420 |
| Cooling water requirement (30 °C) | l/h | 330 | 470 | 700 |
| Cooling water inlet pressure*** | bar | 1 ... 5 | 1 ... 5 | 1 ... 5 |
| Cooling water inlet, PE pressure tube | 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 limescale, no corrosive components; settleable 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/Nm$^3$ must be factory configured as a non-standard design

**) Nm$^3$ = m$^3$ at standard temperature and pressure (p = 1.013 x 105 Pa, T = 273 K)

***) 2 bar only with free output directly to the system

## 15.2 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 | Veff |

Connection to L1, N, PE

* +/- 10 %

OZMa 4-6

| Data | Value | Unit |
|---|---|---|
| Mains supply frequency | 50/60 | Hz |
| Nominal voltage* | 400 | Veff |

Connection to L1, N, PE

* +/- 10 %

Fuses

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

| Descrip-tion | Type | Supplied . . | Terminals | Part no. |
|---|---|---|---|---|
| F1 | 3.15 ATT | Relay outputs for solenoid valves | X5: 1-12,<br>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 |

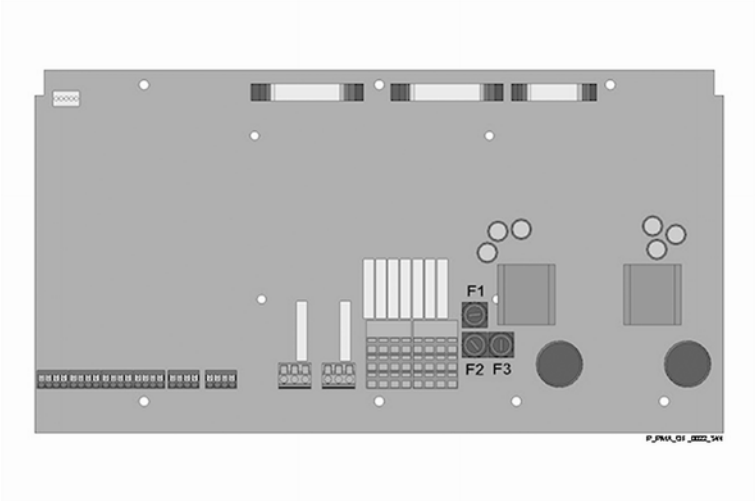



*Fig. 44: Position of fuses on the communication circuit board*

Power supply PCB (1-16): Micro fuse 5 x 20 mm

| Descrip-tion | Type | Supplied . . | Terminals | Part no. |
|---|---|---|---|---|
| F4 | 0.63 AT | Main supply to control | - | 712030 |
| F5 | 0.63 AT | Touch panel and external sensors | - | 712030 |

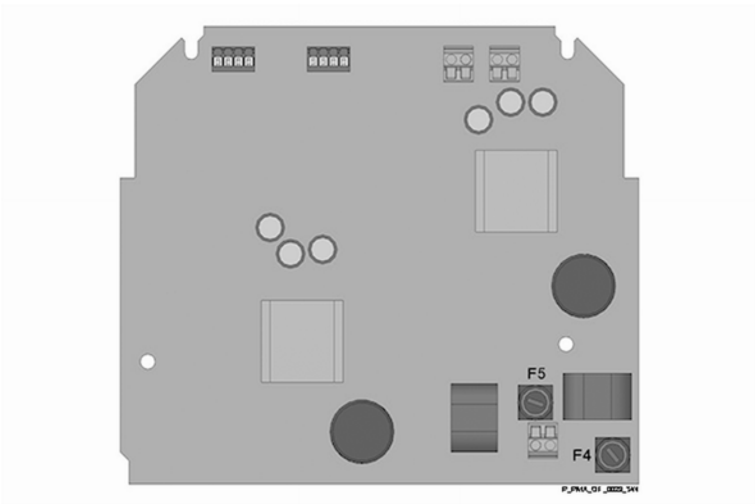



*Fig. 45: Position of fuses on the communication PCB*

## Inputs

### Digital inputs

Pause (X3: 7,8), Ozone 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 (setpoint or ozone sensor, X3: 15,16,17)

Standard signal input 2 (disturbance 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), Operating status messages (X4: 4,5,6), Ozone threshold (X4: 7,8,9)

Type of contact: Changeover contact

| Data | Value | Unit |
|---|---|---|
| Load capacity* | 100 | VA |

* at 250 Veff / 3 A

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

Type of contact: Changeover contact

| Data | Value | Unit |
|---|---|---|
| Load capacity* | 100 | VA |

* at 250 Veff / 3 A

**Standard signal output (mA)**

Protocol output (X3: 25.26)

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

** isolated from system ground

## 15.3 Supplementary information for modified versions

(With identity code specification "Version": "M modified")

**Technical data**

The technical data of modified version systems may deviate from that of standard systems. They can be found in the supplied documentation folder.

**Spare parts**

In a modified version, ordering information for spare and wear parts is contained in the supplied documentation folder.

# 16 Identity code

| Ozone generation systems of type OZONFILT® OZMa | | | | | | | |
|---|---|---|---|---|---|---|---|
| OZMa | Type* | Air | Oxygen | * of the ozone generator | | | |
| | 01 | 70 g/l | 105 g/l | | | | |
| | 02 | 105 g/l | 150 g/l | | | | |
| | 03 | 140 g/l | 210 g/l | | | | |
| | 04 | 210 g/l | 320 g/l | | | | |
| | 05 | 280 g/l | 420 g/l | | | | |
| | 06 | 420 g/l | 630 g/l | | | | |
| | **Operating gas** | | | | | | |
| | A | Operating gas - air | | | | | |
| | O | Operating gas - oxygen | | | | | |
| | | **Version** | | | | | |
| | | P | ProMaqua | | | | |
| | | | **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 HGV) | | | |
| | | | 3 | In stainless steel cabinet (packaging for sea/air freight) | | | |
| | | | M | Modified | * order-related version. For device characteristics 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 (design operating gas - oxygen) | |
| | | | | | 1 | Gas treatment integrated without filter package (design operating gas - air) | |
| | | | | | 2 | Gas treatment integrated with filter package (design operating gas - air) | |
| | | | | | 3 | Gas treatment not integrated (oxygen operating gas version) | |
| | | | | | 4 | Gas treatment integrated without filter package (air operating gas version), including gas control valve | |
| | | | | | 5 | Gas treatment integrated with filter package (air operating gas version), including gas control valve | |
| | | | | | | **Preset language** | |
| | | | | | | DE | German |
| | | | | | | EN | English |

| Ozone generation systems of 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 |
| 2 | Oxygen sensor (only type O) |
| 3 | Dewpoint sensor and oxygen sensor (only type O) |
| | **Certification** |
| 01 | CE mark |
| | **Hardware** |
| 0 | Standard |
| | **Software** |
| 0 | Standard |

**Explanations about the identity code:**

| | |
|---|---|
| Mechanical design: | For 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 already de-oiled compressed air.<br>With filter package for compressed air with residual oil content. |

# 17 Accessories

## 17.1 Classification

Compulsory accessories:

- Ozone warning device

Recommended accessories (available on request)

- Oxygen warning device
- 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

## 17.2 Description

**Ozone warning device**

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

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

**Oxygen warning device**

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

| Accessories | Part 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.

Designed with loose flanges in line with DIN 2501 and an integral stainless steel injection point with a threaded connector for stainless steel pipe ∅12 mm or PTFE tube 12/9 mm using stainless steel support inserts. 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.

Material PVC-U

| Flow | Length | Connector | Part no. |
|---|---|---|---|
| m3/h | mm | | |
| 5 – 10 | 718 | DN40 | 1024324 |
| 10 – 15 | 718 | DN50 | 1024325 |
| 15 – 25 | 718 | DN65 | 1024326 |
| 25 – 35 | 1,100 | DN80 | 1024327 |
| 35 – 50 | 1,100 | DN100 | 1024328 |
| 50 – 90 | 1,300 | DN125 | 1034641 |
| 90 – 160 | 1,700 | DN150 | 1034640 |

Material 1.4404

| Flow | Length | Connector | Part no. |
|---|---|---|---|
| m3/h | mm | | |
| 5 – 10 | 718 | DN40 | 1022503 |
| 10 – 15 | 718 | DN50 | 1022514 |
| 15 – 25 | 718 | DN65 | 1022515 |
| 25 – 35 | 1,100 | DN80 | 1022516 |
| 35 – 50 | 1,100 | DN100 | 1024154 |

Other sizes on request

| Connectors for the gas piping | Part 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 support inserts, 2 no. for PTFE tube 12/9 mm, grease-free | 1025397 |
| Stainless steel threaded connector 12 mm - R 1/4, grease-free | 1025755 |

| Connectors for the gas piping | Part no. |
|---|---|
| Stainless steel threaded connector 12 mm - R 3/8, grease-free | 1034642 |
| Stainless steel 90° bend D 12 - D 12, grease-free | 1022462 |
| Stainless steel back pressure valve, Adjustable pressure range 0.07 – 2 bar, Connector size: 1/4" NPT, 2 additional inputs for connecting 2 manometers. | 1029032 |

## 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 output 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.

### PVC version

| Type | Ozone output (g/h) | Part 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 outputs 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 operating gas and a maximum quantity to be added of 1.5 g ozone/m$^3$ of treated water.*

Stainless steel version

| Max. gas flow | Heating power | Dimen-sions | Connector | Part 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 | 1,154 x 275 x 240 | DN 25 | 1019155 |
| 28 | 140 | 1,154 x 300 x 259 | DN 25 | 1021037 |
| 40 | 500 | 1,156 x 330 x 264 | DN 25 | 1026335 |
| 73 | 500 | 1,158 x 400 x 320 | DN 32 | 1019971 |
| 110 | 500 | 1,160 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. Connections 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 must only be used in chlorine-free gas flows.*

*The PVC version must therefore be used with swim-ming pool applications.*

**Potassium iodide starch paper**

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

| Accessories | Part no. |
|---|---|
| Potassium iodide starch paper | 1025575 |

# 18 Appendix

## 18.1 Operating Report

Operating report for ozone production systems OZONFILT® OZMa

OZMa-Typ:____________________ Series number:____________________ d=daily m=monthly

| Display / Date | | | | | | | | | | | | | | | Unit | Intervall |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Setpoint (ozone) | | | | | | | | | | | | | | | % | d |
| Ozone output | | | | | | | | | | | | | | | g/h | d |
| Gasflow rate | | | | | | | | | | | | | | | l/h | d |
| Cooling water (outl.) | | | | | | | | | | | | | | | °C | d |
| Control range | | | | | | | | | | | | | | | % | d |
| Line voltage | | | | | | | | | | | | | | | Veff | d |
| Line current | | | | | | | | | | | | | | | Aeff | d |
| Primary voltage | | | | | | | | | | | | | | | Veff | d |
| Primary current | | | | | | | | | | | | | | | Aeff | d |
| Operating hours | | | | | | | | | | | | | | | h | d |
| Operating hours with ozone | | | | | | | | | | | | | | | h | d |
| Power on | | | | | | | | | | | | | | | | d |
| Faults | | | | | | | | | | | | | | | | d |
| Cooling water Flow rate | | | | | | | | | | | | | | | l/h | d |
| Pressure drier sys. | | | | | | | | | | | | | | | bar | d |
| Pressure $0_3$ gener. | | | | | | | | | | | | | | | bar | d |
| Filter mat inspection | | | | | | | | | | | | | | | | m |
| Inspection of the non-return-valves (11, 37) at the ozone outlet | | | | | | | | | | | | | | | | m |
| Maintenance tasks | | | | | | | | | | | | | | | | |
| Signature | | | | | | | | | | | | | | | | |

P_PMA_OF_0024_SW

*Fig. 46*

## 18.2 Terminal Wiring Diagram

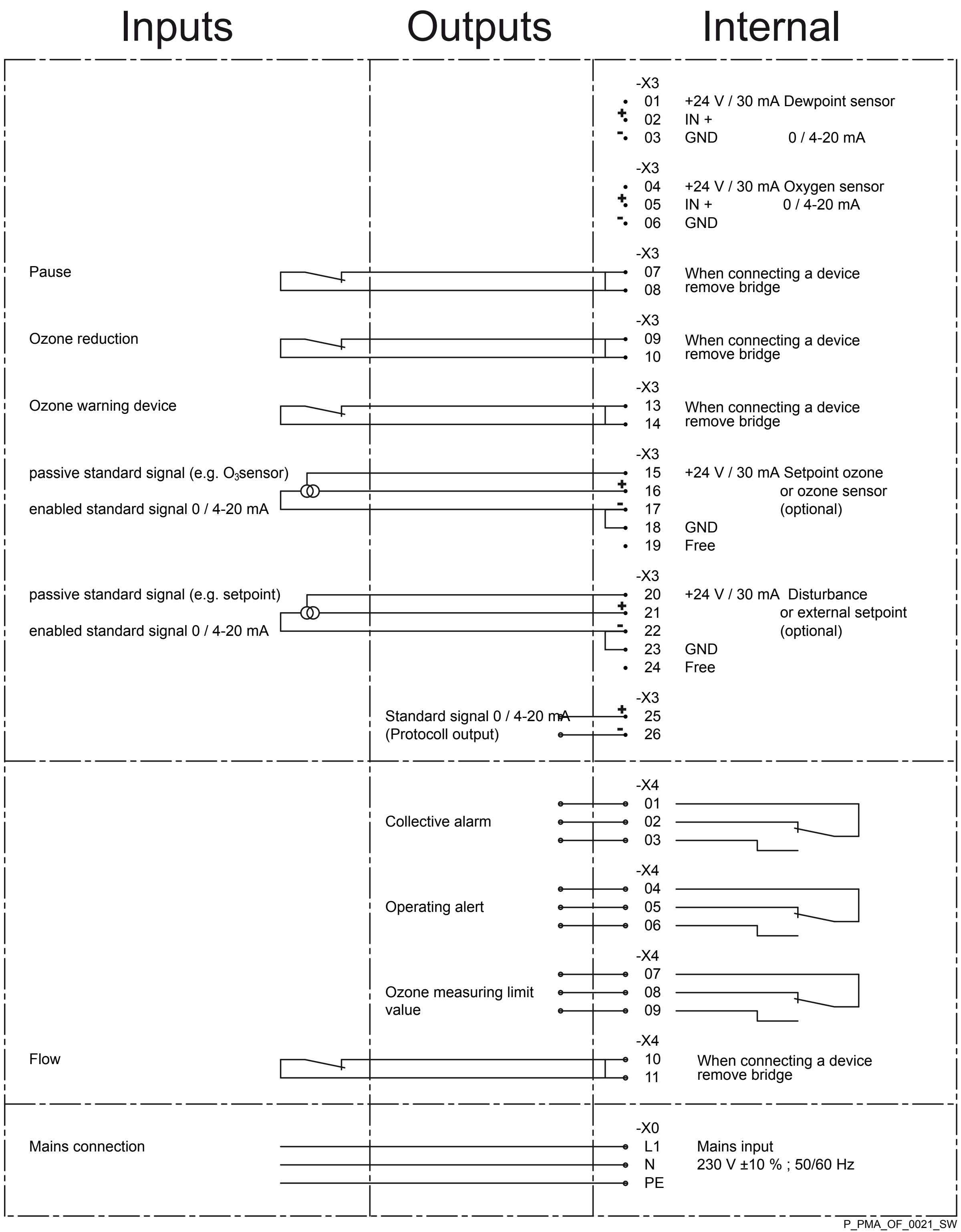



*Fig. 47*

## 18.3 EC Declaration of Conformity

# EU Declaration of Conformity

We, hereby declare that,

**ProMaqua GmbH**
**Maaßstraße 32/1**
**D - 69123 Heidelberg**

on the basis of its functional concept and design and in the version marketed by us, the product specified in the following complies with the relevant, fundamental safety and health stipulations laid down by EC regulations.
Any modification to the product not approved by us will invalidate this declaration.

| | |
|---|---|
| Product description: | *Ozone generating system Ozonfilt®* |
| Product type: | *OZMa...* |
| Serial number: | *Please refer to the type plate on the device* |
| Relevant EC regulations | *EU - Low Voltage Directive (2006/95/EC)*<br>*EU - EMC Directive (2004/108/EC)*<br>*EU Pressure Equipment Directive (97/23/EC)* |
| Harmonised standards applied, in particular: | *EN 60204-1, EN 61010-1, EN 60529*<br>*EN 61000-3-2/3, EN 61000-6-2/4*<br>*DIN EN 60664-1* |
| Harmonised national standards and other technical specifications applied, in particular: | *DIN 19627*<br>*ZH 1/474*<br>*VBG 4*<br>*BGI 617* |
| Technical documents have been compiled by documentation specialists: | *Dr. W. Weibler*<br>*Maaßstraße 32/1*<br>*D - 69123 Heidelberg* |
| Date /manufacturer's signature: | *21.4.2010* |
| The undersigned: | *Ralf Kiermaier, Managing Director of ProMaqua GmbH* |

*Fig. 48*

# 19 Index