Operating Instructions Manual

OZONFILT® OZVa, Type 5-7

Please affix device label here!

Please read the operating instructions through completely before commissioning this equipment! Do not discard!
Any part which has been subject to misuse is excluded from the warranty!

Publishing Details:
Operating Instructions Manual
OZONFILT® OZVa, Type 5-7

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Subject to technical alterations.

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Instructions for use

This operating instructions manual includes all the information required to install, commission and operate the OZONFILT® OZVa. Please read through the operating instructions manual - particularly the safety guidelines - carefully.

Keep the instructions in an accessible place in the vicinity of the system.

These operating instructions incorporate pictograms as follows:

- ▶ Indicate step by step instructions.
- • Indicate enumerated points.

Safety guidelines are indicated with symbols:

WARNING

Could result in loss of life or serious injury if safety guidelines are not observed.

CAUTION

Could result in lesser injuries or damage to property if safety guidelines are not observed.

IMPORTANT

Could result in damage to property if safety guidelines are not observed.

Working guidelines:

NOTE

Notes are intended to make your job easier.

1 Information about Ozone

1.1 What is ozone

Under normal environmental conditions, oxygen is a molecule which consists of two atoms. A dual bond links these two atoms. The chemical symbol for this molecule is O_2.

If energy is applied to this molecule, one of the links breaks, allowing another oxygen atom to fit into the space. The result is a molecule consisting of three oxygen atoms – ozone, O_3.

Ozone molecule has a tendency to degrade to a lower energy level. It breaks down again after a short period, producing oxygen and heat. This short-life means that ozone cannot be produced in large quantities and stored but has to be produced on-site.

In its concentrated form, ozone is a colourless gas which is some 1.5 times denser than air. Therefore, ozone released near to ground level enriches the oxygen content of the surrounding air. Ozone gets its name from its characteristic odour (from the Greek ozein = to smell), which is perceptible even at a concentration of 1:500 000. This is the odour detected occasionally during electrical storms, or from photocopiers in frequent use. The odour threshold for ozone is in the region of 0.04 mg/m³. Ozone gas is poisonous and is a powerful germicide. Relatively low concentrations cause extreme irritation to the mucous membranes in the nose and eyes. However, even in very low, non-hazardous concentrations, ozone can be detected by its characteristic odour. This warns anyone in the vicinity well before concentrations reach the higher levels, which could represent a danger to health.

Ozone is the most powerful commercially available oxidant. This is the basis for its application in the treatment and disinfection of drinking water, bathing water, process water and wastewater. Undesirable contaminants are oxidised into easily removable materials. The great advantage of ozone lies in the fact that after use it breaks down into oxygen which is already an inherent part of water itself. Ozone produces none of the unpleasant side effects associated with, for example, chlorine, so that water quality can be maintained at consistently high standards.

1.2 The Use of ozone in water treatment

A commercial application for ozone was made possible only by the invention of the ozone tube by Werner v. Siemens in 1857. In 1873 Fox determined that ozone possessed sterilising properties, which led to the first investigations into the use of ozone as a disinfectant in the treatment of water. At the turn of the century ozone was used for the first time in Germany in water treatment plants (Berlin, Wiesbaden and Paderborn). In 1906 and 1909 the first major water treatment plants to use the ozone process were built in Nizza and Paris.

In the nineteen twenties the ozone-disinfection process passed into obscurity. It was replaced by the more economical and technically simpler indirect chlorine process. The fifties, however, saw renewed efforts to develop applications using ozone. These resulted in the application of ozone not just as a disinfectant but as an oxidant in the treatment of water.

As well as the treatment of drinking water, ozone is used today to treat water in swimming pools, as a disinfectant in the food and drinks industry, to remove iron from tap water, as a bleaching agent in the manufacture of paper and textiles, for flue gas purification in large boiler systems and in the treatment of waste water.

1.3 Manufacturing process

Ozone is produced by the reaction of an oxygen molecule and an oxygen atom. The only commercial method which uses this process employs the principle of silent electrical discharge. The system produces ozone from a gas containing oxygen, usually normal air or pure oxygen. The gas is passed through an electrical field produced between two electrodes. The gas has to be treated to ensure it is dry and free from dust particles.

The oxygen is converted into ozone in the electrical field. The gas stream, which now contains ozone, is then fed to wherever it is required (e.g. into a mixing system for dissolving in water requiring disinfection).

1.4 Glossary of terms in ozone technology

Ozone system

This term refers to the entire ozone system comprising:

- The ozone generating system
- A mixing system with
- A reaction tank and
- An exhaust ozone gas extraction system.

Ozone generating system

The part of the system in which ozone is generated. This section consists of the gas treatment system, ozone gas generator and the electronic controller.

Ozone generating element

Electrode system in which the input gas (air or pure oxygen) is subjected to a silent electrical discharge for the production of ozone.

Ozone generator

Term referring to all ozone generating elements.

Mixing system

The part of the system in which the ozonated gas from the ozone generating elements is mixed with the water requiring treatment. The mixing system consists of the ozone transfer system and a mixing system connected downstream.

Reaction tank

The reaction tank is connected downstream from the ozone mixing system. The reaction of ozone with the contaminants in the process water takes place here.

Exhaust ozone gas extraction system

The part of the system in which exhaust ozone is broken down.

2 System components and their function

2.1 Overview OZVa 5

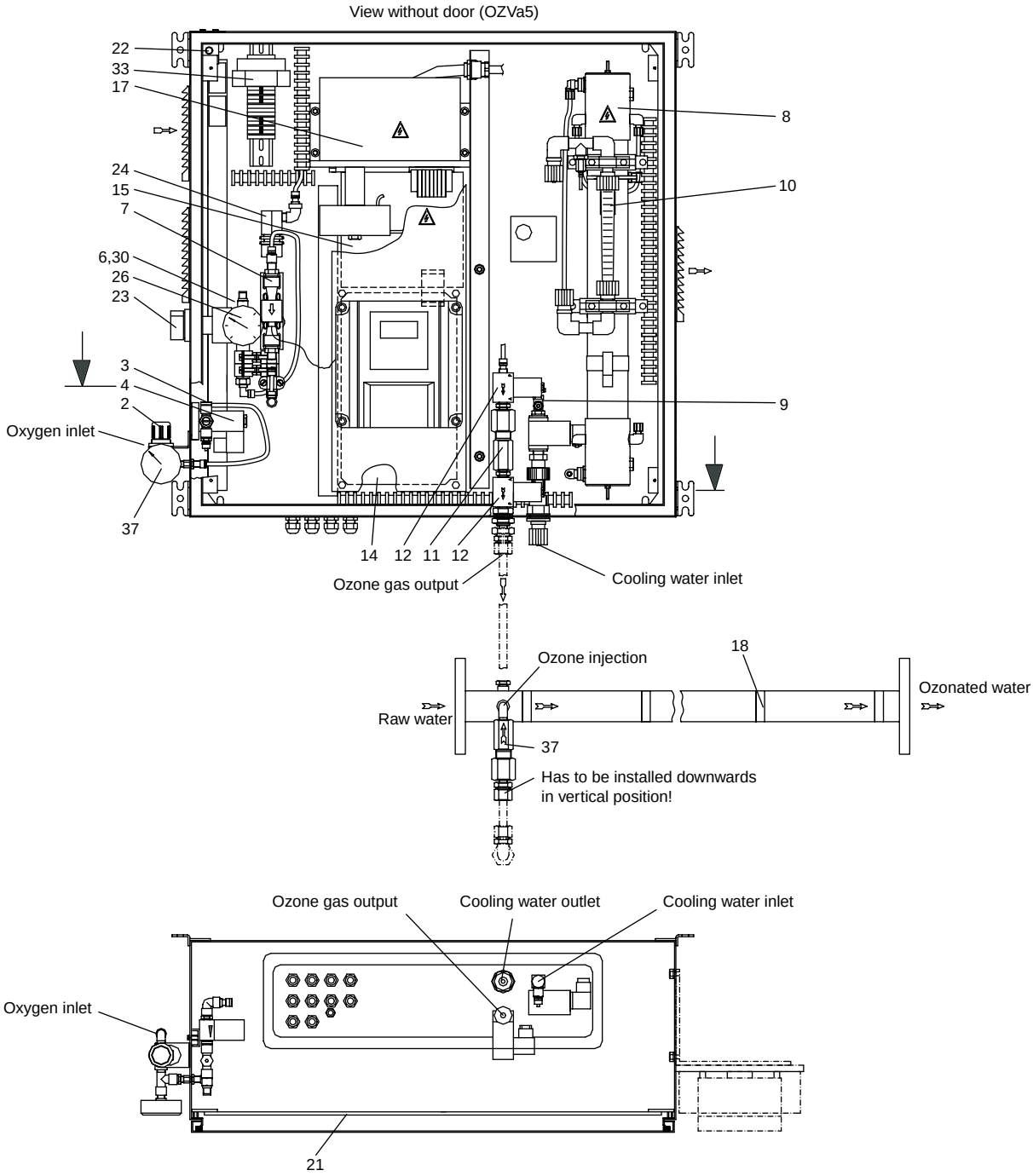


Fig. 1: Ozon generating system OZVa 5, mixing system

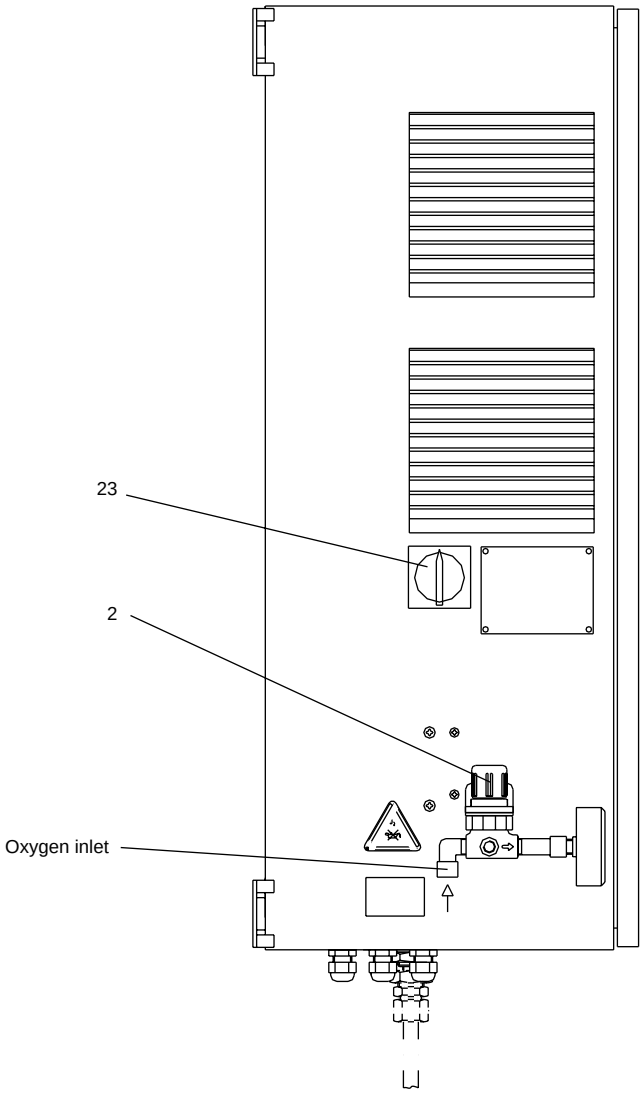


Fig. 2: Ozone generating system OZVa 5, side view (left)

2.2 Overview OZVa 6 and OZVa 7

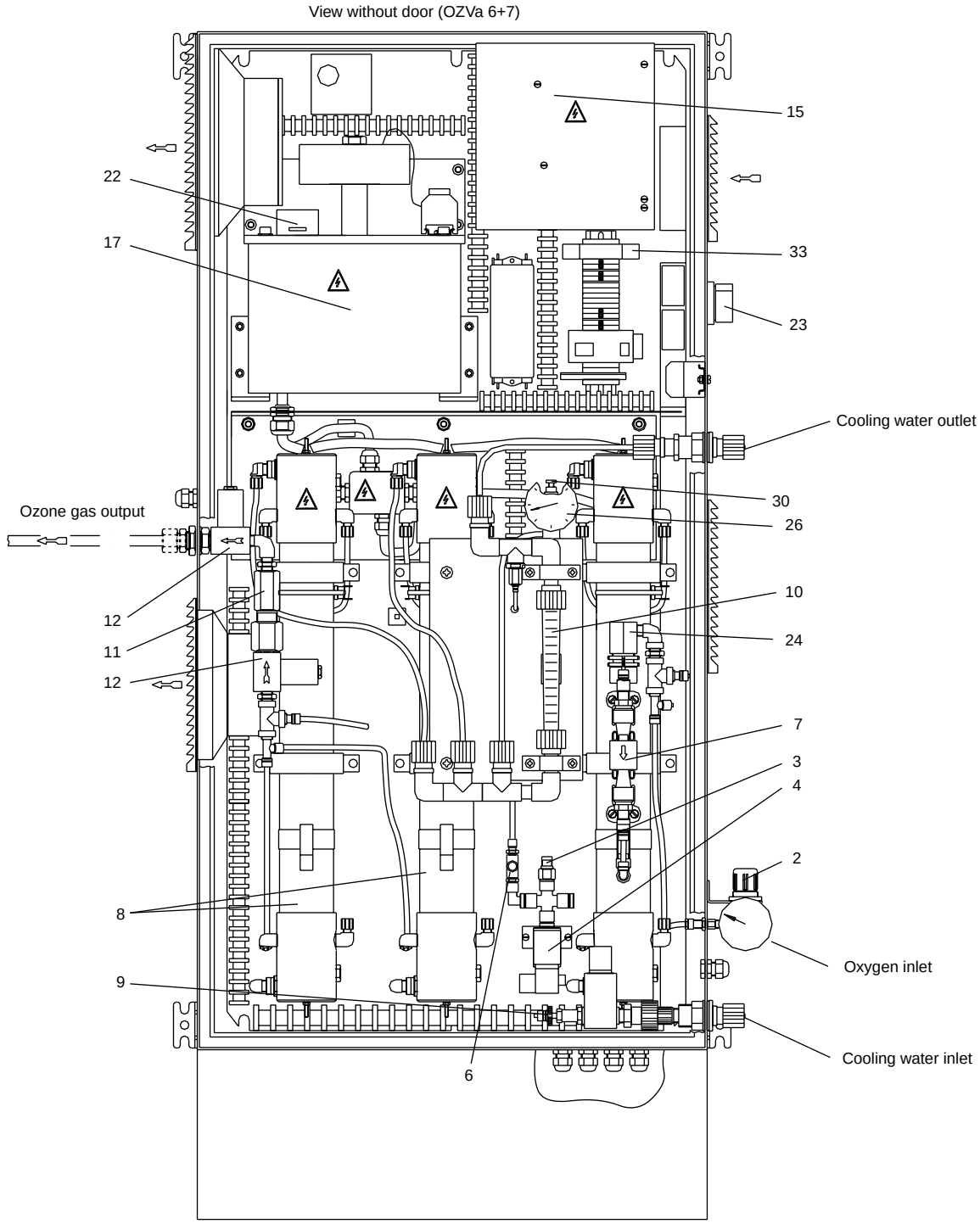


Fig. 3: Ozone generating system OZVa 6 and OZVa 7

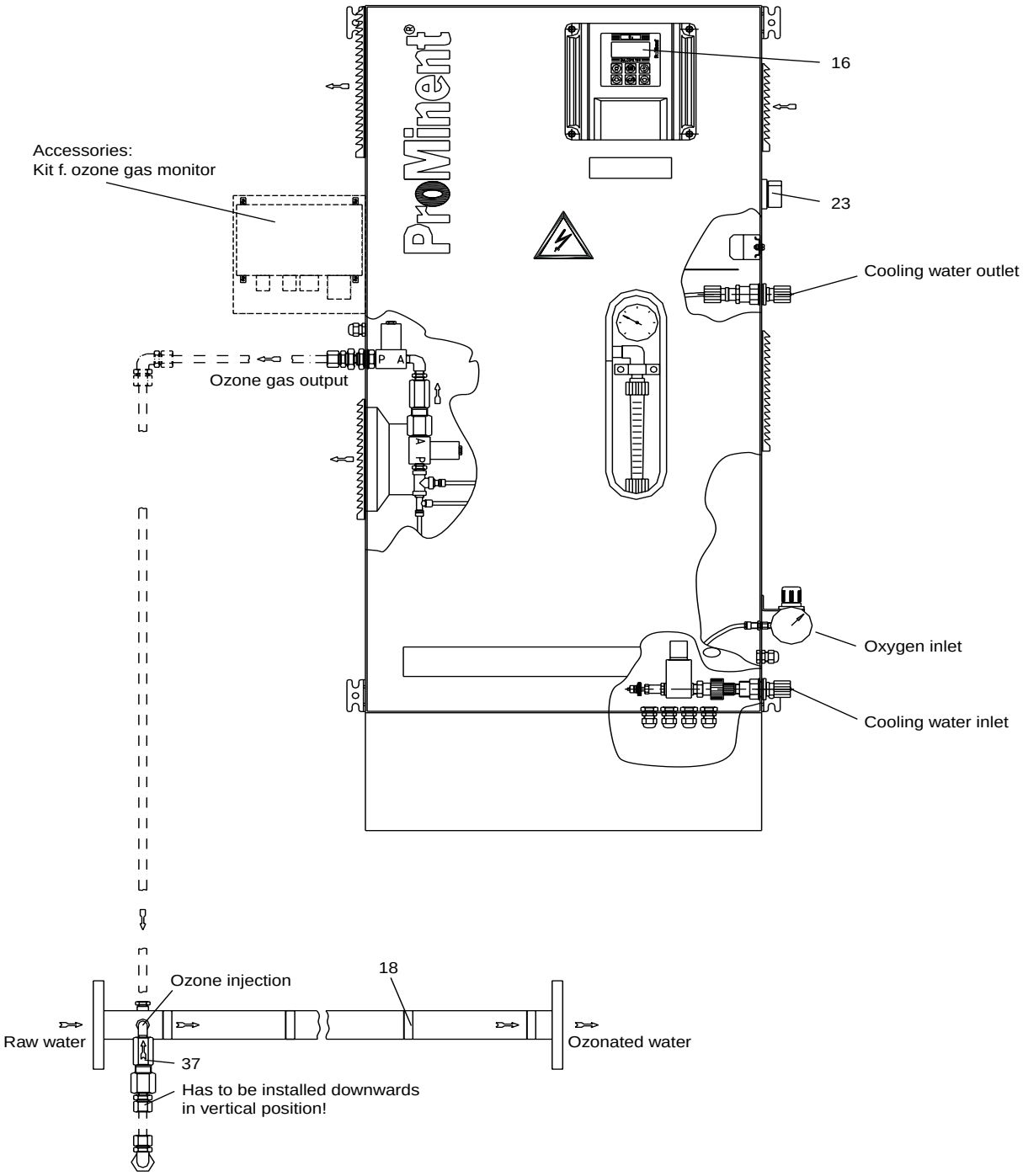


Fig. 4: Ozone generating system OZVa 6 and OZVa 7 with mixing system

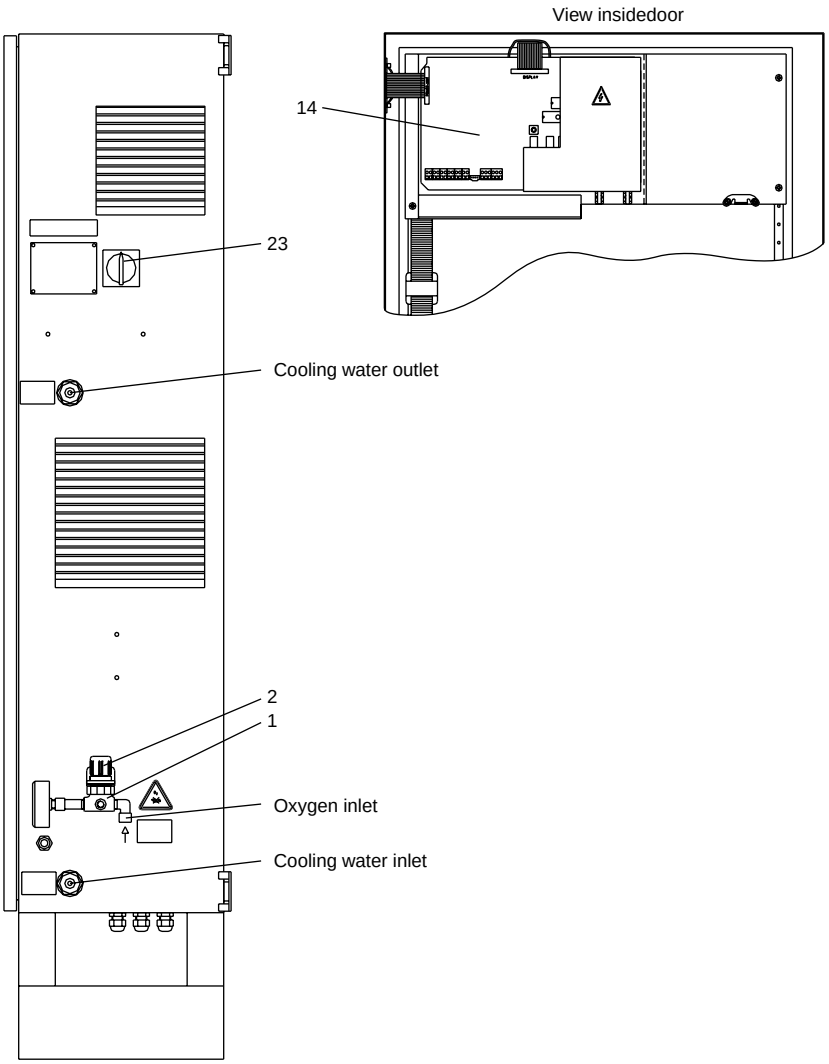


Fig. 5: Ozone generating system OZVa 6+7 side view (right)

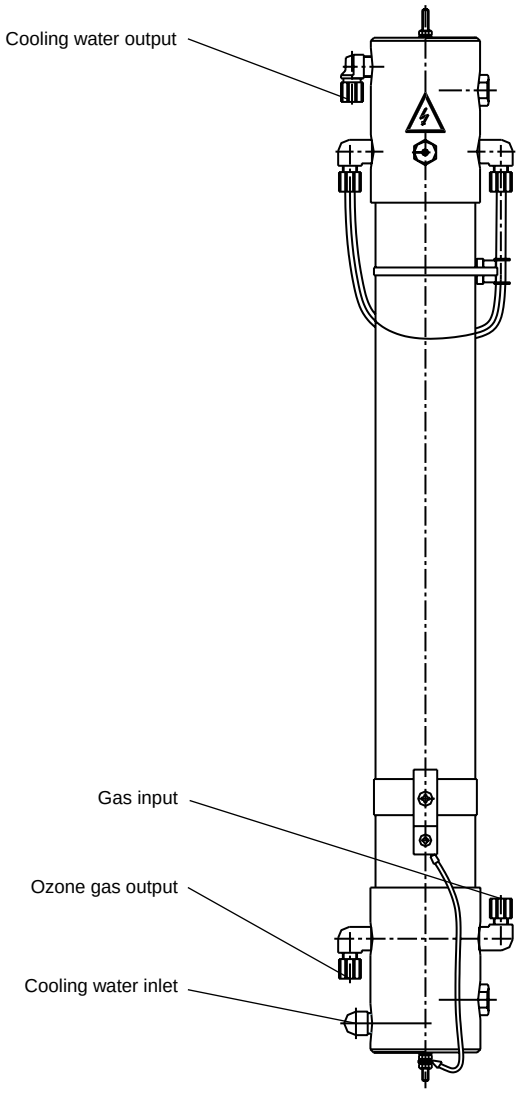
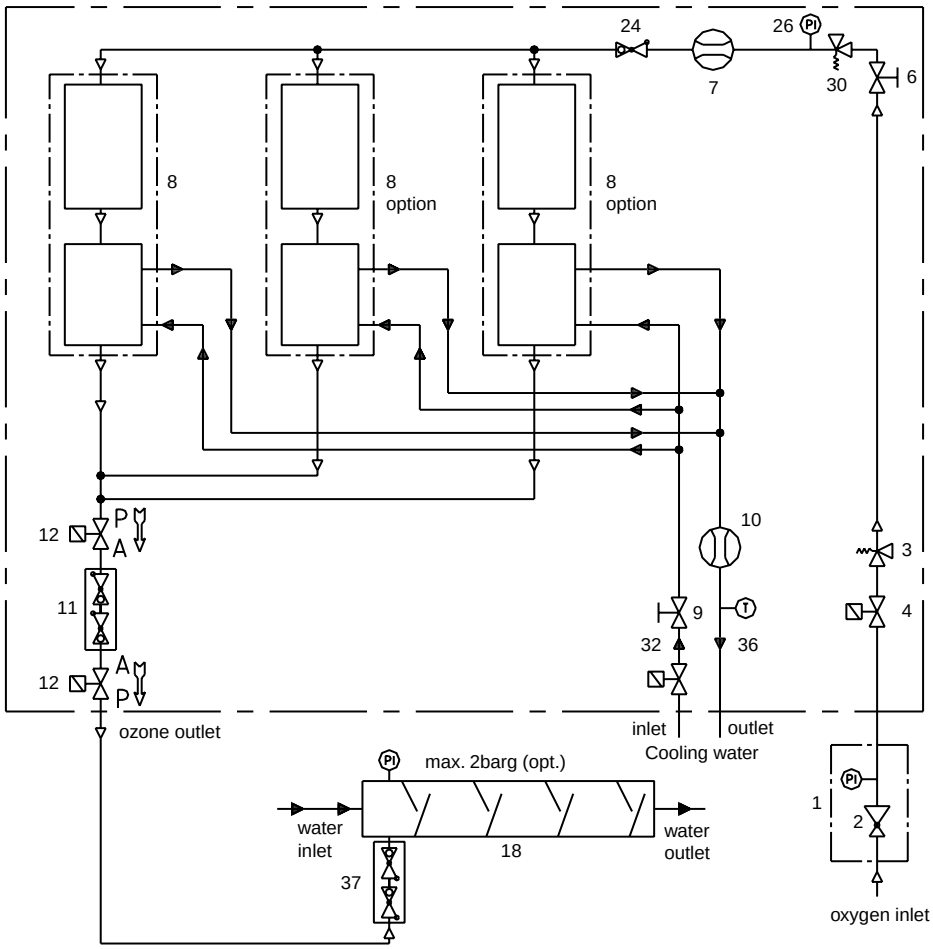


Fig. 6: Ozone generating element OZVa 5-7



1: pressure regulator w. gauge
2: pressure regulator
3: safety valve system input 7 bar
4: solenoid valve system input
6: regulating valve operating gas for ozone production
7: gas flow meter
8: ozone generator
9: regulating valve cooling water
10: cooling water flow meter with min. contact
11: double spring loaded non return valve (with spring)
12: solenoid valve ozone output
18: mixing system
24: spring loaded non return valve
26: pressure gauge operating pressure ozone generator
30: safety valve ozone generator 2.5-3 bar
32: solenoid valve cooling water input
36: Temperature cooling water outlet
37: non return valve (without spring)

Fig. 7: Pneumatik and hydraulic flowchart of the OZVa 5-7 ozone generating system

System components and their function

1	Pressure regulator with gauge	Used to set and monitor the systems priming pressure.
2	Pressure regulator	Used to set the system priming pressure.
3	System inlet, bypass valve	The bypass valve limits the system priming pressure to a maximum 7 bar.
4	System inlet, solenoid valve	The solenoid valve serves to direct the compressed gas to the ozone generators.
6	Regulating valve, process air	The process gasflow is adjusted via the regulating valve.
7	Flow meter, gas	The gas flow meter measures and monitors the process gasflow.
8	Ozone generator	In the water-cooled ozone generator, part of the oxygen is converted into ozone via a process of silent electrical discharge.
9	Corner valve, cooling water inlet	The cooling water flowrate is adjusted at the corner valve.
10	Flow monitor for cooling water	Monitors the cooling water flowrate and detects when the cooling water flow is below the minimum threshold.
11	Spring loaded double non return valve, ozone outlet	The spring loaded double non-return valve situated at the ozone generator outlet prevents any process water backflow into the ozone generator.
12	Ozonated air-loading valves	The solenoid valves transfer the ozonated air to the process water injection point.
14	Electronic controller	The electronic controller is fitted with a microcomputer which controls and monitors the entire system.
15	HV transformer power unit	Provides the high voltage transformers primary with current pulses.
16	Display and control unit	For the display and adjustment of control parameters.
17	High voltage transformer	The HV-transformer produces the high voltage for the ozone generation.
18	Mixer	Mixes the raw water with the ozonated gas.
21	Safety screen	Protects against contact with electrically charged parts.(only OZVa 5)
22	Door trip switch	The door trip switch turns the system off. When the safety screen is removed (OZVa 5) or the door is opened (OZVa 6,7).
23	Main/emergency off switch	The system is switched on at the main switch. This switch also serves as an emergency cut-out switch.
24	Non-return valve, ozone inlet	The spring loaded non-return valve at the entrance to the ozone generator prevents ozonated gas passing back out of the ozone generator and the gas system.
26	Pressure gauge, ozone operating pressure	This pressure gauge displays the pressure in the ozone generator (maximum pressure 2 bar).
30	Ozone generator bypass valve	The bypass valve limits the operating pressure of the ozone generator to approx. 2.5 bar.
33	Automatic cut out	Switches the system off at too high current consumption.
37	Double non return valve, not spring loaded	Prevents process water backflow into the ozone generating system.

2.3 Description of the OZONFILT® OZVa 5-7 ozone generating systems

2.3.1 Oxygen supply for the OZONFILT® OZVa 5-7 (option)

The OZONFILT® OZVa 5-7 are generating ozone from pure or enriched oxygen. The oxygen supply system has to provide the OZONFILT® OZVa with dry, pure and pressurized oxygen. This can be done by:

- a (P)ressure (S)wing (A)dsorption or PSA unit.
  The PSA unit uses ambient air from a compressor and concentrates the oxygen by means of a special molecular filter. The molecular filter separates the oxygen from nitrogen and water and delivers the dry, pressurized and concentrated oxygen (typically 90-95 vol-%,
- bottled oxygen,
- evaporation of liquid oxygen.

2.3.2 The gas system of the OZVa

The OZONFILT® OZVa 5-7 ozone generating systems require dry, pure and pressurized oxygen at the inlet of the pressure regulator (2). For detailed technical specifications refer chapter 13.1 “Technical data” on page 52. The pressure of the incoming oxygen gas has to be reduced by means of the pressure regulator to less than 3.5 bar. Refer to chapter 7 “Assembly and installation” for detailed procedure.

When the OZONFILT® OZVa is in operation and started, the solenoid valve (4) is open and the gas can reach into the gas system of the OZONFILT® OZVa. The safety valve (3) limits the pressure of the incoming gas. The appropriate flow rate of the gas can be adjusted at the needle valve (6).

The gas pressure for the ozone generation is monitored on the pressure gauge (26) and limited by the safety valve (30) to a pressure of less than 3bar. The actual value of the gas pressure in the ozone generators depends on the pressure in the process water at the point of injection, the backpressure of the pneumatic components (11, 12, 37) located between ozone outlet and injection point and the flow rate of the gas.

The flow rate of the gas is measured by the gas flow meter (7). The non return valve (24) avoids a backflow of ozone when the plant is stopped and the solenoid valves (4,12) in the gas system are closed.

After passing the non return valve (24), the gas enters the ozone generator.

2.3.3 The ozone generator

The ozone generator contains one to three (depending on type of OZVa) ozone generating elements (8). One element consists of an outer earthed metal tube, a high voltage electrode, a thermal conducting insulator and an inner earthed electrode. First the gas enters the large gap between the earthed metal tube and the outer surface of the high-voltage electrode through the ozone generator. Because of the large gap no ozone is generated in this part of the generator. This first gap formed by the two metal electrodes serves as pressure and electric shield of the ozone generator and acts as safety element as well. After that, the gas passes through the small gap between the inner surface of the high voltage electrode and the outer surface of the insulator, where ozone formation by silent discharge takes place. An alternating high voltage signal in the medium frequency range is applied between the high voltage electrode and the inner metal electrode providing the silent discharge with electrical energy. By the silent electrical discharge a part of the oxygen is converted into ozone. The heat generated by the discharge is transferred through the wall of the thermal conducting insulator to the cooling water flowing between the inner earthed metal electrode and the inner side of the insulator. The direct cooling and the excellent thermal conductivity of the insulator ensures a optimal heat transfer to the cooling water. This effects an excellent performance of the ozone generating elements.

2.2.4 The ozone gas transfer system

The ozone gas mixture is transferred from the output of the ozone generator via the solenoid valves (12) and a double spring loaded non return valve (11) to the ozone outlet of the OZONFILT® OZVa. The non return valve (11) prevents process water escaping from the mixer entering the ozone generator. The ozonated gas is transferred to the mixing system (18) through stainless steel pipes (option) attached at the ozone outlet of the OZONFILT® OZVa.

2.3.5 Mixing system (option)

The ozone gas mixture is fed into the process water flow via a non return valve (37), which is mounted directly at the input of the mixing system (18). The non return valve (37) prevents a backflow of water in the stainless steel gas piping between the OZONFILT® OZVa´s ozone outlet and the inlet of the non return valve (37).

The stainless steel mixing system (18) contains single mixing elements for dissolving the ozone gas in the process water. For optimal ozone transfer into the process water the mixing system has to be chosen according to the process water flow rate (refer to chapter ´Technical data´). Too low process water flow results in low mixing performance.

2.3.6 Cooling water system

The cooling water is necessary to remove the heat generated by ozone formation in the gas room of the ozone generator (8). In order to keep the ozonated gas at low temperature, to maintain excellent ozone performance and to avoid damages to internal parts of ozone generator the heat has to be transferred to the cooling water.

The cooling water is fed from the cooling water inlet to the corner valve (9). The flow rate can be adjusted via the corner valve. The cooling water is then fed to the ozone generator (8). The flow monitor located after the cooling water outlet of the ozone generator switches the system off, when the flow rate falls between the minimum threshold. In addition, the cooling water temperature is measured by a temperature sensor (36). If temperature exceeds the maximum value, the system is switched off with an appropriate failure message. For detailed specifications concerning quality, temperature and flow rates refer to chapter ´Technical specifications".

2.3.7 Electrical Components

2.2.7.1 Electronic controller

The system is fully controlled and monitored by the electronic controller (14).

The electronic controller performs the following tasks:

- controls the electronic power supply (15) for the high voltage generation,
- measures and monitors the systems supply voltage.
- measures and monitors primary voltage of the high voltage transformer (17),
- measures and monitors primary current of the high voltage transformer (17),
- measures and monitors the frequency for the high voltage generation,
- measures and monitors the gasflow through the ozone generator,
- measures and monitors the operating hours, the number of faults and the number of line voltage breaks of 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-Transformer, cabinet, ozone generators, electronic power supply),
- controls the solenoid valves on the cooling water inlet, the gas inlet and the gas outlet of the system,
- actuates a fault indicating relay to signal system failures,
- allows the use of an electrically isolated pause input,
- allow the use of an electrically isolated standard signal input (0/4-20mA) for automatic control of the ozone quantity, and control panel (16).

2.2.7.2 Electronic power supply

The electronic power supply (15) supplies an alternating voltage in medium frequency range to the high voltage transformer (17). The high voltage transformer (17) thereby produces the alternating high voltage required for the ozone generation process. Supplying a medium frequency range voltage offers significant advantages for the ozone generated as compared with the mains frequency supply that is normally used. The use of medium frequency high voltage signals improves the efficiency of the ozone generation and at the same time allows to reduce the size of the ozone generator. The electronic controller (14) allows complete control of the electronic power supply (15) and the all the parameters for the ozone production process.

2.4 Safety equipment

2.3.1 Flow monitor (option)

In accordance with German safety directives ZH 1/474 and GUV 18.13 (Directives for the Use of Ozone in Water Treatment), ozone may only access the mixing system when the process water flow is above the minimum flow threshold.

In addition, it is necessary to halt ozone dosage by stopping the circulation pump. This can be performed by the pause input on the electronic controller (14).

The system starts independently at the preset “Ozone reference value” when

- The pause signal is inactive (switch input XPs is closed),
- There is no other failure present.

2.4.2 Trip switch

In order to prevent contact with electrically charged parts, the OZONFILT® OZVa is fitted with a door trip switch (22).

WARNING

Do not short-circuit the door trip switch (22). This can result in life-threatening high-voltages passing through parts of the system. Even when the door trip switch is released, or the main switch is OFF, parts of the system may still be subject to mains voltage. For this reason the system must be disconnected from the mains power supply before any work is carried out on it.

2.4.3 Emergency cut-out in ozone system control room (option)

The safety directives ZH 1/474 and GUV 18.13 stipulate that it must be possible to switch off ozone systems with an emergency cut-out switch (emergency command system). This emergency cut-out switch must be located in an easily accessed and safe position near the door of the ozone system control room. The emergency cut-out switch must cut off the electrical power supply to the system.

2.4.4 Main / Emergency off switch on system

The system is switched on via a mains power supply switch (23). This switch also serves as the emergency cut-out switch.

2.4.5 Bypass valves

The bypass valve (3) at the entrance to the system limits the priming pressure of the system to approx. 7 bar. The bypass valve downstream from the regulator, used to adjust the process airflow (6), limits the pressure in the ozone generators to approx. 2.5 bar. It thereby protects the electronic components from overload.

2.4.6 Non-return valves

The spring loaded non-return valve (24) at the entrance to the ozone generator prevents ozonated air from re-entering the air treatment system from the ozone generator.

The spring loaded double non-return valve (11) at the outlet of the ozone system, between the solenoid valves (12), prevents process water from escaping from the mixer into the ozone generators.

2.3.7 Ozone gas detector (option)

In accordance with the current German commercial trade associations' safety directives (ZH 1/474 and GUV 18.13), rooms in which ozone gas leaks might occur as a result of system failure must be monitored by a gas detector.

These directives apply to ozone systems with ozone generating capacity of 2 g/h or more, irrespective of whether the gas containing ozone is above (positive pressure systems) or below (negative pressure systems) atmospheric pressure.

The gas detector should be located at the point at which the highest concentration of ozone gas could be expected in the event of a system failure. In positive pressure systems the gas detector should be installed in the vicinity of the ozone generating system, in negative pressure systems, in the vicinity of the exhaust ozone gas destructor. The OZVa is a positive pressure system.

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

The gas detector must be fitted with optical and audio warning indicators.

In the case of the OZONFILT® OZVa the gas detector is fitted with an isolated alarm switch. This must be connected to the XOz input on the electronic controller (14) as instructed in the accompanying system circuit diagrams (see also Fig. 8.2 "Electronic In/Outputs").

Outside Germany, please observe applicable national regulations and directives.

3 Functional characteristics of the OZONFILT® OZVa

NOTE

All references in this operating instructions manual relate to the numbering on Figures 1 to 5.

Ozone is generated in the OZONFILT® OZVa and mixed with water requiring treatment. To do this, it transforms a proportion of oxygen gas into ozone.

The functioning characteristics of the system are described with reference to the diagram (Fig. 6), the overview drawing (Fig. 1) and the following descriptions.

Internal system functions:

Electrical current

Mains power is fed to the electronic controller (14). The electronic controller controls the high voltage transformer (17) via the HV power supply (15) which supplies the electrical power used for the silent electrical discharge in the ozone generator.

The electronic controller also:

- Controls the solenoid valves
- Controls the compressor (if one has been supplied with the system)
- Monitors the system
- Controls an alarm system

The electronic controller is fitted with the corresponding terminals required to fulfil these tasks.

Process gas flow

Compressed, dry and pure oxygen is fed to the pressure regulator (1) at the system gas inlet. Using the pressure regulator (2) the system priming pressure can be set to its nominal value. (Refer chapter “Technical specifications” for details).

The oxygen gas is fed through a solenoid valve (4), a safety valve (3) and a regulating valve (6) to the gas flow meter (7).

The pressure gauge (26) displays the operating pressure in the ozone generator(s) and the safety valve (30) limits this pressure.

The oxygen gas is then fed via a non return valve (11) to the ozone generator(s) (8), where a part of the oxygen is converted to ozone via silent electrical discharge.

The ozonated air is fed, via a non-return valve (11) and a solenoid valve (12), to the mixing system (18, 19) where it reacts with water contaminants.

The solenoid valves (4) and (12) halt the airflow in the event of failure or if the system is stopped. This prevents ozone from escaping from the system. The non-return valve (11) also prevents process water from entering the ozone generator. The non-return valve (24) prevents ozonated air from penetrating the air treatment system.

Cooling water flow

The cooling water is fed from the cooling water inlet to the corner valve (9), where the flow rate can be adjusted. The cooling water is then fed to the ozone generator(s) (8). The flow monitor (10) switches off the system if the water flow falls below the minimum threshold. The cooling water, now heated, is fed to the cooling water outlet. The cooling water flow is halted by a solenoid valve (32) at the cooling water inlet in the event of failure or during a longer period of system standstill.

Raw water flow

The raw water is taken to the mixing system where the metering point (12) of the ozone gas is. In the mixing system (18) the raw water is mixed with the ozonated gas. The ozonated raw water flow (process water) can be extracted from the outlet of the mixing system (19).
The diameter of the mixer needs to be selected according to the raw water flow (see technical data, chapter 13).

Flow diagram of water treatment using the OZONFILT® OZVa, Type 5-7

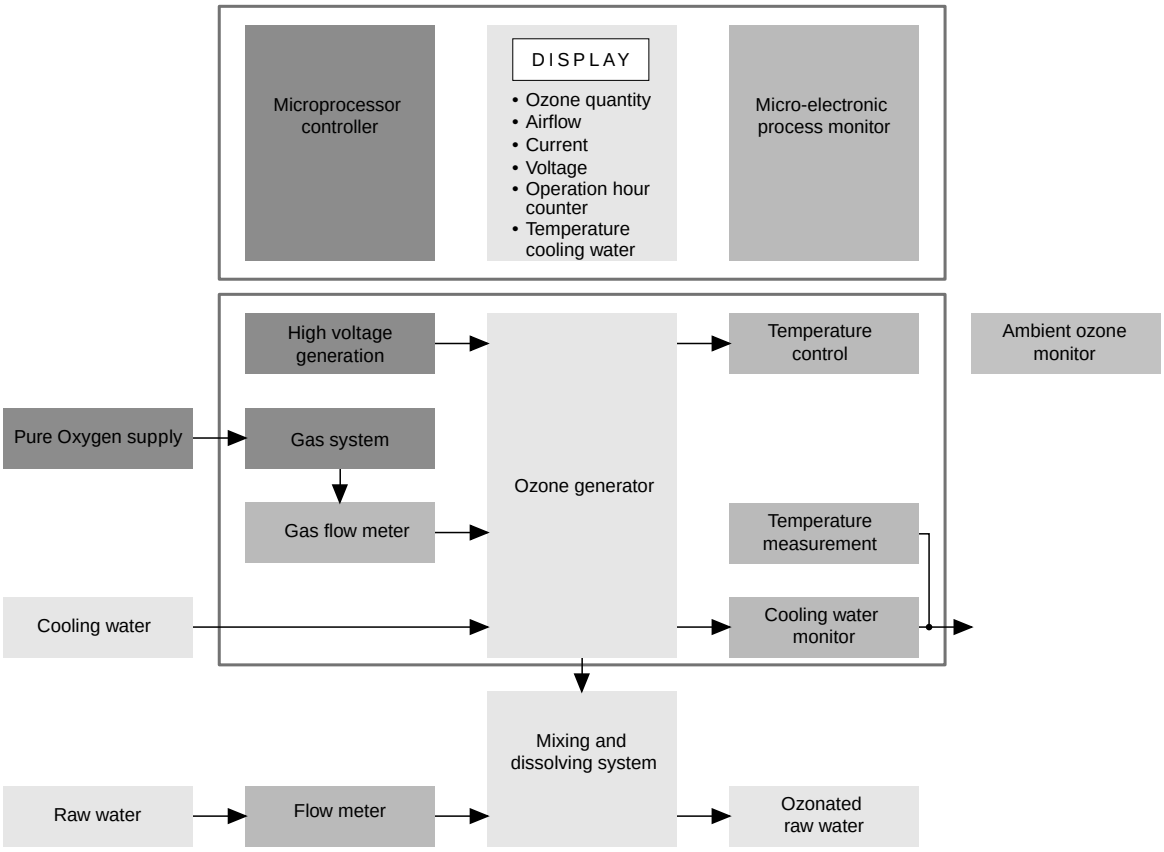


Fig. 8: Flow diagram of system

4 Application, design and integration of the OZONFILT® OZVa 5-7

4.1 Correct use

The OZONFILT® OZVa is an ozone generating and metering stage which has been developed for general water treatment for the purpose of oxidising water contaminants. Correct usage of this equipment requires the proper installation of the system in a water treatment system.

It is particularly important to follow the procedures outlined in section 7 “Assembly and Installation”.

4.2 System design

The OZONFILT® OZVa system has been designed for water treatment and is used to generate and meter ozone to a flow of raw water. The user can adjust the ozone concentration to any value between 0 and 100 % (see section 10, “Operation”, 10.6.1).

An on-site booster pump, if necessary with a pressure release/bypass valve, is required to supply the correct flow volume. DIN 19643, section 5 (Design) requires that the system should be fitted with a reaction tank downstream, to ensure a sufficient reaction period, and a filter with a layer of activated carbon where residual ozone is not required. This should incorporate a means of venting exhaust ozone gas out of the building via an exhaust ozone gas destructor.

WARNING

Observe all general directives and safety regulations when installing and operating the system

In Germany in particular the currently valid version of DIN 19627 and the directives for prevention of accidents to industrial employees (ZH 1/474 and GUV 18.13: Guidelines for the Use of Ozone in Water Treatment) must be observed. We recommend that these guidelines be read and the OZONFILT® OZVa ozone system be installed and assembled correspondingly.

GUIDELINE FOR THE OPERATOR

The operator has the duty to create a working directive (including instructions for avoiding danger, and an alarm plan) taking into account the local conditions on side.

As further sources of information apart from the operating instructions manual, the following German directives of the main league of the trade associations and of the trade association of the chemical industry have to be taken into consideration too:
a) ZH 1/474 “Directives for the use of Ozone in water processing”
b) ZH 1/262 “Spezification leaflet 052 Ozone”

5 Safety

The OZONFILT® OZVa 5, 6 and 7 systems employ the latest technology in order to guarantee the highest level of operational and functional safety. In this section all safety measures and safety devices are described.

This chapter has to be read carefully prior operating the system to ensure a safe operation.
Keep these instructions in an accessible place in the vicinity of the system.

The OZONFILT® OZVa 5, 6 and 7 ozone systems are generating ozone from pure oxygen with a concentration above 90 vol.-%. Therefore the guidelines for the use of oxygen have to be observed.

5.1 General Safety Requirements

- All persons coming in contact with the ozone system have to be familiar with the safety requirements and the operation of the ozone system to ensure a maximum safety level.
- The ozone system has to be used in a correct way. Use of the system for other purposes than intended by the manufacturer may result in unforeseeable risks.
- Interference from unauthorized personnel renders void all guarantees or liability claims on behalf of the operator.
- Always observe locally applicable:
  - laws
  - labour and safety regulations
  - regulations on environmental protection.
- If you as user become aware of faults or risks, please immediately inform the operator or your responsible superior.
- Never remove any protective devices when the plant is operated. Never bridge any safety elements.
- If you have to remove protective devices to set up, maintain or repair the plant, switch off the plant prior to commencing the work and make sure that it cannot be switched on again. Install the protective devices before switching on again and check that these devices are complete, safely mounted and check their function.
- Work at technical equipment (e.g. pneumatics, hydraulics, electrics) may only be performed by qualified technicians.
- All safety and danger labels at the plant must always be legible.

5.2 Guidelines for handling ozone and oxygen

5.2.1 Safety instructions for ozone

Ozone consists of three oxygen atoms with a molar mass of ~48kg/kmol. Under standard conditions (0°C and 1.013 bar (abs)), ozone has a density of 2.15kg/m³. The symbol is O_3.

Ozone is heavier than air!

At normal pressure, ozone is a transparent to blue gas whose boiling point is -112°C. Ozone condenses into a blue liquid.

Depending on the concentration, ozone has a clove-, hay- or chlorine-like smell. The threshold value of smell is ~0.02mg/m³ (~0.01ppm$_v$), the MAK*) value ranges at 0.2mg/m³ (~0.1ppm$_v$), 0.1ml/m³.

Ozone is non-combustible, however, promotes combustion processes such that spontaneous explosive reactions may be possible.

Ozone oxidizes almost all metals, inorganic and organic substances (with the exception of gold, platinum, stainless steel, glass, and ceramics).

The strong oxidation property of ozone is used for disinfection purposes (heavily damaging effect on lower organisms such as e.g. bacteria, fungi) and to oxidize or re-oxidize organic and inorganic substances (e.g. CSB decomposition, AOX decomposition). Organic compounds are oxidized by ozone. They can be decomposed down to carbon dioxide and water.

*) MAK= maximum admissible concentration at working places in Germany

5.2.2 Health risks posed by ozone

Ozone is a physiologic irritant. Mucous membranes of eyes, nose and lungs are affected in particular. Ozone may lead to intoxication when inhaled. Physical exertion and the increase of the ambient temperature increase the toxicity of ozone such that otherwise harmless concentrations may have a toxic effect. An increase of the room temperature by 8°C increases the toxicity two-fold.

Long-time exposure to an atmosphere with an ozone concentration above 0.2mg/mm³ (~0.1 ppm_v) will cause coughing.

Concentrations above 1.0mg/m³ (~0.5ppm_v) will lead to irritations of the eyes and the mucous membranes in the respiratory tract. After some minutes of exposure, heavy coughing occurs and the sense of smell is numbed. Breathing difficulties occur which show symptoms of a toxic pulmonary edema.

At concentrations above 2.0mg/m³ (1.0ppm_v), restricted thorax, dizziness and headaches will be felt. At higher concentrations, circulatory disturbances and sialism will occur. Persons who are frequently or over a long period of time exposed to the effect of lower ozone concentration may develop chronic bronchial symptoms.

Ozone concentrations above 20mg/m³ (~10ppm_v) lead to unconsciousness, pulmonary bleeding and death after a long period of exposure. Inhaling ozone in concentrations above 10,000mg/m³ (~5,000ppm_v) results in death within a few minutes.

5.2.3 Recommended protective measures for ozone

Ozone plants must be installed in closed, lockable rooms. Rooms in which ozone plants are installed may not contain any permanent workplaces.

If the installation location of the plant cannot be separated from the workplace because of application-technical reasons, the ozone concentration in the ambient air in this room must be monitored.

In this case, the MAK value of 0.2mg/m³ (~0.1ppm_v) is applicable.

Rooms in which ozone may be released in case of an accident must be monitored effectively using gas detectors with visual and acoustic alarm.

These rooms include e.g.: ozone plant rooms, rooms with ozone-carrying piping.

The monitoring equipment (sensor) must be located at the position where the highest ozone concentration is expected in case of an incident.

If this layout is observed, the shutdown value may be set to 1.0mg/m³ (~0.5ppm_v) and the alarm value may be set to 0.2mg/m³ (~0.1ppm_v).

Rooms in which ozone plants are installed must be identified by the following warning symbols:

Warning about toxic substances

Ozone plant! Only authorized personnel

Fire, open light, and smoking prohibited

No access for persons with pacemakers

The symbols must comply with the Regulations for Prevention of Accidents “Safety identification at the workplace“ (VGB 125).

Rooms in which ozone plants are installed must include a technical ventilation which ensures at least a three-fold air exchange per hour. A sucking ventilation must be installed with its suction end directly above the floor. This ventilation must automatically start when the gas detector is activated.

Only enter rooms in which an ozone leak is present or to be expected using respiratory equipment to rescue injured persons or to prevent imminent danger.

Do not keep respiratory equipment in rooms in which installations of the ozone plant are located.

An ozone-resistant full mask with effective filter may be used as respiratory equipment. Provide a mask for each user marked with the user’s name.

Only persons meeting the following qualifications may repair ozone plants:

- Persons which have sufficient knowledge in handling ozone plants based on their specialist training and experience,
- and who are sufficiently familiar with the applicable statutory worker’s protection rules, regulations for prevention of accidents, local standards as well as principles and regulations of electrical engineering to be able to evaluate the condition of the ozone plant with regard to working safety.

Parts which come into contact with ozone or oxygen must be free of oil and grease.

Ozone-containing waste gas must be released to the exterior through an effective residual ozone destroyer.

The operator is obliged to post the operating instructions “Handling ozone“ readily legible for all employees in the operational premises.

5.2.4 Safety instructions for oxygen

Oxygen consists of two oxygen atoms with a molar mass of ~32 kg/kmol. At standard conditions (0°C and 1.013 bar (abs)), oxygen has a density of 1,43kg/m^3. The symbol is **O_2**.

Oxygen is heavier than air!

At normal pressure, oxygen is a transparent and odourless gas. Oxygen condenses at -183°C and at normal pressure into a blue liquid. Below -219°C, oxygen crystallizes into a blue dye.

Oxygen is not combustible, however, facilitates and promotes combustion processes. No combustion occurs in an environment without any oxygen. This means that any flame extinguishes in case of lack of oxygen.

The air contains ~21 percent by volume of oxygen.

If the oxygen content of the respiratory air falls below 17 percent by volume, health may be endangered.

In case of increased oxygen concentration, the combustion rate is increased significantly. In addition, safety-technical characteristics are also altered as e.g. pressure increase rate, ignition and glow temperature, explosion pressures, and flame temperatures.

Oxygen may cause spontaneous ignition of oil and grease. This also applies to clothing contaminated with oil and grease.

Oxygen bonds with almost all elements. Most substances strongly react with oxygen such that they either combust after ignition or even spontaneously ignite.

5.2.5 Health risks posed by oxygen

At normal pressure, oxygen concentrations below ~50 percent by volume may be considered harmless even in case of persisting exposure.

In case of inhaling pure oxygen over a longer period of time, damages to the lungs and malfunctions of the vegetative nervous system may occur. The pulmonary damages may even lead to a toxic pulmonary edema.

Inhaling pure oxygen at higher pressures (>3 bar) leads to intoxication symptoms such as dizziness, nausea, impaired vision, hearing disorders, disturbance of balance, spasms, unconsciousness up to death even after a short time of exposure.

Minor breathing difficulties after acute inhalation of high oxygen concentrations mostly disappear when exposed to fresh air again.

There exists an increased fire hazard in case of oxygen-enriched clothing.

There exists a high risk associated with oxygen enrichment because people are not able to detect any signs of an increased oxygen concentration. It is thus to be avoided that

- oxygen penetrates the clothing
- a combustion is favoured by oxygen excess
- an ignition is triggered.

Thus, never

- use oxygen for ventilation
- remove dust or dirt from the clothing using oxygen
- wear clothing contaminated with oil and grease
- work on oxygen-carrying piping with oil- or grease-contaminated hands
- smoke in areas where oxygen might be expected

5.2.6 Recommended protective measures for oxygen

Because of the risk of ignition, all component parts of the plant coming into contact with oxygen must be cleaned and clean. This means that they must be free of any loose parts or parts becoming loose during operation such as slag, welding residues and processing chips as well as oil, grease, and solvents. This requirement can be met by pickling the stainless steel component parts after welding.

Exclusively use fittings, seals, and measuring instruments expressly accepted for oxygen and keep them free of oil and grease.

Do not touch any parts which may come into contact with oxygen or ozone with oily rags or greasy fingers.

Oily and greasy substances may spontaneously ignite when exposed to oxygen or ozone.

Only persons experienced in handling oxygen may perform leakage tests.

Mark oxygen-carrying piping by paint, labels, or signs.

Rooms in which oxygen may be released during operation must be ventilated such that an enrichment of the air with oxygen is prevented. If natural ventilation is not sufficient, a technical ventilation must be installed.

Floorings in areas where liquid oxygen may be released may only consist of non-combustible material.

In rooms where O_2 is present, fire, open light, and smoking are prohibited!

Inform your employees about possible hazards posed by oxygen and inform them about the required protective measures.

The operator is obliged to post the operating instructions “Handling oxygen“ and “Handling ozone“ readily legible for all employees in the operational premises.

6 Delivery Range, Storage and Transport of the system

6.1 Delivery range

The system comprises several component groups:

Minimum delivery range

- control cabinet
- PE hoses for cooling water supply of the plant
- operating instructions
- terminal diagram
- test sheet
- assembly components

Enhanced installation (on request only)

- ozone gas detector,
- oxygen gas detector,
- mixing system,
- oxygen supply system,
- reaction tank.

The ozone gas detector, required in order to comply with conditions for correct use of the system, is available as an optional accessory.

IMPORTANT

Those component groups required with in order to comply with the conditions for the correct use of the system, e.g. the adsorption filter, reaction tank and exhaust ozone gas destructor, are not included in the delivery range of this system.

6.2 Storage

WARNING

The system has to be stored in his original cargo box in a closed room

- **at a temperature between 5 °C and 50 °C,**
- **at a relative humidity less than 95 %, non condensing,**
- **in an non aggressive atmosphere (fumes, chemicals,..)**
- **protected from direct sun irradiation, rain and water**

6.3 Transport and unpacking

WARNING

- **The system has to be transported with care in an upright position as indicated on the cargo box,**
- **Mechanical shocks have to be avoided,**
- **During transportation the OZONFILT® OZVa system has to be protected from direct sun irradiation, rain and water.**

Refer to chapter “13 Technical Specifications” for the transportation weight.

CAUTION

After unpacking the OZONFILT® OZVa the cabinet has to be protected against dropping to avoid the risk of injuries.

7 Assembly and Installation

7.1 Safety Guidelines and general requirements

WARNING

The system produces highly concentrated (up to 150g/Nm³), pressurized (up to 2bar (g)) ozone gas using pure or enriched oxygen and high voltage. For safety reasons, this system must be commissioned, installed and maintained only by qualified personnel. Unauthorised handling of the system may result in life threatening electrical shocks or the leakage of toxic gas.
Qualified personnel must receive a training in this system from the manufacturer.

7.2 System location requirements

WARNING

The national and local rules concerning the use of oxygen and ozone have to be taken into account.

The operator of the ozone system is responsible for the application of the rules!

- The directives for the use of ozone for water treatment (ZH 1/474 and GUV 18.13) stipulate, that ozone systems are to be located in closed secure rooms to which access is permitted only to authorised personnel.
- Rooms where ozone systems are located must not contain any permanent workplaces. If this condition is not met, technical measures must be taken to ensure that the ozone concentration does not exceed a maximum concentration of 0.2 mg/m³.
- The control room must be monitored by an ozone gas detector which will switch off the system in the event of ozone gas leaks. The gas detector has to have an optical and acoustical alarm. The measuring ozone sensor has to be installed at a location, where the highest concentration can be expected in case of hazardous incidents.
- The ozone gas detector has to be installed in every room, where ozone gas tubes with detachable connections are installed. Rooms in which only pipes without detachable fittings are installed need not be monitored by an ozone gas detector if a leakage test by a qualified person has been performed.
- The room has to be free from dust, aggressive fumes and chemicals.
- The room temperature and humidity must not exceed the specification limits (refer to chapter ´Technical data´). If this cannot be guaranteed the room has to be air conditioned.
- The OZONFILT® OZVa has to be protected from direct sun irradiation.
- The room has to be equipped with a sufficient technical ventilation to prevent oxygen or ozone enrichment in ambient air. The ventilation should guarantee at least three complete air changes per hour or more if necessary. If it is not possible to prevent oxygen enrichment in ambient air by ventilation an oxygen warning device has to be installed.
- The walls and floor covering must be free from combustible materials.
- At the left and right side of the system cabinet a free space of at least 30 cm is necessary for proper operation of the cooling fans and for maintenance purposes.
- The room has to be equipped with line voltage connections sufficient for the operation of the appropriate OZONFILT® OZVa (refer chapter ´Technical specifications´ for details)
- The room has to have a sufficient cooling water supply.
- There must be a possibility to secure the OZONFILT® OZVa from falling over by mounting the
  cabinet e.g. at a wall. If this is not possible other measures must be taken to secure the cabinet of the OZONFILT® OZVa from falling over.

7.2.1 Safety signs

In accordance with DIN 19627 the control room has to be provided with the following safety signs:

- ´Ozone system-access only to trained personnel´
- the hazard symbol
- the ´No smoking´ symbol
- the ´No fire or open flame´ symbol

The signs must be fixed permanently and clearly recognisable at the entrance to the control room.

7.3 Requirements of the system components

CAUTION

Ozone resistant material must be used for all system components which can come into contact with ozone in either gas form or in an aqueous solution. This applies especially to the pipe work system, reaction tanks and filters and exhaust gas components wherever there may be possible contact with ozone. All materials coming in contact with ozone and/or pure oxygen have to be absolutely free of oil and grease.

7.3.1 Mixing modules (optional)

For the best efficiency the mixing modules have to be selected according to the raw water flow.

The connection of the ozone gas outlet to the point of injection into the raw water at the mixing module requires a stainless steel pipe gas connection and a non return valve directly mounted at the inlet of the mixing module.

ProMinent uses mixing modules from stainless steel with integrated double non return valve (1.4571).
The non return valve is used to prevent damage to the OZONFILT® OZVa by backflow of raw water into the gas system. The mixing module has to be installed to allow easy access to the non return valve for maintenance. Furthermore the non return valve has to be installed in an upright direction to ensure his proper function.

Refer to chapter ´´ for technical details of ProMinent mixing modules and the allowed pressure range a the injection point of ozone.

IMPORTANT

The installation of a non return valve directly at the point of injection to the raw water is required for the proper operation of the ozone system. The valve has to have low pressure drop (<0.1 bar) at the specified gas flow rate and has to be constructed only with ozone resistant materials. As this valve is in contact with the gas phase as well as the liquid phase a valve with a double seat is required. The recommended valve materials are ceramics (i.e. AL_2O_3, ZrO_2), stainless steel (1.4571) and PTFE. Operation without non return valve may result in damages to the ozone system. The valve has to be installed in that way, that no particles can enter the valve from the raw water side. The non return valve is a subject for periodical maintenance.
The non return valve is available on request.

The gas pipe connection to the point of injection requires a stainless steel pipe (1.4571) with diameter 12/10mm. The steel pipes and angle unions are available on request.

CAUTION

The pipe length and the number of detachable connections have to be minimized for safety reasons. According to the German safety guidelines a gas warning device is necessary in each room with a detachable gas pipe connection.

After installation the whole pipework a leakage test has to be performed by an experienced person.

7.3.2 Ozone gas extraction from filters and reaction tanks

In order to exploit the capacity of the ozone thoroughly it may be necessary, depending on the type of application, to install a reaction tank to ensure a sufficient reaction time of ozone with the raw water. In the reaction tank, the water contaminants are oxidised and disinfection takes place.

Furthermore in some applications the residual dissolved ozone, destabilised colloids, clumped and coated micro organisms and ozone flocculated organic reaction products has to be removed completely from the water before entering the point of use. For this purpose multi layer filters, activated carbon filters or mixed bed filters are used.

Reaction tanks and/or filters have to have a powerful exhaust ozone gas extraction system to vent out the remaining ozone gas out of the system. The gas extraction system must be ozone resistant and has to be checked at regular intervals to ensure its proper function.

CAUTION

If the function of the gas extraction system in the filters or reaction tanks is not guaranteed there exists the danger, that ozonated water will pass through the system to the point of use. This must be prevented by adequate maintenance.

The water has to be extracted from the exhaust oxygen/ozone mixture which emerges from the reaction tank or the filter. For this purpose **only catalytic ozone destructors** can be used. **The purified ozone free gas mixture has to be vented outside to prevent any oxygen enrichment in the control room.**

WARNING

Ozone gas destruction by using activated carbon ozone destructors may lead to heavy explosions by excessive ozone enrichment in the carbon layer especially at high ozone gas concentrations generated with oxygen ozone plants. This implies, that destructors for gaseous ozone using activated carbon cannot be used in combination with the OZONFILT® OZVa 5-7.

7.4 Mechanical assembly

WARNING

After unpacking the OZONFILT® OZVa, care should be taken that the system is placed on a stable base. The cabinet has to be secured against falling over.

The OZONFILT® OZVa 5 is supplied in a wall mounting cabinet.

The OZONFILT® OZVa 6 and 7 are supplied in floor standing cabinets.

The systems have to put in a place which allow easy access for maintenance work. For this purpose and for the proper operation of the cooling fans a space of at least 30 cm is necessary at the left an right side of the cabinet. Introduction of hot air exhaust air from other units in the inlets of the fan filters of the OZONFILT® OZVa has to be avoided.

The OZVa 5 has to be wall mounted.

The OZVa 6 and 7 have to be fixed additionally at the backwall. If this is not possible, the cabinet has to be secured against falling over.

The following assembly components are supplied with the system:

- 4 bolts M8x80
- 8 rubber spacers (for assembly with mounting plates only)
- 4 washers, 24mm O
- 4 nuts M8

Assembly steps for the cabinet

- ▶ Drill 4x10mm holes for the plugs as shown in the dimension sheet on next page
- ▶ Screw M8 bolts into plugs
- ▶ Put the cabinet in place
- ▶ Place the washers over the bolts
- ▶ Fix the system in position using the nuts provided

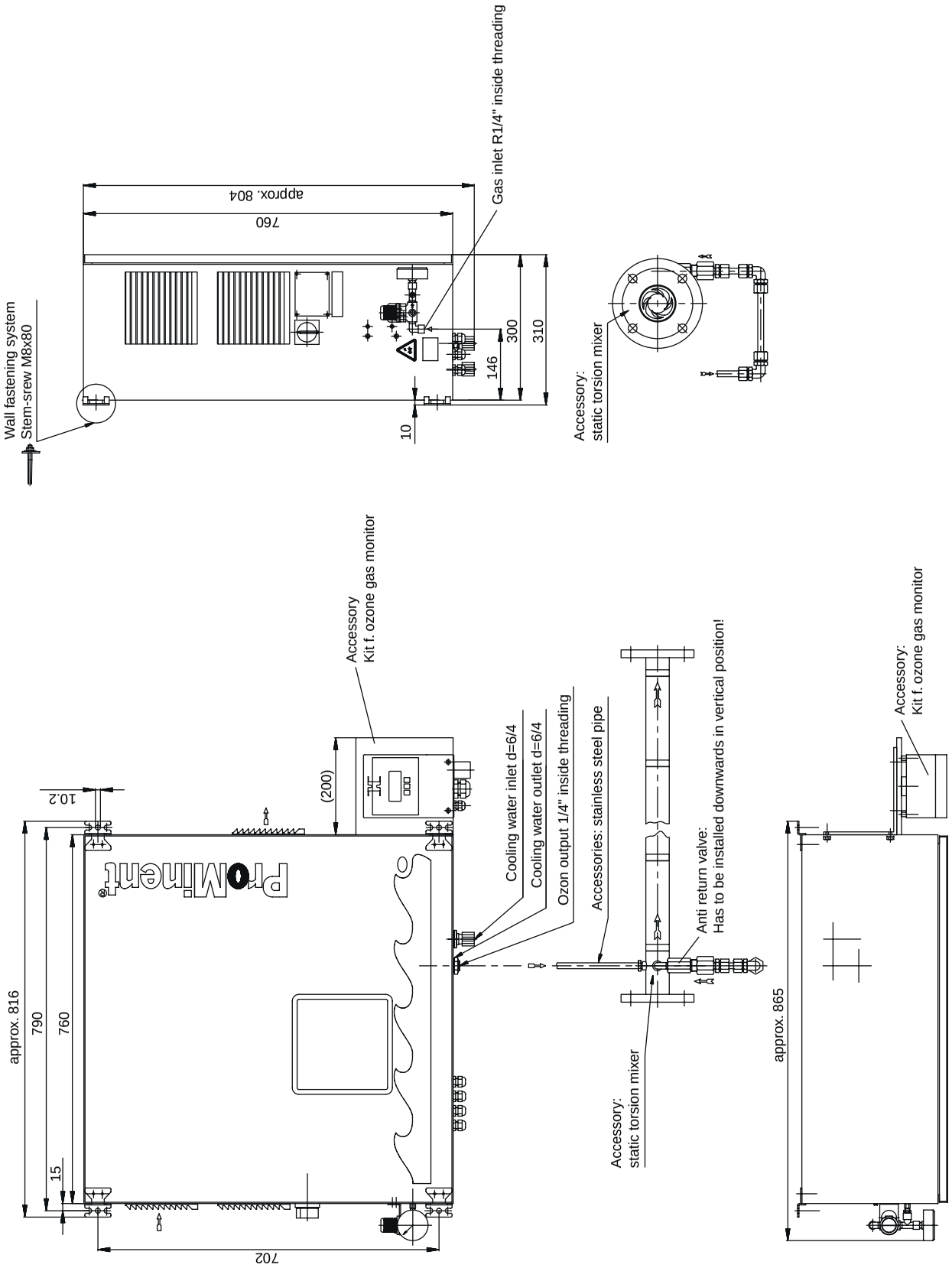


Fig. 9: Dimension sheet OZONFILT® OZVa 5

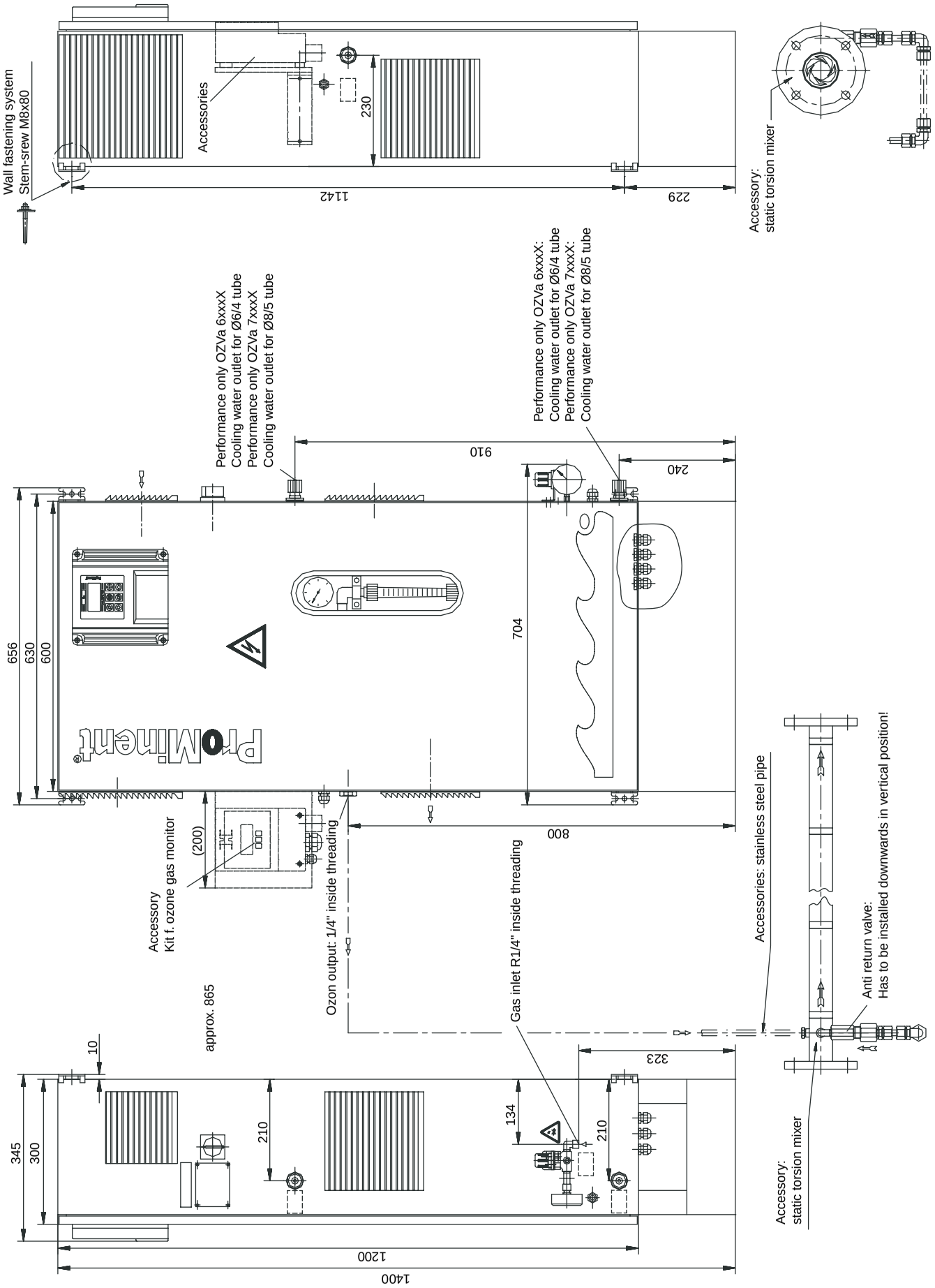


Fig. 10: Dimension sheet OZONFILT® OZVa 6/7

7.4.2 Raw water pipes

All raw water pipes

- to the system (raw water inlet) and
- from the system (ozonated water outlet)

can be made of rigid PVC, range 5 or stainless steel (1.4571). The optimum choice depends on the type of application and the type of dissolved corrosives in the process water.

IMPORTANT

Ensure, that all pipes are laid free from mechanical stress.
Keep all connecting pipes as short as possible. The raw water pipe leading to the mixing system (raw water inlet) must be fitted with a non return valve in an ozone resistant material.

The outlet pipe should be arranged in such a way that it is rising continuously. If the connection point on the reaction tank or filter is lower than the line itself, the height difference must be compensated by a pipe inserted vertically.

7.4.3 Oxygen supply system

The oxygen gas supply for the OZONFILT® OZVa 5-7 can be:

- a (P)ressure (S)wing (A)dsorption unit or PSA unit, separating nitrogen and water from oxygen using compressed ambient air,
- a station with compressed (up to 200bar(g)) bottled oxygen (up to 200bar)
- a station with oxygen stored in the liquid phase with evaporation unit.

WARNING

The connection from the output of the oxygen supply system to the gas inlet of the Ozonfilt OZVa 5-7 have to be oxygen (>90 vol%) approved pipes or tubes free from dust, dirt, particles, oil and grease.

Always observe locally applicable:

- laws

- labour and safety regulations

- regulations on environmental protection

The pipes have to be laid free from mechanical stress and have to be as short as possible. After the installation the piping has to be leakage tested by an expert.

Refer chapter “13 Technical data” for specifications of connectors, pressure ranges and required oxygen quality.

Refer Fig. 9,10, “ Dimension sheets OZVa 5, 6 and 7” for the location of the oxygen inlet of the OZONFILT® OZVa

7.4.4 Ozone gas system

The ozone gas output of the OZONFILT® OZVa 5-7 has to be connected by rigid pipes to the inlet of the mixing system.

WARNING

For the connection from the ozone output of the OZONFILT® OZVa 5-7 system to the point of injection into the raw water mixing system stainless steel pipes (1.4571) have to be used. The pipes have to be free from dust, dirt, particles, oil and grease.

Always observe locally applicable:

- laws

- labour and safety regulations

- regulations on environmental protection

for the use of oxygen and ozone mixtures

The pipes have to be laid free from mechanical stress and have to be as short as possible. After the installation the piping has to be leakage tested by an expert.

Refer chapter “13 Technical data” for specifications of connectors and pressure ranges. Refer chapter “7.3.1 Mixing modules” for installation details.

Refer Fig. 9,10, “Dimension sheets OZVa 5, 6 and 7” for the location of the ozone output of the OZONFILT® OZVa.

7.4.4 Cooling water system

- The cooling water system connections are made using PE delivery hoses which are attached to the system cabinet using PVC conector set (see Fig. 9 and 10, “Dimension sheets OZVa 5, 6 and 7”)
- Ensure, when attaching hoses, that the O-rings are located in the groove of the PVC threaded connector.
- The connection of the delivery hose to the cooling water inlet with the cooling water supply can be created with a screw in threaded connector. A connector is in the delivery range of the plant.

IMPORTANT

If cooling water priming pressure fluctuates widely or the water supply system has become fouled, a filtration relief valve has to be installed upstream from the cooling water inlet.

Refer chapter “13 Technical Specifications” for the required cooling water quality.

Refer Fig. 9,10, “Dimension sheets OZVa 5, 6 and 7” for the location of the cooling water inlet and outlet of the OZONFILT® OZVa.

8 Electrical installation

8.1 Guidelines to electrical connections

All electrical power leads to the system are passed into the system through the strain-relieving threaded connectors on the underside of the system (see Fig. 2). The power leads are laid in the ducts provided. After installation the threaded connectors are tightened. Any unused connectors are sealed using the blind plugs provided.

IMPORTANT

The system is fully wired and ready for use. It simply needs connecting to a single-phase mains power supply. Ensure that *phase, zero and earth leads* are connected in accordance with the system circuit diagram.

The system must be permanently connected to the power supply. It may not be plugged into a mains power supply via a domestic power cable!

Faulty connection to the power supply prevents correct functioning of safety equipment, in particular the trip switch, which deactivates the system when the door is opened.

It must be possible to isolate the electrical socket with an emergency switch (emergency cut-out system). This should be installed in an easily accessed position near to the entrance door to the system room.

- ▶ It must be possible to deactivate the ozone system by stopping the water treatment system booster pump via the pause input XPs on the controller circuit board (see 8.2) “Electrical In and Outputs”).
- ▶ The compulsory gas detector must be fitted with an electrically isolated contact which is connected to the clamps X3:11 and X3:12 (see circuit diagram).
- ▶ All other electrical connections must be made in accordance with the accompanying system circuit diagram.

8.2 Electrical inputs and outputs

The system is provided with the following inputs and outputs for the control of the ozone generator (see Fig. 13 “Electrical connections on the controller circuit board“):

- An ozone gas detector can be connected to the clamps XOz (see circuit diagram). The gas detector used must be provided with an isolated alarm switch which is connected to the clamps.
- Standard signal input (0/4-20 mA) for the control of the ozone quantity within a range of 0 % to 100 %. A current of 0 and/or 4 mA (depending upon the pre-settings in menu option “0/4-20 mA”) corresponds to an ozone quantity of 0 %. A current of 20 mA corresponds to an ozone quantity of 100 %.
  The XmA input is only active if the ozone quantity setting in the menu option “Internal/ external” has been activated (display: “1”). The XmA input is electrically isolated from all other electrical system components.
- Switch input XPs is a contact via which the system can be switched to PAUSE mode. The switch input XPs is electrically isolated from all other electrical system components.
- Alarm output XUsr is used to transmit failure signals. The output is a change over contact.

All electrical outputs are wired in such a way as to switch off the ozone generator should a fault in any of the leads develop.

IMPORTANT

The XOz, XPs and XPD inputs are switch inputs. They cannot be configured with external voltage! The contacts connected to the inputs must be potential free, otherwise the controller will be damaged!

Connection	Function switch	Status description contact	Voltage and current
XOz	Switch input for ozone gas warning device	Open: ozone alarm Closed: normal	Open: +12 V Closed: 1.2 mA
XmA	Electrically isolated current input 0/4-20 mA for the control of the quantity of ozone	0/4 mA: 0 % 20 mA: 100 %	Resistance: approx. +1.7 V at 20 mA
XPs	Electrically isolated switch input for pause function	Open: pause Closed: normal	Open: +15 V Closed: 10 mA
XPD	Switch input for flow controller with minimum contact	Open: raw water low Closed: raw water flow on	Open: +12 V Closed: 1.2 mA
XUsr	Alarm relay	Pin 3 → Pin 1: alarm Pin 3 → Pin 2: normal	Voltage free, can be connected by the user to 230 V/max. 8 A

9 Commissioning

WARNING

Commissioning must be carried out by qualified personnel in accordance with ZH 1/474 and GUV 18.13.

Outside Germany, the national regulations for the operation of ozone systems must be observed.

Qualified personnel are persons who have received training and authorisation from ProMinent.

Interference from unauthorised personnel renders void all guarantees or liability claims on behalf of the operator.

The system produces toxic gas using pure oxygen and high voltage.

Unauthorized access to the system or any part of the system may result in lives being endangered.

It may be necessary to do some settings inside the cabinet during commissioning.

Do not touch any electrical components inside the cabinet, when the system is energized. When the system is de energized at the mains switch wait at least 5 minutes before reaching into the cabinet.

Once the system has been installed, a function inspection must be carried out in order to detect any possible damage in transit.

Before the ozone system is energized it must firstly be ensured that:

- The systems local requirements are met (refer chapter “Assembly an Installation”, “Safety” for details)
- the system location requirements are met,
- the system is installed properly (refer chapter “Assembly an Installation”)
- pneumatic and hydraulic connections are in order, free of leakages and pressure tested,
- all electrical connections are in order and an emergency switch is installed near the entrance of the installation room,
- the personnel safety equipment is available and working properly,
- all system parameters are within permissible limits (refer chapters “Technical specifications”, “Assembly and installation”, “Safety” for details)
- the safety components are installed and working properly,
- all safety signs are installed,
- the oxygen supply system is working properly.

After that the ozone system can be energized. To energize the system ensure that

- the mains cutout (33) is activated,
- the trip switch (22) is released,
- the systems mains switch (23) is on,

Now the systems wakes up in operating mode “Stop” (refer chapter “Operation”, 10.4.5)

- **Ensure, that display “ozone setting” is at 0%. Use “arrow down” key to reduce the ozone set point to 0%, if not. At this setting the high voltage generator is deactivated and no ozone is produced.**
- Start the system using the “Start/Stop” key. Now the system has to be in operation mode “Start without ozone generation” (refer chapter 10 “Operation”, 10.4.2).

Now, the following events take place

- The pneumatic solenoid valves (gas input 4 and ozone output 12) and the cooling water inlet valve are opened by the controller.
- Set the cooling water flow rate to nominal value at the corner valve (refer chapter 9.3).

IMPORTANT

Before an ozone reference value is set to 3% or greater, make particularly sure, that the ozone generator(s) are full of cooling water, i.e. when a continuous water flow with no air bubbles is visible in the cooling water flow meter (9).

- Set the systems priming pressure to the desired value (refer chapter 9.1)
- Set the process gas flow rate to the desired value (refer chapter 9.2)

IMPORTANT

The pressure gauge (26) located inside the cabinet shows the actual value of the pressure in the ozone generator(s). This pressure has to be in the allowed limits. The pressure value depends on:

- the systems priming pressure

- the actual value of the gasflow (minor influence)

- the pressure in the raw water system (major influence).

If the pressure is above the upper limit, the safety valve (30) starts to bleed and the gas flow decreases to very low values. In this case, the pressure in the raw water system is too high and has to be decreased. Otherwise there will be shutdowns of the plant with the failure message "gasflow ↓" or "primary voltage ↑". Continuous operation with too high pressure can damage the ozone generator(s) and/or the electrical system of the plant.

- Before ozone is generated be sure that the ozone warning is working, activated and connected properly to the system. The proper function of the interlock between the ozone warning device and the OZVa has to be tested.
- Before ozone is generated be sure that the ozone warning is working, activated and connected properly to the system. The proper function of the interlock between the ozone warning device and the OZVa has to be tested.
- Check the proper function of the installed alarm system connected to the alarm relay (XUsr terminals) of the OZVa .
- Be sure that all exhaust ozone gas destructors and degassing valves in the installation are properly installed and activated.
- Reactivate door switches and close cabinet door

IMPORTANT

Before an ozone reference value is set to 3% or greater, make particularly sure, that the ozone generator(s) are full of cooling water, i.e. when a continuous water flow with no air bubbles is visible in the cooling water flow meter (9).

- Increase the ozone setting using the arrow up key from 0% to a value above 3%. After a short delay ozone is being generated and the rate is displayed in the panel ("ozone gen. rate").
- Set the desired ozone generation rate using the arrow up and down keys in manual mode (refer chapter "Operation" for details).

IMPORTANT

During the commissioning the staff responsible for the OZVa ozone plant has to be introduced in the operation of the ozone system as well as the measurement (calibration of sensors,..). Also all safety aspects have to be discussed.

The staff responsible has to have access to the operation manual and all safety notes. This has to be signed by the people in charge in the commissioning protocol of the OZONFILT® OZVa.

The commissioning protocol has to be filled out completely and signed by the customer, the people in charge of the ozone plant and the person commissioning the OZONFILT® OZVa. One copy of the protocol has to be sent to Prominent department in charge.

9.1 Setting the gas priming pressure

The pneumatic system is pre adjusted to the nominal process gas flow rate at a priming pressure of 3 bar(g) and an ozone outlet pressure of 1.5 bar(g). However, the system can be operated at different priming and ozone outlet pressures. The priming pressure can be adjusted at the pressure regulator (2) and read from the pressure gauge (37) located on the outside of the cabinet.

Reducing the priming pressure effects also a reduction of the process flow rate. After changing the systems priming pressure the process gas flow rate needs to be readjusted to the desired value. At low priming pressures the pressure range admissible at the ozone outlet may be reduced also.

WARNING

For the following settings, the system has to be operated with open cabinet door.

When the system is de energized at the mains switch wait at least 5 minutes before reaching into the cabinet. Do not touch any electrical components, when system is energized. Be sure, that the high voltage is deactivated, when performing the following settings. To deactivate the high voltage, the system has to be operated in the mode “Start without ozone generation” at an ozone setting of 0%.

9.2 Setting the process airflow

The process gas flow can be adjusted to the desired value at the regulating valve (6) located inside the cabinet. The display “gasflow” in the control panel shows the actual value. Refer chapter 13 ´Technical specifications” for acceptable values of the gas flow rate.

If the process gas flow has been adjusted, be sure that the gas regulating valve (6) is fixed with the locking nut after adjustment.

IMPORTANT HINT

Reducing the gas flow rate below the nominal flow rate results in an increase of the ozone concentration and a decrease of the ozone output of the system. Be sure, that gas flow rate is within the permitted limits, otherwise the controller will effect a shutdown of the plant showing a failure message in the display.

9.3 Setting the cooling water flow

The cooling water flow rate can be adjusted at the corner valve (9) located inside the system cabinet near the cooling water inlet of the system. The value can be read off the flow monitor (10) in the system cabinet. Refer chapter 13 ´Technical specifications” for nominal flow rate of the cooling water.

IMPORTANT HINT

Reducing the cooling water flow rate below the nominal flow rate results in a decrease of the ozone output of the plant and an increase of the cooling water temperature at the output of the ozone generators. Be sure, that cooling water flow rate and temperature is within the permitted limits, otherwise the controller will effect a shutdown of the plant showing a failure message in the display.

10 Operation

The system is switched on by turning the main switch (23) to setting “1”. The main switch (23) is situated on the right hand side of the control cabinet.

10.1 Oxygen supply

10.1.1 Operating with external oxygen supply

If the system is operated via an external oxygen supply, the following values relating to the pressure range and the air quality must be adhered to.

		OZVa 5	OZVa 6	OZVa 7
treatment	Nominal process gas quantity:	300 l/h	600 l/h	900 l/h
	Maximum pressure at systems gas inlet (1,2):	10 bar	10 bar	10 bar
	Nominal operating pressure at systems gas inlet (1,2):	2.5-3 bar	2.5-3 bar	2.5-3 bar
	Bypass valve (3) setting System inlet:	approx. 7 bar	approx. 7 bar	approx. 7 bar
	Bypass valve (30) setting at ozone generator inlet:	approx. 2.7 bar	approx. 2.7 bar	approx. 2.7 bar
	Pressure at ozone outlet:	0.8-2 bar	0.8-2 bar	0.8-2 bar

Refer chapter “Technical Specifications” for details.

10.2 Function events sequence

After the system has been switched on for the first time at the main switch (23), the system is in “STOP” mode (“STOP Key” on display and control panel). The system is then ready to operate.

The system starts operation using the START/STOP key if

- PAUSE mode has not be externally activated and
- If an additional flow monitor is connected to terminal XPD of the controller board and
- If the flow detector registers sufficient water flow and allows the system to commence operation.

NOTE

The required ozone quantity (“Ozone reference value” display) is set to 0 % the first time the system is commissioned. If the system is started by pressing the START/STOP key, however, the system will be in normal operating mode without ozone generation (high voltage switched off). In order to switch on the ozone generation, the “Ozone reference value” should be set to at least 3 %.

10.3 Keypad operation

The keypad on the display and control panel is used to:

- Stop/start the whole system,
- Set the required ozone quantity,
- Display the system dimensions in turn and
- Set different system parameters.

START/STOP key

Starts/stops system (toggle action). If a failure occurs the system is automatically switched off by the controller. Once the failure is remedied, use this key to restart the system.

CHANGE DISPLAY key

This key is used to change from the current to the subsequent display value. The display changes cyclically i.e. after displaying the last value, automatically returns to the first value “Ozone reference value”.

BACK key

This key is used to return to first display value “Ozone reference value” from any other display value.

ENTER key

This key is used to acknowledge a failure and to confirm settings changes. If this key is pressed after a failure has occurred, the failure message display is replaced with a display of the current value.

UP key

UP and DOWN keys are used to alter values shown in the display and control panel if this is allowed, i.e. if the change value symbol is flashing on the display.

DOWN key

See UP key

10.4 Important system modes

10.4.1 Operating mode “Start” with ozone generation

The system is in the “Start” mode, with ozone generation, when

- It has not been externally placed in PAUSE mode,
- The “Ozone reference value” has been set to 3 % or more,
- The system has not been stopped by the STOP/START key and
- No other failure requiring acknowledgement is displayed on the display/control panel.

10.4.2 Operating mode “Start” without ozone generation

If the “Ozone reference value” is set to less than 3 % the system will operate in normal operating mode:

- Gas flow on,
- Cooling water flow on and
- Process water flow on.
- The high voltage required for ozone generation is switched off, however, and ozone is not generated.
- In this operating mode the fault indicating relay on the controller circuit board (14) is not activated!

If the “Ozone reference value” is increased to 3 % or more, the ozone generator will switch on automatically!

10.4.3 Operating mode “Failure”

If a failure occurs the controller will transfer the system to “STOP” mode.

- The gas in and outlets and
- The cooling water inlet solenoid valves will close and
- The high voltage required for ozone generator will be switched off.
- The corresponding failure message will appear in the display and control panel (see section 12 “Troubleshooting” and 10.5.2 “Display and Control Panel”).
- The fault indicating relay XUSr on the controller circuit board (14) is activated and triggers an external failure signal.

10.4.4 Operating mode “Process water flow low”

See chapter 5.6.1.

If an additional flow monitor is connected to terminal XPD of the controller board and if the flow of water requiring ozonising (process water) is interrupted or falls below the lower threshold of the flow monitor, the controller switches the system to “STOP” mode. This is a normal operating mode and the fault indicating relay is not activated in this case!

If the process water flow is at a sufficient level, the system automatically starts up again.

10.4.5 Operating mode “Stop”

The “STOP” operating mode can be activated in two ways:

- When a failure occurs and has stopped the machine.
- When the system has been stopped using the STOP/START key.

When switching to the “STOP” mode

- The gas inlets and outlets and
- The cooling water inlet solenoid valves close and
- The high voltage generator is switched off.
- The message: “STOP key” alternates with the current display message on the display and control panel.
- If the “STOP” mode was the result of a failure.

10.4.6 Operating mode “Pause”

The PAUSE switch input can be activated externally. In PAUSE mode

- The gas in and outlets and
- The cooling water inlet solenoid valves close and
- The high voltage generator is halted.
- The message: “PAUSE” alternates with the current display message on the display and control panel. After removing the pause message (contact on XPs input on controller circuit board closed) the system will automatically switch to the operating mode active prior to the activation of the PAUSE switch.

10.4.7 System response to power connection

When it is connected to the power supply the system responds in one of two ways depending upon the software in the EPROM on the electronic controller (14):

1. The system initiates in “STOP” mode and must be started manually by pressing the STOP/START key, irrespective of the operating mode that was active before the system was last disconnected from the power supply.
2. The system initiates in the operating mode that was active before the system was last disconnected from the power supply. This means that the system controller memorises the operating mode as the system is being shut down. This applies to:
   - The preset “Ozone reference value”,
   - The status of the STOP/START key,
   - And the failure status.

   The system does **not** start ozone generation independently if, before the system was last shut down
   - A failure was present which required acknowledgment,
   - Ozone generation had been stopped using the STOP/START key.

Otherwise, ozone generation automatically starts at the preset “Ozone reference value” after power has been switched on.

In the current software version the system response to power connection is preset to automatic re-start (option 2). This can be changed by using the hardware key, if necessary.

10.5 Displays

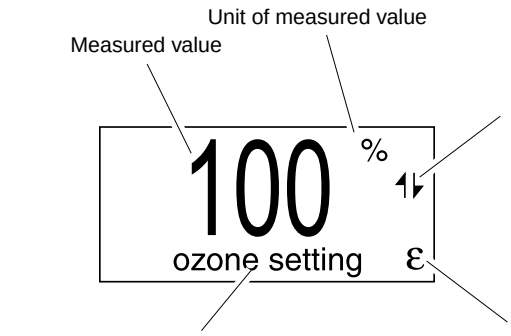
10.5.1 Whole system

The following functions and displays appear in normal operating mode:

- The main switch for the system is set to “ON”,
- The automatic cut off has not been activated (lever points to the left),
- The system priming pressure is within the allowed limits (gauge on air-cleaning unit (1)),
- The pressure at the injection point is within its allowed limits,
- This corresponds to display value at the the pressure gauge (26) of approximately 2.4 bar(g) at the nominal air flow of the plant,
- No failure is displayed in the display and control panel.

10.5.2 Display and control panel

The information contained in the display and control panel (16) is displayed as shown below in the menu option relating to setting the required “Ozone reference value”. More information, see chapter 10.6 “Control menu”.



Normal operating: Displayed measured value
mode in case of failure: First cause of failure

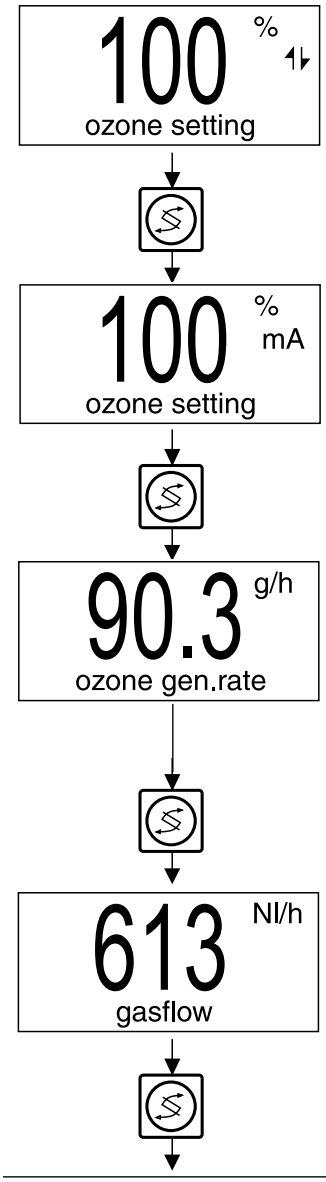
Measured value status information:

Display	Operating mode for displayed value
↑↓	Adjustable value
mA	Value can be adjusted via external interface
None	Display value only

Failure display:

Display	Description
None	Normal operating mode
ε	Failure, system stopped
ω	Warning
*	· Failure information
Flashing	· Reference value below 3 %

10.6 Control menu



10.6.1 Ozone reference value; internal operation

The required ozone value is set in percent in the “Ozone reference value” display. In internal operating mode, settings are adjusted using the “UP” and “DOWN” keys. A 100 % reference value setting corresponds to the maximal ozone quantity (see Technical Data, chapter 13).

10.6.2 Ozone reference value; external operation

The required ozone value is set in percent in the “Ozone reference value” display. In external operating mode, settings are adjusted using a current interface connected to the XmA input. A 20 mA reference value setting corresponds to a display value of 100 %.

10.6.3 Ozone quantity

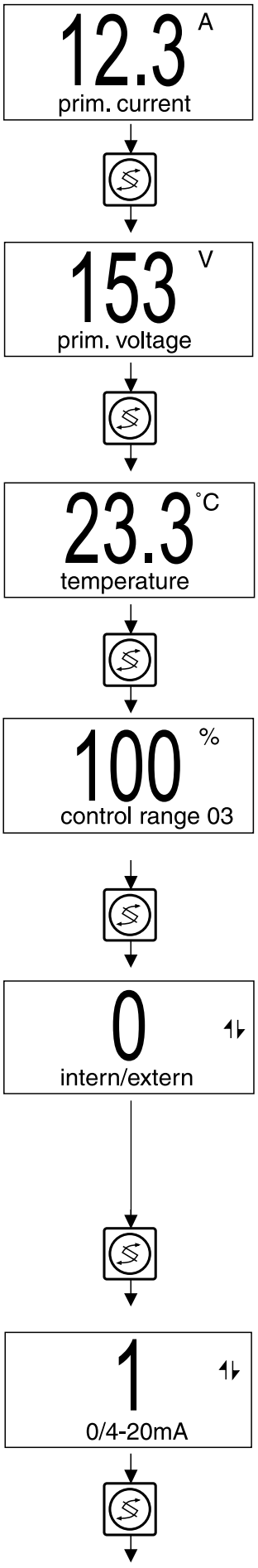
The display shows the current amount of ozone being generated in g/h.

The displayed value is calculated from measured electrical values and is corrected in relation to the current measured value of the process airflow.
Deviations of the displayed value from the actual value occure when:

- the purity dew point or temperature of the process gas are out of range,
- the pressure in the ozone generators is out of range,
- the temperature of the cooling water or the flow rate are different from the specifications.

10.6.4 Gas flow

The display shows the current measured value of the gas flow through the ozone generator. The display value is related to Standard conditions (air pressure 1013.25 mbar, temperature 0 ºC). See Technical Data (chapter 13) for nominal process airflow.



10.6.5 Primary current

The display gives the current flowing on the primary side of the high voltage transformer. The displayed measured value is dependent on the preset “Ozone reference value”.

10.6.6 Transformer voltage

The display gives the voltage present on the primary side of the high voltage transformer. The displayed measured value is dependent on the preset “Ozone reference value” and the operating pressure displayed on the pressure gauge in the system cabinet (26).

10.6.7 Temperature

The display gives the mid temperature measured at the cooling water outlet of the ozone generator. The display is dependent on the “Ozone reference value” the temperature of the cooling water inlet, and the flow rate of the cooling water.

10.6.8 Control range ozone

The control range ozone can be used to restrict the ozone output of the plants to lower values or to adapt external current signals to the desirred ozone range in external mode.

Eg.: ozone setting 0-100 % corresponds to 90 g/h at control range 100 %
ozone setting 0-100 % corresponds to 56 g/h at control range 80 %

The control range can be set to values between 20 % and 100 %.

10.6.9 Internal/External

Here, the UP and DOWN keys are used to change the ozone quantity settings options:

0 = Internal: The ozone quantity can be set in % increments using the keypad, as described above, in the “Ozone reference value” display.

1 = External: The ozone quantity is set via a 0-20 mA or 4-20 mA current interface connected to the XmA input.

Any changes in operating mode are confirmed using the “Enter” key.

If the operating mode is changed, the system starts up in “Stop” mode and must be restarted by the operator.

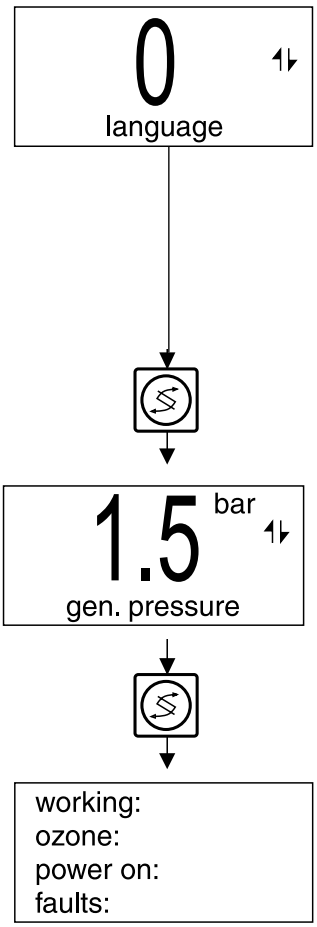
10.6.10 0/4-20 mA

If the current interface was selected in the previous display for setting the ozone quantity, this display can be used to set the type of current interface:

0 = 0-20 mA - current interface

1 = 4-20 mA - current interface

Any changes in operating mode are confirmed using the “Enter” key.



10.6.11 Language

Setting required display language:

0 = German

1 = English

2 = French

3 = Spanish

4 = Italian

Only German and English are currently available. Changes to the language are confirmed using the “Enter” key.

10.6.12 Generator pressure

This display is used to enter the pressure present in the installed system so that the ozone quantity can be precisely corrected in relation to this pressure. The pressure is read from the gauge (26) in the system cabinet.

The display value is altered using the UP and DOWN keys and confirmed using ENTER.

The value displayed when the system is first commissioned is the factory setting.

10.6.13 Operating parameters

This display shows the following values:

- Working hours of the system with mains switched on.
- Working hours with ozone generation switched on.
- Number of mains switches (main switched on).
- Number of occured failures.

11 System Maintenance

WARNING

All maintenance and repair work must be carried out by qualified personnel who have been authorised by ProMinent.

Qualified personnel are persons who, as a result of specialised training and experience, have sufficient knowledge in the field of ozone systems, and are sufficiently familiar with relevant national legislature on safety at work, accident prevention, directives and general technical regulations to be able to correctly judge the safety conditions within an ozone system.

Interference from unauthorised personnel renders void all guarantees or liability claims on behalf of the operator.

11.1 Safety guidelines for maintenance or repair activities

Be sure, that the persons maintaining or repairing the system have read and understood the operating instructions and, in particular, the chapter “Safety”.

In order to ensure safety while protection devices are open always switch off the power switch, when system is standing still. In order to prevent the system from starting accidentally, always secure it against unintentionally switching on.

When the OZONFILT® OZVa is de-energized at the mains switch parts of the electric system inside the cabinets are still under line voltage. After de-energizing the OZONFILT® OZVa wait at least 5 Minutes before working at any parts inside the eabinet.

If it is necessary to remove safety devices during set-up, maintenance or repair, ensure that these device are refitted and checked immediately upon completion of maintenance and/or repair work.

When working on gas lines make sure, that the parts are depressurized and free of ozone. When depressurizing oxygen leading pipes or hoses ensure, that the oxygen cannot harm any persons.

Always use original spare parts for maintenance and repair.

Maintenance and inspection of the system at regular intervals is of importance for the safe and proper function and prevents malfunctions.

11.2 Routine inspections

in the following table a list of routine inspections is given as a suggestion to maintain the proper function of the OZONFILT® OZVa 5-7. Keep a log of all maintenance and inspection work carried out. There is a template for this in the appendix.

OZVa display values	value	Unit	comments	suggested frequency of checks
ozone setting		[%]		daily
ozone gen.rate		[g/h]		daily
gasflow		[l/h]		daily
prim. current		[A]		daily
prim. voltage		[V]		daily
cooling water outlet temperature		[°C]		daily
control range 0_3		[%]		daily
working hours		[h]		daily
working hours w.ozone		[h]		daily
number of power on				daily
number of faults				daily
Other parameters				
cooling water flow rate		[l/h]		daily
system inlet pressure	2.5-3	[bar]		daily
ozone pressure	< 2.4	[bar]		daily
inspection of filter mats in the ozone cabinet			according to ambient conditions	monthly
inspection of ss check valves (11, 37) at the ozone outlet			according to raw water quality	monthly

WARNING

- **If the filter mats in the fan or the air exit filters become clogged, the control cabinet may overheat and the controller will effect shutdowns with the failure message “system temperature ^”. In the worst case components may be destroyed, if overheated.**
- **The fan filter mats and air exit filter should be replaced at least once a year or more frequently under unfavourable conditions.**

11.2.1 Test procedure for the non return valves (11, 37) at the ozone outlet

WARNING

- **If the non return valves (11, 37) are blocked by particles from the raw water side, the ozone generators may be damaged. By this, it is important to perform periodical tests of the non return valves.**

- set ozone production to 0 %
- run the plant at 0 % ozone at least for one minute to remove residual ozone in the piping,
- switch off the plant at the mains switch,
- open cabinet door,
- disconnect ozone hoses at the stainless steel check valve (11) at the ozone output of the plant,
- start plant at 0 % ozone output,
- reduce gasflow rate at the pressure regulator (1) outside the OZVa to the lowest possible value.

WARNING

For the time of the test a small amount of oxygen is bleeded into the installation room! Read safety precautions!

- wait until water pump is running and the raw water system as well as the ozone outlet piping is pressurized,
- check, if there is any backflow of water through the open end(s) of the check valve(s):
- clean or replace the check valves (11, 37) to prevent damage to the ozone generators,
- reset plant to initial operating conditions.

11.3 Regular Maintenance

The maintenance of the OZONFILT® OZVa 5-7 has to be performed in regular intervals to maintain the proper function of the system. **The safety guidelines for maintenance activities (chapter 11.1) have to be observed.** Standard maintenance activities for the OZONFILT® OZVa 5-7 are:

- inspection of the pneumatic system (leakages, hoses),
- inspection (leakages, deposits, hoses) and, if necessary, cleaning of the cooling water system,
- functional test of the solenoid and bypass valves in the gas and cooling water system,
- replacement of the non retum valves (11, 37) at the ozone outlet,
- replacement of the solenoid valves (12) at the ozone outlet,
- replacement of the PTFE hoses at the outlets of the ozone generators,
- functional tests of the electrical system (interlocks, system parameters,..),
- replacement of filter mats in the ozone cabinet.

WARNING

Maintenance of the OZONFILT® OZVa has to be performed at least once a year or more frequently under unfavourable conditions. If the OZONFILT® OZVa system is not serviced this may result in severe damages to system components.

Maintenances activities for other components i.e. gas warning device(s), compressor(s) and oxygen concentrators have to be performed according to the maintenance instructions described in the appropriate operating instructions.

12 Troubleshooting

WARNING

When trouble shooting or rectifying malfunctions in the OZONFILT® OZVa ensure that work is only performed after switching off the line voltage.
After cutting the line voltage a delay time of at least 5 minutes has to be elapsed before any components inside the cabinet are touched.
The system has to be secured against unwanted application of line voltage during trouble shooting or service activities.

WARNING

For safety reasons this system must be trouble shooted only by qualified and trained personnel. Always read the Safety instructions in chapter "Safety" prior starting work at the OZONFILT® OZVa. If the ozone gas system has to be opened remove any ozone gas from gas lines in a safe way.

The failures described in the following table cause the system to shut down.

There are delays of varying lengths, depending upon the type of failure, between initial failure recognition and system shutdown. During the delay time a star flashes in the lower right-hand corner of the LCD display. After the delay time, the appropriate failure message appears in the lowest row of the LCD display. The system switches off in stages:

- First, the high voltage is switched off. The system continues to run for a certain time without generating ozone. During this period, the remaining ozone is extracted from the generator.
- Solenoid valves then pneumatically and hydraulically isolate the system (gas inlet, gas outlet, cooling water inlet),
- A failure message appears in the display and control panel giving the cause of the failure.

The **failures highlighted in bold** in the following table activate the fault indicating relay (XUsr) on the controller circuit board (see section 8.2 "Electrical in and outputs). These must be acknowledged, after remedying the fault, at the display and control panel. The ozone generator must be restated manually using the STOP/START key.

No.	Shutdown by	Failure message in display	Reason	Actions
1	Safety system	none	Current consumption of the plant too high	Locate and correct short circuit(s) inside the cabinet.
2	Door trip switch	none	Cabinet door open	Close cabinet door
3	**Ozone gas detector**	**ozone alarm!!**	**Ozone gas leak**	**Observe safety instructions before entering the room.** Locate and seal ozone gas leak.
5	**Flow monitor; cooling water**	**cooling water ↓**	**Cooling water flow below minimum level**	- Check cooling water priming pressure, increase if necessary. - Check for deposits blocking the cooling water system outside and/or inside cabinet, clean if necessary. - Check function of solenoid valve - Adjust flow rate at the corner valve (9), if necessary. - Install pressure reducer with filter at the cooling water inlet outside the cabinet.
6	Flow monitor; process water	water↓	Process water flow below. minimum level.	The system restarts operation without any required action, when the process water flow comes above the adjusted minimum level. **The alarm relay is not activated!**

No.	Shutdown by	Failure message in display	Reason	Actions
8	**Power system monitor**	**current dyn.↑**	**Several consecutive excessive current spikes at the output of the power board.**	Check for - excessive pressure in the ozone generators (too low, or too high) - humid process gas - process water in the ozone generators and/or the gas system - short circuit on the primary side of the HV transformer - short circuit on the secondary side of the HV transformer
9	**System temperature monitor**	**temp. system ↑**	Temperature of system components too high (Cabinet, power board, HV transformer, ozone generator(s)). The system first reduces the power input to the ozone generators to 50% of the actual value and activates the alarm relay. A complete shut-down takes place when this situation persists for a time longer than 10 minutes. If during a delay of 10 minutes temperature decreases to normal values, the system restarts operation with full capacity and the alarm relay is deactivated.	- Check proper operation of the cabinet fans, - Clean fan filters, - Reduce ambient temperature - Reduce ozone setting
12	**Process gas flow measurement**	**gasflow ↓**	**Gas flow through ozone system too low**	- Check for excessive pressure in the ozone generators, - Check for excessive pressure in the process water system, - Check for low pressure at the oxygen inlet, - Check pneumatic valves - Correct the gas flow by adjusting inlet pressure and/or the needle valve (6).
		gasflow ↑	**Gas flow through ozone system too high, above measurement range of gas flow monitor**	- Check for too high pressure at the process gas inlet, reduce pressure at the pressure reducer (2), - Decrease gas flow at the needle valve (6) - Check for large pressure variations in the raw water system.
13	**Primary current measurement**	**prim. current ↑**	**Current in the primary winding of the high voltage transformer above upper limit**	Excessive current consumption in the primary windings of the high voltage transformer.
14	**Primary voltage measurement**	**prim. voltage ↑**	**Primary voltage of the high voltage transformer too high**	- Check connections from the output of the power board (15) to the primary windings of the HV transformer (17) and correct if necessary. - Check for process water in the ozone generators and/or the gasystem. Dry system completely, clean or replace non return valves (11,37), sole noid valves (12) and/or ozone generator(s) (8) if necessary. - replace high voltage transformer (17) if necessary.

No.	Shutdown by	Failure message in display	Reason	Actions
		prim. voltage ↓	Primary voltage of the high voltage transformer above upper limit	- Check connections from the output of the power board (15) to the primary windings of the HV transformer (17) and correct if necessary. - Reduce pressure at the ozone outlet.
15	Temperature sensor in cooling water outlet of the ozone generators	cooling temp. ↓	Temperature of cooling water below 5°C	Increase cooling water inlet temperature
		cooling temp.↑	Temperature of cooling water outlet above 45°C	Decrease cooling water inlet temperature or increase cooling water flow rate.
16	Power supply monitor	dc voltage ↓	Line voltage at the power board (15) out of range or completely interrupted	- Line voltage at the input of the power board (15) too low, check power supply, increase line voltage. - Fuse on the power board (15) tripped, replace fuse or power board if the failure persists.
		dc voltage ↑		Line voltage at the input of the power board (15) too high, check power supply of the plant, decrease line voltage.
18	Power system monitor	duty cycle ↑	Several consecutive current pulses with a too long duration at the output of the power board.	- Check connections from the output of the power board (15) to the primary windings of the hv transformer (17) and correct if necessary. - Reduce pressure at the ozone outlet - Reduce ozone setting

13 Technical Data, Standards, Directives

13.1 Technical Data

System type:

OZONFILT® OZVa 5-7, ozone generating and metering system.

Compulsory accessories:

Ozone gas detector

Recommended accessories (available on request)

Oxygen supply
- oxygen enrichment system from ambient air with compressor system or
- bottled oxygen or
- iquid oxygen evaporation system,

Oxygen gas detector,

Static mixer with non return valve,

Catalytic exhaust gas destructor,

Reaction tank with ventilation equipment,

Filter with activated carbon layer and ventilation system for ozone destruction in liquid phase.

Ozone generating module

Ozone system		OZVa 5	OZVa 6	OZVa 7
Number of generator modules		1	2	3
Ozone output measured in accordance with DIN 19627 at ambient temperature 20°C, cooling water inlet 15°C, cooling water flow rate nominal, ozone pressure 1.5 bar (g) oxygen purity (vol.) >= 96 % at full capacity. (*) = standard specification (**) = available on request	ozone concentration			
	150 g/Nm³ (**)	17,5 g/h	35 g/h	52 g/h
	100 g/Nm³ (*)	30 g/h	60 g/h	90 g/h
	80 g/Nm³ (*)	35 g/h	70 g/h	105 g/h
Nominal cooling water flow rate	l/h	30	70	100
Ozone control range	%	3 – 100		
Max. humidity of surrounding air	%	85, non condensing		
Ambient temperature °C		5 – 40		
Ambient air		free from dust, fumes and aggressive chemicals		

Gas supply				
Gas connector		G ¼" inside thread		
Gas type oxygen purity	Vol.-%	oxygen, >= 90		
Dew point	°C	<= -50		
Process gas flow rate related to standard conditions (0°C; 1013,25 mbar) (*) = standard specification (**) = available on request	ozone concentration			
	150 g/Nm³ (**)	117 Nl/h	234 Nl/h	347 Nl/h
	100 g/Nm³ (*)	300 Nl/h	600 Nl/h	900 Nl/h
	80 g/Nm³ (*)	438 Nl/h	875 Nl/h	1313 Nl/h
Oxygen flow range threshold	Nl/h	50 - 550	150 - 1000	200 - 1500
Oxygen pressure at system inlet		2.5 – 10 bar (g)		
Standard pressure at system inlet		3 bar (g)		
Operation at lower oxygen input pressure		possible with reduced pressure range at ozone outlet		
Oxygen temperature at system inlet		<= 30°C		
Particle size		<= 5 µm		
Hydro carbon compounds		<= 20 ppm		

Ozone system		OZVa 5	OZVa 6	OZVa 7
Cooling water				
Cooling water PE hose connector	mm	6x4	6x4	8x5
Nominal cooling water flow rate	l/h	30	70	100
Cooling water flow range	l/h	30-60	70 –100	100-160
Cooling water inlet pressure		max. 5 bar(g), no pressure surges		
Cooling water outlet		zero pressure outlet		
Cooling water inlet temperature at ambient temperature < 35°C	°C	< 30		
Cooling water inlet temperature at ambient temperature 35°C-40°C	°C	< 25		
Cooling water quality				
gas content	free from gas bubbles			
volume fraction deposits	ml/l	< 0,1		
Iron	mg/l	< 0,3		
Manganese	mg/l	< 0,05		
Chloride	mg/l	< 250		
Conductivity	uS/cm	> 100		

Ozone outlet		**OZVa 5**	**OZVa 6**	**OZVa 7**
Connector			G ¼" inside thread	
Pressure range at ozone outlet	bar (g)		0.8 – 2.0	
Electrical connections				
Supply voltage			230 V (-15% / +10%), 50/60 Hz	
Main fuse	A	3	6	10
Current consumption at line voltage 230V and full capacity (typ.)	A	1.7	3.6	4.9
Total power consumption at 230V line voltage, (typ.)	W	380	780	1060
Power consumption for ozone generation (typ.) at full capacity	W	300	600	900
Power factor at full capacity			>= 0.95	
Switch input, pause (XPs)			Isolated, load: +15Vdc / max. 10mA	
Switch input ozone warning device (XOz)			load: +12V Vdc / max. 1.5 mA	
Standard signal input, ozone reference value (XmA)			Isolated, load: +1.7 Vdc at +20mAdc	
Alarm output (XUsr)			Isolated, change-over 230V / 8A, free contact	
Total cabinet dimensions				
Width	mm	865	705	705
Height	mm	804	1400	1400
Depth	mm	310	345	345
Weight	kg	75	109	114
Transportation Weight	kg	107	143	149
Enclosure Rating			IP 43	

Mixing equipment module

Process water flow range	Unit	Process water connector , flange DN	Length [mm]
5 – 10	m^3/h	40	718
10 – 15	m^3/h	50	718
15 – 25	m^3/h	65	718
25 – 35	m^3/h	80	1100
35 – 50	m^3/h	100	1100

13.2 Standards and Directives

System complies with DIN 19627 “Ozone Generators for Water Treatment”, as well as ZH 1/474 or GUV 18.13
“Directives for the Use of Ozone for Water Treatment.”

Applicable EU Guidelines:
The system is constructed in accordance with the following standards:
EU - Low Voltage directives (73/23/EWG)
EU - EMV - Directive 89/336/EWG i.d.F. 92/31/EWG

Related harmonised standards, in particular:
DIN EN 60204 - 1
EN 50081 - 1/2, EN 50082 - 1/2
EN 60555 - 2, EN 60553 - 3

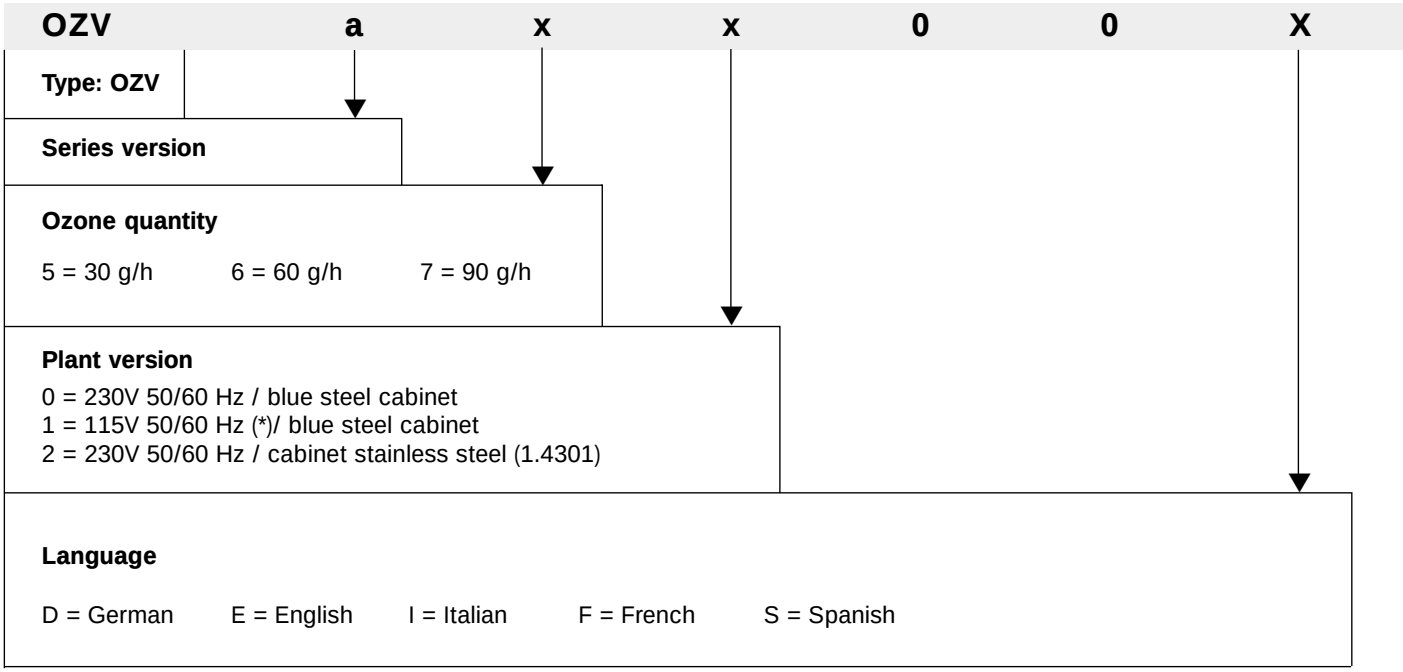
Related national standards and other technical specifications, in particular:
E DIN 19627
DIN VDE 0110 T1 and T2
DIN VDE 0700 T1
VDE 0101
ZH1/474

13.3 Permissions/Approvals for the OZONFILT® OZVa

The system carries the CE symbol.

Identity code for Ozone plants OZVa 5-7

OZV = Ozone plant with variable ozone control (3% - 100%)
Ozone production under pressure (upto 2.0 bar) and middle frequency (2500 to 6000 Hz)



Hint:
OZVa 5-7: mixing systems have to be ordered separately.

Operation Log for OZONFILT® OZVa ozone systems

Type of OZVa:_____ **Serial number:_____** **d=daily m=monthly**

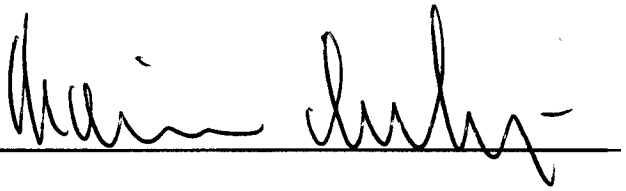
date / display															Unit	
ozone setting															%	d
ozone gen.rate															g/h	d
gasflow															l/h	d
prim. current															A	d
prim. voltage															V	d
cooling temp.															°C	d
control range 0_3															%	d
working hours															h	d
working hours with ozone															h	d
no. of power on																d
no. of faults																d
Other parameters																
cooling water flow rate															l/h	d
system inlet pressure (gauge (2))															bar	d
ozone pressure (gauge (26))															bar	d
inspection of filter mats																m
inspection of ss check valves (11, 37) at the ozone outlet																m
maintenance work carried out																
signature																

EC Declaration of Conformity

We,

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

hereby declare that, on the basis of its functional concept and design and in the version brought into circulation 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 :	***Ozonfilt® ozone generator***
Product type :	***OZVa***
Serial number :	***see type identification plate on device***
Relevant EC regulations :	***EC - machine regulation (98/37/EEC)*** ***EC - low voltage regulation (73/23/EEC)*** ***EC - EMC - regulation (89/336/EEC subsequently 92/31 EEC)***
Harmonised standards used, in particular :	***DIN EN 292-1, DIN EN 292-2*** ***DIN EN 60204-1*** ***DIN EN 50081-1/2, DIN EN 50082-1/2*** ***DIN EN 61000-3-2, DIN EN 61000-3-3***
National standards and other technical specifications used, in particular :	***DIN 19627*** ***DIN VDE 0700 T1*** ***DIN VDE 0110 T1, T2*** ***ZH1/474*** ***VBG 4***
Date/manufacturer´s signature :	***26.01.2000*** 
The undersigned :	*Dr.- Ing. R. Dulger, President*