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Original Manual

Manual
WEDECO EFFIZON®
Ozone Generating System
SMOevo^{PLUS} Series

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1 Table of Contents

2 About this Manual

In this section you will learn how this manual is organized. For your orientation, this section specifies all the means and symbols of presentation used in this manual.

Xylem Water Solutions Herford GmbH is the full legal name of the manufacturer of Wedeco products. For simplicity's sake, the term Wedeco is used in this manual when referring to Xylem Water Solutions Herford GmbH.

The manual was created with utmost care. However, if you find any incomplete information and/or errors, please let us know immediately. *Refer to Chapter Contact Addresses.*

Your improvement suggestions will be appreciated. They will help design our manuals even more user-friendly.

2.1 Contact Addresses

- If you have any queries, please contact your regional Sales Company for Wedeco products, also refer to www.xylem.com.

2.2 Target Group

This manual is intended for

- the owner / operator of the ozone system,
- the operating personnel of the ozone system,
- the qualified personnel in charge of installation, commissioning, maintenance and repair work with regard to the ozone system.

2.3 Storage of the Manual

The manual is an integral part of the ozone generating system. It must be accessible to the operating personnel and the maintenance and repair staff for the whole duration of the service life of the system. Always keep this manual near the ozone system for future reference.

Further copies of this manual can be ordered from your regional Wedeco Customer Service. *Refer to Chapter Contact Addresses.*

2.4 Liability and Warranty

All the data and information concerning operation and maintenance of the system are to the best of our knowledge, based on our previous experience and know-how. We are only liable within the framework of the warranty obligation agreed upon in the main contract for any legal entitlements resulting from this contractual agreement.

The original version of this manual was created in German language. The translation into the relevant language of the contracting country was done by certified translators.

Any warranty becomes void if

- the information given in this manual is not or not sufficiently observed
- the ozone generating system is used not according to its intended use
- spare parts or any parts not approved by Wedeco are used
- functions or materials of the system are modified without approval
- the system is incorrectly operated or operated by unqualified personnel
- protective equipment is removed, manipulated, or not employed
- the system is incorrectly or unprofessionally cleaned
- maintenance work is done improperly or if maintenance intervals are not observed
- wear parts are concerned.

Modifications and/or adjustments on the ozone system are possible in certain cases.

Such cases require written approval by Wedeco.

2.5 For Your Orientation

2.5.1 Pictographs

This section gives an outline of the kind of pictographs used in this manual.

Pictograph	Description
	Warning signs are triangular with a black pictograph on a yellow background.
	Prohibition signs are round with the safety color red around the edge and a red transverse bar.
	Mandatory signs are round with a white pictograph on a blue background.
	Notices contain general important information not related to personal injury.

2.5.2 Manual Structure

This section gives an outline of the information given in the individual sections of this manual.

Name of the section	Contents of the section
About this Manual, section 2	How is this manual organized, liability and warranty, pictographs, terms and abbreviations, information on contact addresses.
Basic Safety Guidelines, section 3	What does endanger my own safety or the safety of the system? What do I have to observe when handling ozone and oxygen?
Technical Data, section 4	What are the performance, dimensions and weight of the ozone system?
System Description, section 5	How does ozone generation work? What are the process steps and the layout of the ozone system?
Transport and Storage, section 6	What do I have to observe regarding transport and storage of the system?
Installation and Initial Start-Up, section 7	How is the ozone system installed? What do I have to observe prior to commissioning?
Operation, section 8	How do I operate the ozone system? What is to be considered in normal operation mode?
Troubleshooting, section 9	How do I have to respond to fault messages?
Cleaning , section 10	How do I clean the ozone system? What is to be observed?
Maintenance, section 11	How do I keep the ozone system in functional condition? What maintenance work do I have to carry out?
Shutdown and Disposal, section 12	What do I have to observe when decommissioning and disposing of the ozone system?
Appendices	Form 'Confirmation of Briefing' Example Operating Directives Swagelok – Assembly Instructions for External Connections Where and how do I order spare parts? Spare Parts Lists

2.5.3 Abbreviations and Reference States

This section gives an overview of abbreviations used in this manual.

Abbreviation	Meaning	Description
TLV	Threshold Limit Value	Upper limit on the acceptable concentration of a hazardous substance in workplace air
FU	Frequenz Umrichter Frequency converter	Conversion of the mains AC voltage into an AC voltage which is variable in frequency and amplitude.
HMI	Human Machine Interface	The HMI is used to visualize information and to allow the operator to interact with the ozone system.
PID Controller	Proportional-integral-derivative controller	Element of control technology
P&ID	Piping & Instrumentation Diagram	Identification of measuring and control points
PLC	Programmable Logic Control	Programmable control unit with microprocessor
UPS	Uninterruptible Power Supply	Ensuring the supply of electrical loads in the event of faults
WOD	Wedeco Ozone Destructor	Catalytic residual ozone destructor
WCL	Wedeco Closed Loop	Closed cycle cooling system for ozone generators

Reference state

Nm³	volume at standard condition 0°C and 1.01325 bar according to DIN1343:1990
Nm³/h	m³/h Flow rate at standard condition 0°C and 1.01325 bar according to DIN1343:1990

3 Safety

This section describes the safety equipment and safety measures relating to the use of the ozone generating system. Read this section carefully prior to operating the system.

Ensure that the manual for the system is accessible to the user and the maintenance and repair personnel for the duration of the system service life.

Keep a copy of this manual in close vicinity to the system!

3.1 Intended Use of the System

	Herewith the manufacturer declares that the ozone generating system including, where required, provided optional parts is exclusively designed to be used for the generation of ozone as per its specification. The ozone may only be introduced in closed systems. The intended use of the ozone generating system for different applications is laid down in the agreement made by and between the owner / operator and Wedeco. Any use exceeding this purpose is inadmissible and bears unforeseeable risks for the safety of the operating personnel.
Disclaimer of warranty	The manufacturer is not liable for any damage or consequential damage in terms of the Product Liability Act resulting from inadmissible use of the ozone system.
Safety requirements	The ozone system was built in accordance with the basic safety and health requirements of the European Union. However, dangerous situations may occur. The ozone system was built in accordance with the current state-of-the-art technology, and is operationally safe if all the instructions given in this manual as well as the system and operation related specifications and the accident prevention regulations are observed.
Residual hazards	When using the ozone generating system, residual hazards may occur. By observing corresponding safety measures as described in this manual, such residual risks can be minimized.
Installation location	The ozone generating system is only permitted to be used in closed, dry, and frost-protected rooms.

Intended use also includes observance of

- the safety instructions
- professional and regular maintenance work
- professional and regular cleaning work.

The personnel assigned to the installation, commissioning, operation and maintenance of the ozone system and its equipment must read and understand this manual including the safety section. Depending on the qualification of the personnel, additional training might be necessary.

If any unpredictable incidents or dangerous situations occur despite observance of all the safety precautions, please inform us immediately.

3.2 Definition of Pictographs and Signal Words

In this section, pictographs and signal words used in this manual are explained.

3.2.1 Action-Related Hazard Warnings

When operating the ozone generating system, hazards may occur in certain situations or due to certain behavior. Relevant procedures are preceded with hazard warnings as follows:

SIGNAL WORD!

Kind and source of hazard

Possible consequences if not avoided

- Instructions on how to avert the hazard

3.2.2 Signal Words

DANGER!

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING!

Indicates a hazardous situation which, if not avoided, could result in serious injury or death.

CAUTION!

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE!

Indicates a hazardous situation which, if not avoided, could result in property or environmental damage.

3.2.3 Hazard Signs

Warning Signs

Pictograph	Description
	Danger! Hazardous voltage!
	Warning of ozone
	Warning of suspended loads when loading and unloading
	Warning of poisonous / toxic substances
	Warning of explosion hazard
	Warning of hot surfaces
	Warning of hazard
	Warning of electromagnetic field

Prohibiton Signs

Pictograph	Description
	Smoking and open flames forbidden
	Do not spray water
	Do not touch, live parts

Mandatory Signs

Pictograph	Description
	Wear ear protection
	Wear safety gloves
	Wear safety shoes
	Wear safety helmet
	Isolate before working on the system

Safety Signs at the Place of Installation

Rooms housing ozone generating systems must be provided with the following warning and prohibition signs:

	Warning of poisonous substances! Ozone plant! Access for authorized personnel only
	No persons with pacemaker
	Smoking and open flames forbidden

Safety Signs on the Ozone System

Symbol	Description
	Warning of ozone
	Warning of poisonous substances! Ozone plant! Access for authorized personnel only
	Danger! Hazardous voltage! Contact may cause electric shock or burn
	Warning of hot surfaces
	Warning of hazard
	No access for unauthorized persons

Symbol	Description
	No persons with pacemaker
	Smoking and open flames forbidden
	Do not touch, live parts
	Wear ear protection
	Isolate before working on the system
	Ozone labeling on pipework
	Oxygen labeling on pipework
	compressed air labeling on pipework
	Cooling water labeling on pipework
	Process water labeling on pipework

3.3 Safety Devices

This section describes all the available safety equipment and that what is to be provided by the owner / operator. Always make sure that all the safety equipment is in perfect condition.

3.3.1 Emergency Stop

The electrical equipment of the ozone system is equipped with a red Emergency push button with a yellow background.

The operator can connect an additional Emergency Stop device by which the ozone production will be stopped. The control is provided with an appropriate connection option.

Ensure that the Emergency push button / device is located and identified at an easily and safely accessible place.

Only use the Emergency push button in the event of a potential danger to life and limb or of potential damage to the system.

Once the Emergency push button is activated, the electrical energy supply and the feed gas flow will stop immediately.

Prior to re-starting the system, the Emergency Stop circuit must be reset.

3.3.2 Main Switch

The main switch of the ozone system is located at the side panel of the control cabinet.

By means of the main switch the complete voltage supply of the ozone generating system is turned on or off.

Always turn off the ozone system and check for absence of voltage prior to carrying out maintenance or repair work on the system!

3.3.3 Gas Detectors (Ambient Air Monitoring)

Ensure that rooms in which ozone leaks may occur are effectively monitored by means of gas detectors with visual and acoustic indicators.

Such rooms are, for example: rooms containing ozone systems, rooms crossed with removable ozone supplying pipelines.

Ensure that the monitoring device (measuring sensor) is positioned at a place where the highest ozone concentration is to be expected in the event of a hazardous incident (at ground level).

3.3.4 Technical Ventilation System

Ensure that rooms housing ozone systems are equipped with a technical ventilation system guaranteeing an air exchange of at least three times per hour. A suction ventilation system with a suction opening located directly above the floor must be installed. The ventilation system must turn on automatically when a gas detector responds to the potential danger.

3.3.5 Door Switch

The ozone generating system is equipped with a door switches located in the electrical cabinets. Once a cabinet door is opened during operation, the ozone system will turn off immediately.

Do not remove or bridge the door switch at any time!

3.3.6 Protective Covers

All system components of the converter, all electrical equipment and the system control are installed in a cabinet secured by a lockable door to prevent contact with the components which could lead to severe injuries.

Protective devices may not be removed or bridged during operation of the system!

If removal of any protective devices is required during maintenance or repair work, ensure that these devices are refitted and checked immediately upon completion of the maintenance and repair work. Only use the original mounting material of the protective devices!

3.3.7 Safety and Warning Signs

All the safety and warning signs placed on the ozone system must be clearly legible.

Ensure that damaged type plates and warning signs are replaced immediately.

3.4 Responsibilities of the Owner / Operator

This section describes the responsibilities of the owner / operator of the ozone generating system and the resulting measures.

3.4.1 Classification of Operating Staff

Owner / Operator	The owner / operator, as a higher-ranking legal person, is responsible for the intended use of the ozone generating system and for training and employment of the authorized persons. The owner / operator determines the binding competencies and respective authorities of the authorized personnel of his company.
Qualified person	A qualified person is a person who, due to his or her technical training, knowledge and experience, as well as his or her knowledge of the relevant regulations, can correctly judge the work appointed to them, and who can recognize possible danger. Trained staff or personnel who have been selected and deemed to be capable by the owner / operator are qualified persons.
Instructed person	An instructed person is a person who has been informed and, if necessary, trained with regard to the tasks appointed to him or her and possible danger in the event of improper behavior. The person has also been instructed with regard to the required protection devices and protective measures.
Lay person	A lay person is a person who is neither qualified nor instructed.
Trainee personnel	Trainee personnel may only work on the ozone system under the supervision of a qualified person.

3.4.2 Safety Measures

Personnel	The owner / operator of the system is obligated to instruct each person who works with or on this system on the mode of operation, use and the preventive measures which are to be adhered to. The instructed persons have to confirm by signature that they have read and understand all the points in the manual. *Refer to the form Confirmation of Briefing in the Appendix*. The owner / operator is liable for damage that is caused by personnel who have not been instructed.

Local Conditions	Always observe the local employment and safety regulations and laws. The same applies to environmental regulations.
	The owner / operator of the ozone system must ensure that appropriate escape routes have been provided for the personnel in case of emergency. The owner must ensure that the escape routes are neither obstructed nor that their function is impaired (e.g. doors opening in the escape route direction).
	The owner / operator must make sure that sufficient illumination is available at the ozone system.
	The owner / operator is obliged to install fully functional gas detectors in rooms in which ozone may escape in case of a hazardous incident.
	The owner / operator is obliged to install fully functional gas detectors in rooms in which oxygen may escape in case of a hazardous incident or to ensure that the permissible oxygen concentration will not be exceeded within the work area.
	The owner / operator is obliged to install gas pipes which are used to discharge oxygen (oxygen concentration >50%) as far as to the open air.
Personal Protective Equipment	The owner / operator must ensure that an ozone proof breathing protective device in form of a full mask with effective filter is available for and identified with the name of each person working on/with the ozone system.
	The owner / operator must make sure that the breathing protective devices are always ready for use, easily accessible, free from dust, and stored in a moisture-proof place.
	The owner / operator must ensure that the employees are familiar with the use of the breathing protection device by having at least one exercise per year, and that they are properly used.
	Suitable ear protection must be provided.
	The owner / operator of the system is responsible for posting an Operating Directive "Handling of Ozone" in the operating room. The Directive must be clearly legible and accessible for all employees. *Refer to the sample Operating Directives in the Appendix*.
Detection of Ozone	The owner / operator must provide appropriate aids and appliances for measuring the ozone concentration in the ambient air and for detecting leakages.
Ozone System Check	The owner / operator is obliged to have the ozone system checked for proper condition by a qualified person at least once a year or after modification or repair of the system prior to re-starting. The check is to be proven in writing by the owner / operator.

3.5 Requirements for the Operating Personnel

The operating personnel must read and understand this manual and know the applicable regulations regarding operational safety and accident prevention.

The operating personnel must accordingly be instructed and trained by the owner / operator of the system.

Maintenance and repair work may be carried out by qualified personnel only. Only original spare parts or spare parts approved by the manufacturer must be used.

Work on technical equipment may only be carried out by qualified personnel.

Any faults or risks concerning the ozone system immediately must be notified to the owner / operator of the system or his or her authorized representative.

In addition, observe the following instructions:

- Only operate the system in technically perfect condition as well as according to its intended use, safely and aware of potential hazards.
- Rectify any faults immediately which could impair your safety or the safety of the ozone system.

3.5.1 Personal Protective Equipment

The following personal protective equipment may be necessary for work on the ozone generator. The protective equipment must be provided by the owner / operator of the system.

- Hearing protection plugs or earmuffs
- safety gloves
- Safety shoes at least S1
- safety helmet
- Respiratory protective mask with filter NO P3 blue/white for use during ozone alarm to rescue persons in the ozone room

Follow the instructions on "Personal protective equipment" in the individual chapters of this manual.

In addition to this, observe the locally applicable operational safety requirements.

3.5.2 Behavior in Emergency Situations

In the case of emergency, proceed as follows:

- Press the Emergency push button immediately.
- Exit the operating room immediately in the event of ozone alarm.
- In the event of ozone alarm, use the breathing mask only for rescuing injured persons or for averting other hazards.

- The air in the filter of the breathing mask is sufficient for approximately 10 minutes.

- Do not enter the operating room until the ozone concentration has fallen below the alarm limit value.
- Preferably use CO_2 fire extinguishers in case of fire.
- Never extinguish fire in or at the electrical cabinet with water.
- Immediately inform a physician or emergency service and provide first aid if a person has been injured.
- Notify your superior of all accidents.

3.6 Requirements for the Installation Place

Location	Ensure that the ozone system is installed in a closed, frost-free, lockable room. Air-conditioned rooms are recommended. Ensure that the ozone system is protected from direct sunlight. The installation foundation must be designed for the operating weight of the ozone system. *Refer to Chapter Dimensions and Weights.* The installation surface must be dimensioned in such way that operation, maintenance, and repair can be easily carried out. Sufficient space for air circulation around the ozone system must be included. *Refer to Chapter Operating Room.* Do not allow permanent workplaces or work stations in rooms housing ozone systems. If the installation site of the system cannot be separated from the workplace for technical processing reasons, reliably monitor the ozone concentration in the ambient air. Ensure the maximum allowable threshold limit value of 0.2 mg/m^3 (≈ 0.1 ppm$_v$) is not exceeded.
Technical Ventilation	Ensure that rooms housing ozone systems are equipped with a technical ventilation system guaranteeing an air exchange of at least three times per hour. An extraction type ventilation must exist with the intake opening located directly above the floor. The ventilation system must turn on automatically when a gas detector responds to the potential danger.
Special Safety	The installation place of the ozone system must be in accordance with the locally applicable occupational health and safety regulations. In particular, observe the regulations with regard to room ventilation, accessibility, and escape routes. Ensure that rooms are effectively monitored regarding room ventilation by means of gas detectors with visual and acoustic

indicators which interrupt the ozone production immediately once being activated.

Ensure that the monitoring device (measuring sensor) is positioned at a place where the highest ozone concentration is to be expected in the event of a hazardous incident (at ground level).

Ensure that no corrosive gases, i.e. chlorine, can enter the operation room since this would affect the ozone measurement.

Ceilings, walls, and floors must be made of non-flammable materials. As for systems operated with oxygen, make sure that no flammable material is stored within a radius of 5 m from the ozone system.

3.7 Hazardous Substance Ozone

The handling of ozone requires special safety measures which are described in the following section.

Ozone

- contains three oxygen atoms
- is heavier than air
- is a colorless to blue gas
- has an intensive odor similar to carnations, hay, or chlorine
- is difficult to dissolve in water

Ozone is non-combustible. However, it does promote combustion processes.

Ozone oxidizes all metals except for gold, platinum and stainless steel. Organic and inorganic substances can be oxidized by ozone. With the exception of gold, platinum and iridium metals are transferred to a higher or the highest oxidation state.
Organic compounds can be degraded up to carbon dioxide and water.
In microorganisms ozone has a disinfecting effect, for the cell membrane is oxidized and thus the microorganisms will be destroyed.

Chemical and Physical Characteristics of Ozone	
Chemical symbol	O_3
Density	2.141 kg/m^3 (0°C, 1013 mbar)
Molar mass	≈ 48 g/mol
Boiling point	-112 °C
TLV	0.2 mg/m^3 (≈ 0.1 ppm ≈ 0.1 ml/m³)
Smelling threshold value	0.02 mg/m^3 (≈ 0.01 ppm)

3.7.1 Health Risks

Physiologically, ozone acts as an irritant. Particular targets are mucous membranes of the eyes, nose and lungs.

Ozone deadens the sense of smell so that the ozone can no longer be perceived in ozone-polluted air even after a short duration of exposure.

Ozone is difficult to dissolve in water. It is therefore not retained by the mucous membranes and can directly penetrate into deeper sections of the respiratory tract.

Physical strain and a rise in the ambient temperature increase the toxicity of ozone. An increase of the room temperature by e. g. 8°C doubles the toxicity.

Ozone Concentrations	Possible Health Consequences
> 0.2 mg/m^3 (≈ 0.1 ppm)	Urge to cough, chronic bronchitis
> 1.0 mg/m^3 (≈ 0.5 ppm)	Extreme irritation of the eyes and the mucous membranes of the respiratory tract, extreme urge to cough, nosebleed, breathing problems
> 2.0 mg/m^3 (≈ 1.0 ppm)	Constriction of the chest, dizziness, headache, circulatory problems
> 20 mg/m^3 (≈ 10 ppm)	Unconsciousness, pulmonary hemorrhaging, death
> 10000 mg/m^3 (≈ 5000 ppm)	Death within several minutes

3.7.2 Precautions

Technical Ventilation	Ensure that rooms housing ozone systems are equipped with a technical ventilation system guaranteeing an air exchange of at least three times per hour. An extraction type ventilation system must be available with the intake opening located directly above the floor. The ventilation system must turn on automatically when a gas detector responds to the potential danger.
Ambient Air Sensor	Minor leaks can result in an ozone concentration in the surrounding area of the system which is life threatening to people. Therefore, it is vital to ensure that ozone gas detectors (ambient air sensors) are installed in this area.
Cleanness	All parts coming into contact with oxygen or oxygen / ozone mixtures must be free of oil and grease. Change clothes immediately that have been in contact with oxygen or oxygen / ozone mixtures or are soiled with grease or oil.
Breathing Protective Devices	Only enter rooms in which ozone is accumulating or can be expected to accumulate, wearing a breathing protective device, to rescue an injured person or to avert acute danger. Store breathing protective devices only outside of rooms in which ozone systems are operated. An ozone-proof full mask with an effective filter may be used as a breathing protection device. Due to the fact that masks are intended for individual persons, ensure that a mask identified by the person's name is provided for each person operating the ozone system.
Labeling	Ozone supplying pipelines must be marked by appropriate coat of paint, inscriptions or labels.
Residual Ozone Destruction	Prior to opening the ozone system with gas containing ozone, purge it until no more ozone can be detected, however at least 4 hours with nominal gas flow. Ensure that off-gas containing ozone is extracted to the atmosphere via an effective residual ozone destruction system.
Maintenance	Ensure that the ozone system is serviced by qualified personnel only.

3.8 Hazardous Substance Oxygen

The handling of oxygen requires special safety measures which are described in the following section.

Oxygen

- has a share of ≈ 21 Vol % in the air,
- contains two oxygen atoms,
- is a colorless gas,
- is odorless,
- is heavier than air.

Oxygen is non-combustible. However, it enables and promotes combustion processes.

Oxygen can cause spontaneous ignition of oil and grease. This also applies to clothing soiled by oil and grease.

An increased oxygen concentration causes a considerable increase in combustion speed. Furthermore, technical safety characteristics such as rate of pressure rise, ignition and glow temperatures, explosion pressures and flame temperatures also change.

Oxygen bonds with almost all elements. The heavy reaction of most substances with oxygen lead to an increased fire hazard.

Chemical and Physical Features of Oxygen	
Chemical symbol	O_2
Density	1.429 kg/m^3 (0°C, 1013 mbar)
Molar mass	≈ 32 g/mol (under standard conditions)
Boiling point	-183 °C
Melting point	> -219 °C

3.8.1 Health Risks

A drop of the oxygen content of respiratory air below 17 Vol%, or an increase above 21 Vol% can lead to health risks to humans.

When pure oxygen is inhaled for a prolonged period of time, lung damage and functional disturbances of the autonomic nervous system may occur. Increased oxygen concentrations are imperceptible for people.

Inhaling pure oxygen for even a short time will lead to symptoms of poisoning such as dizziness, nausea, vision disorders, defective hearing and disequilibrium, cramps/convulsions, unconsciousness and even death.

Liquid oxygen may cause serious frostbite.

An increased risk of fire exists when clothing is contaminated with oxygen or oil and grease.

Minor difficulty in breathing following acute inhalation of high oxygen concentrations will usually disappear after exposure to fresh air.

3.8.2 Precautions

	Fire, naked light and smoking is prohibited in rooms where O_2 is handled.
Ventilation	Ensure that rooms where oxygen leaks can occur are ventilated in such a way that the air cannot be accumulated with oxygen. In the event that natural ventilation is not sufficient, technical ventilation is required.
Cleanness	Due to the danger of ignition, ensure that all system components coming in contact with oxygen or oxygen / ozone mixtures have been cleaned. They must be free of particles that are loose or may be released during operation, such as slag, welding residues and machining swarf, as well as oil, grease and solvents. This requirement can be fulfilled by pickling stainless steel following the welding process. Change clothes immediately that have been in contact with oxygen or oxygen / ozone mixtures or are soiled with grease or oil. Only use fittings, seals and measuring devices that are approved for oxygen and kept free of oil and grease.

Operating Rooms	Rooms in which oxygen is produced, compressed or in which liquid oxygen is gasified, must be separated gas-tight to adjacent rooms. Adjacent rooms are those which are next to, above and below the rooms in which oxygen is handled. Ensure that floor covering only consists of non-combustible materials in areas where liquid oxygen can escape. Therefore, asphalt (bitumen) is not admissible. For heat insulation, only use materials which do not react dangerously with oxygen, e.g., glass wool or polyurethane foam. Never store combustible or self-igniting materials within a safety area of 5 m surrounding possible outlet points of liquid oxygen Rooms in which oxygen is handled must be located in that way that they can easily be evacuated.
Labeling	Ensure that lines carrying oxygen are identified by a coat of paint, inscription or signs.

3.9 Residual Risks

The ozone system was built in accordance with the current state-of-the-art technology and the recognized safety-related rules. The system is safe due to mechanical and control-related protective equipment.

However, the ozone system is subject to residual risks for persons and property which cannot constructively be remedied. The possible residual risks are described in the following section. In addition, labels and warning signs indicate dangerous areas of the ozone system.

3.9.1 Electrical Hazards

DANGER!

Danger to life due to High Voltage!

- Work on live components may be carried out by qualified electricians or electrically instructed personnel under the supervision of a qualified electrician according to the applicable rules of electrical engineering only.
- Always observe the Five Safety Rules:
  1. Disconnect from power supply.
  2. Take necessary means to prevent unintentional restart.
  3. Check for absence of voltage.
  4. Ensure grounding and short-circuiting.
  5. Protect adjacent live parts by covers.

- Inform the operating personnel of the duration of the planned work.
- Place an appropriate tagout label on the ozone system as long as work is performed on the equipment.

DANGER!

Live components on step-up transformers and converter!

Danger to life due to electric shock. Even with the system switched off dangerous voltage may be present on intermediate circuit.

- Wait at least 10 seconds before starting any work on the step-up transformer or converter.
- Check for absence of voltage on step-up transformer and converter.

3.9.2 Thermal Hazards

CAUTION!

Hot surfaces on the ozone system!

Risk of burns.

- Never touch hot surfaces.
- Turn off the components prior to maintenance and cleaning work.
- Wait until the surface has cooled before starting to work on the system.

CAUTION!

Hot System Components!

Risk of explosion.

- Hot System Components must never get in contact with explosive or highly flammable chemicals.

4 Technical Data

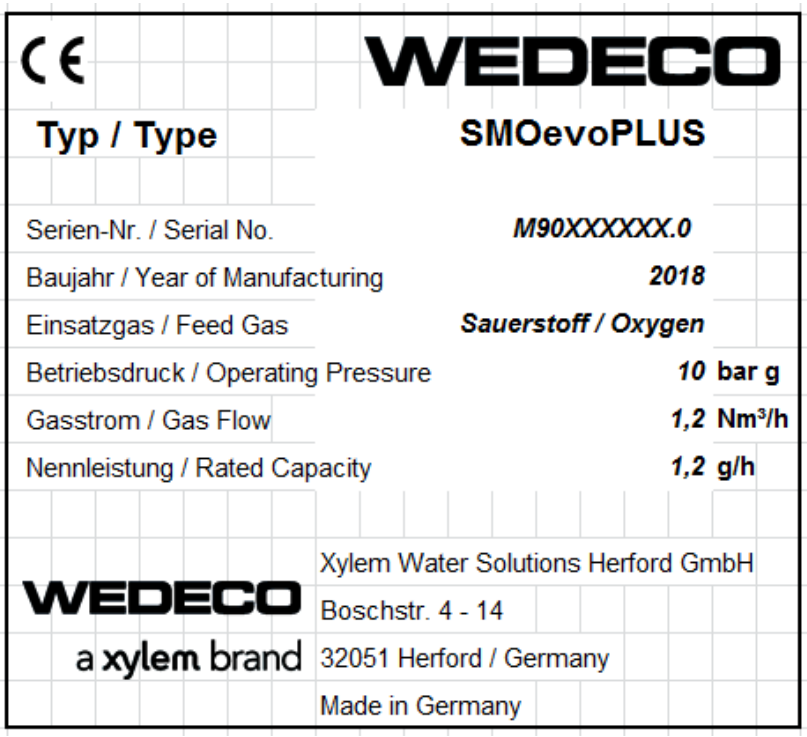
The ozone generating systems of the SMOevo^{PLUS} series comply with the current state of the art.

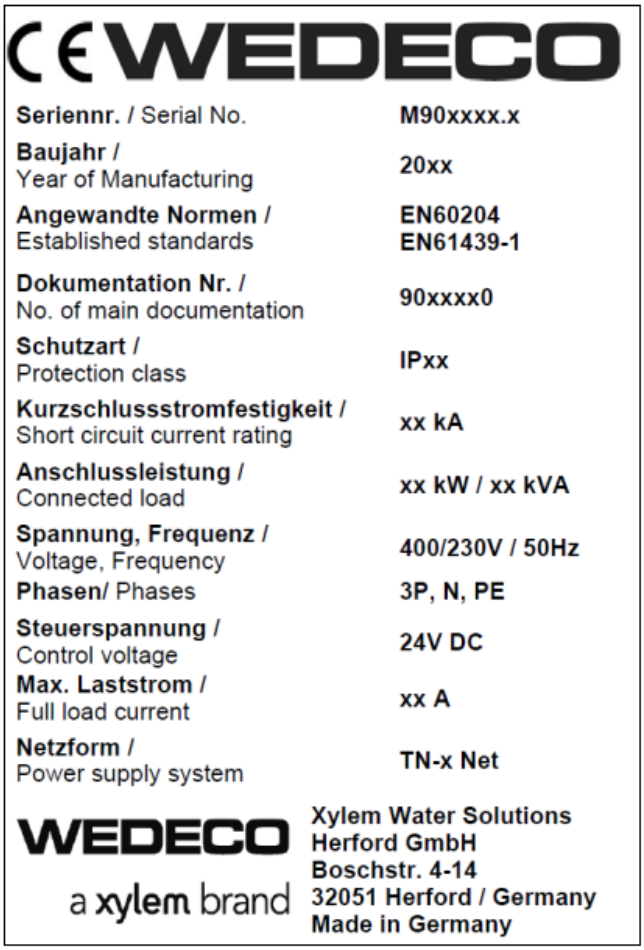
4.1 Type and Identification of the System

The ozone generators of the SMOevo^{PLUS} series are systems for the generation of ozone in the concentration range of up to 15% by weight.

Depending on the equipment, oxygen, PSA (Pressure Swing Adsorption) oxygen, or air can be used as feed gas.

An example of the type plate attached to the electrical cabinet is given below.





CE WEDECO

Seriennr. / Serial No.	**M90xxxx.x**
Baujahr / Year of Manufacturing	**20xx**
Angewandte Normen / Established standards	**EN60204** **EN61439-1**
Dokumentation Nr. / No. of main documentation	**90xxxx0**
Schutzart / Protection class	**IPxx**
Kurzschlussstromfestigkeit / Short circuit current rating	**xx kA**
Anschlussleistung / Connected load	**xx kW / xx kVA**
Spannung, Frequenz / Voltage, Frequency	**400/230V / 50Hz**
Phasen/ Phases	**3P, N, PE**
Steuerspannung / Control voltage	**24V DC**
Max. Laststrom / Full load current	**xx A**
Netzform / Power supply system	**TN-x Net**

WEDECO a xylem brand

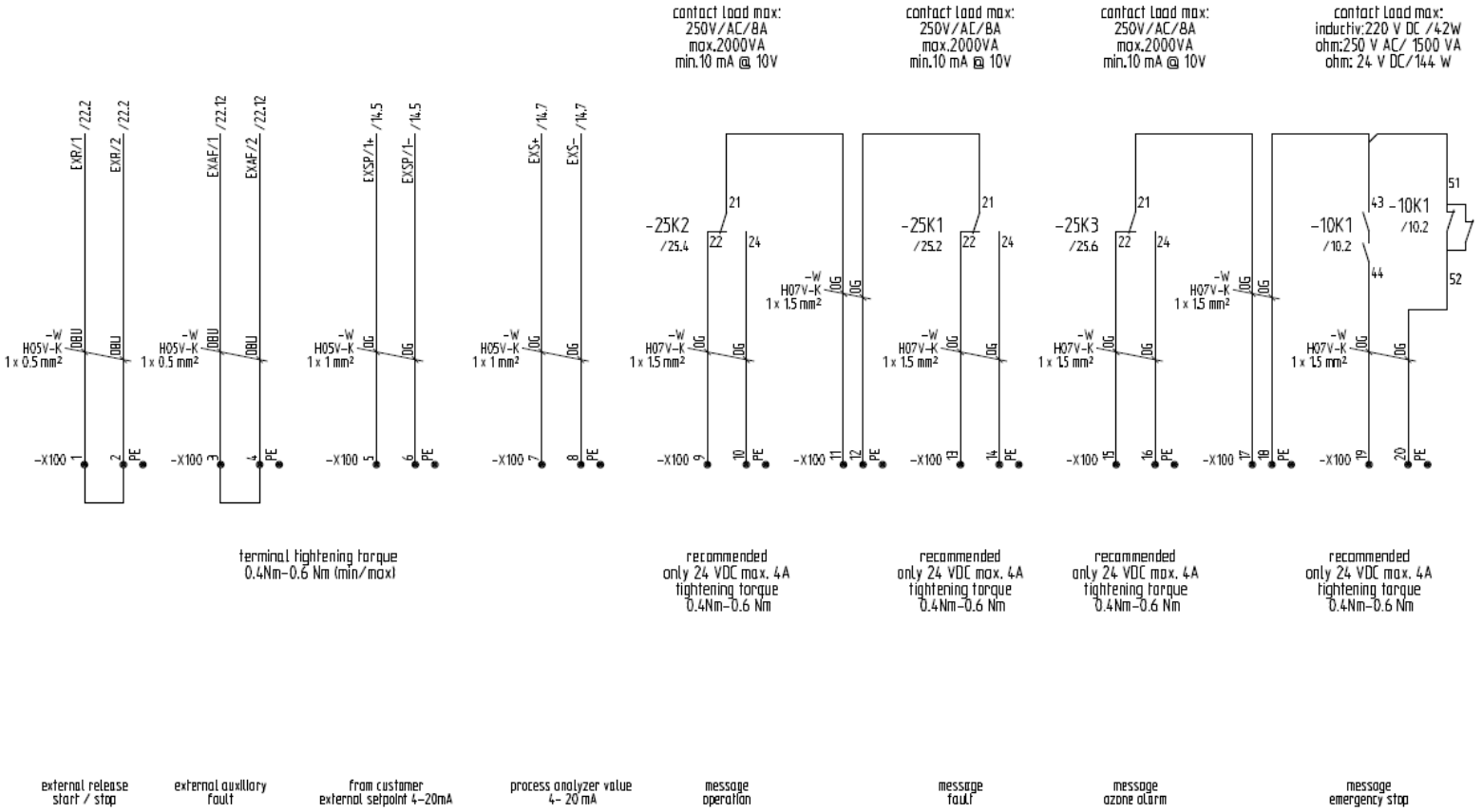
Xylem Water Solutions
Herford GmbH
Boschstr. 4-14
32051 Herford / Germany
Made in Germany

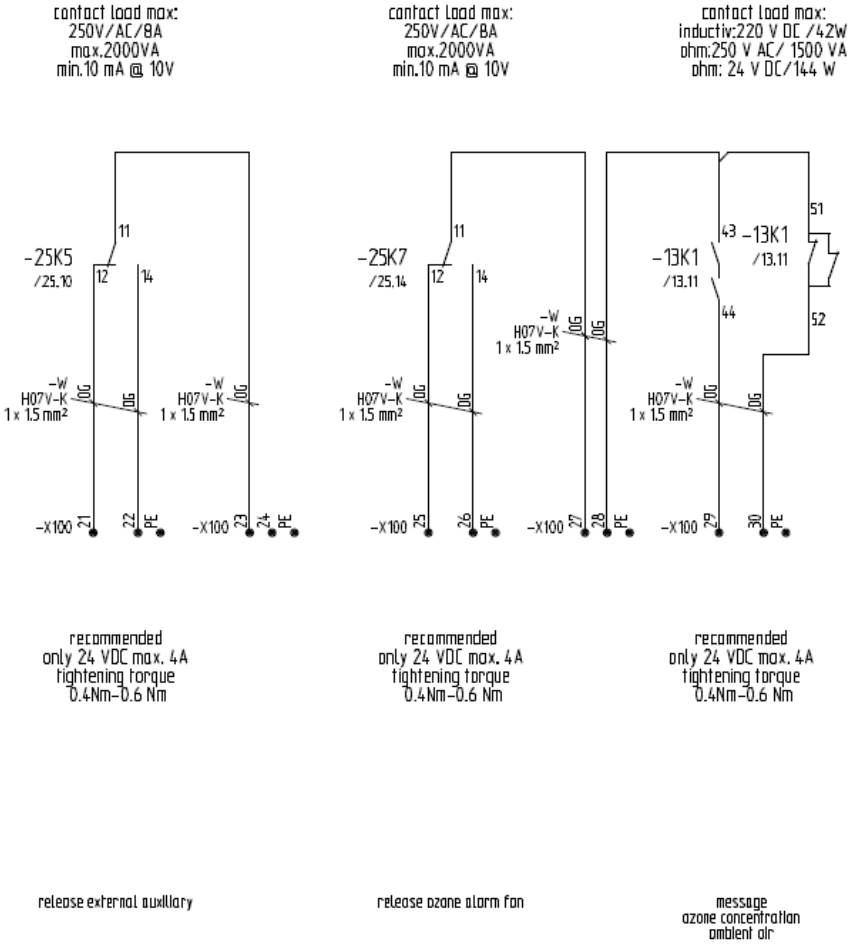
4.2 Operating Data

Refer to the corresponding data sheet in the Appendix.

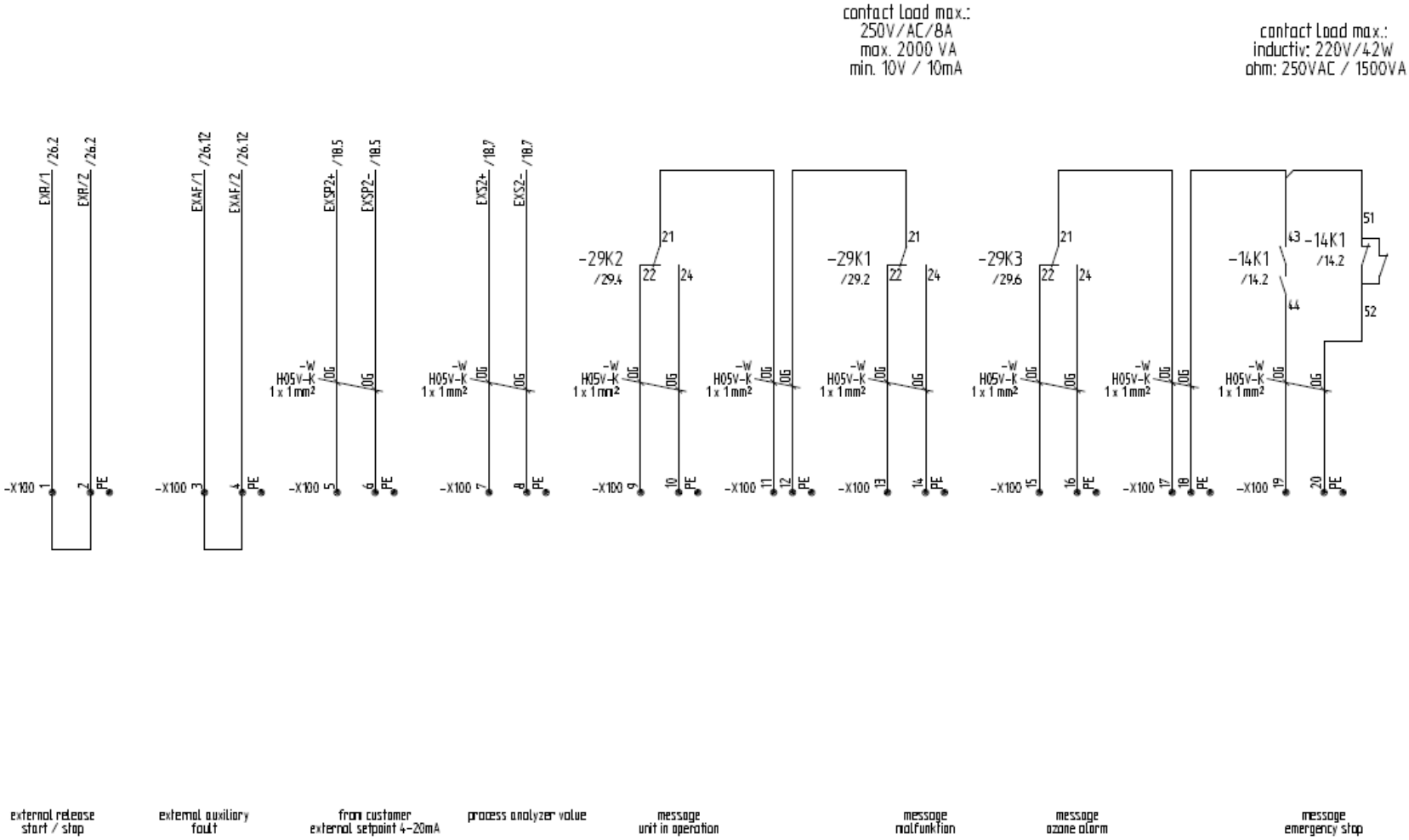
4.3 Signal Transfer (example of electrical wiring diagram)

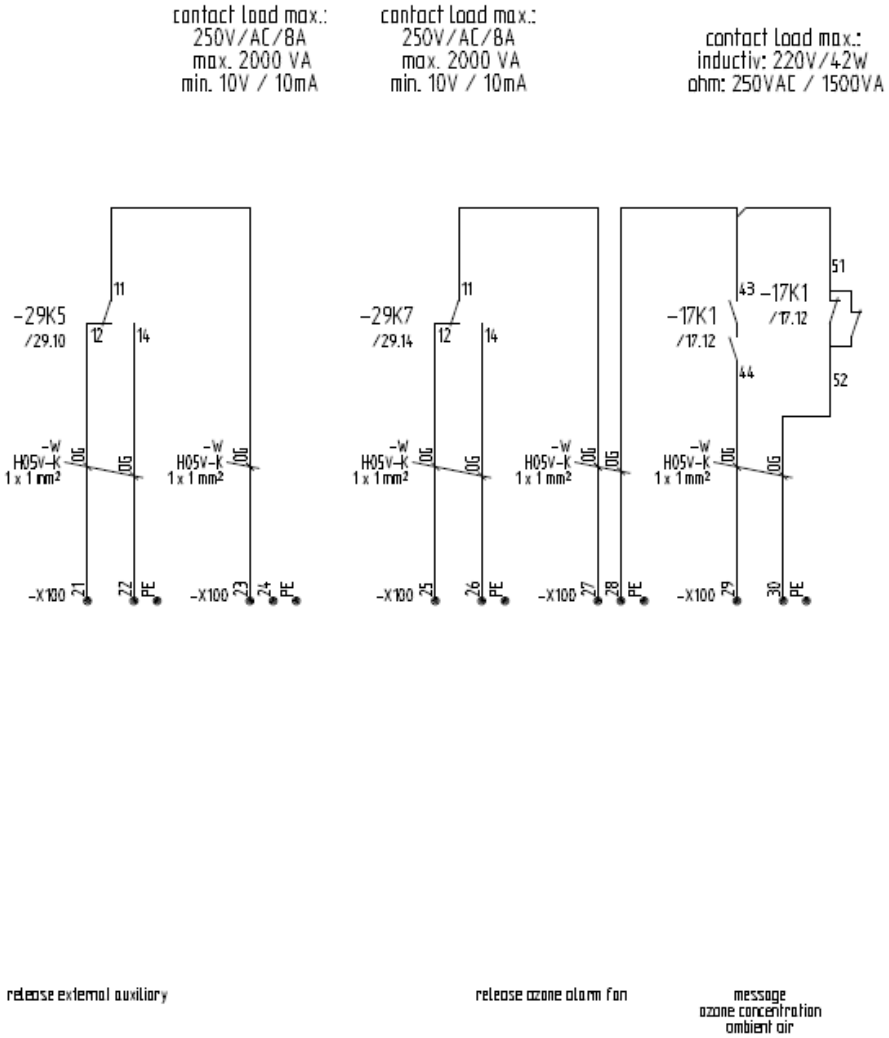
SMOevo^{PLUS} 410 – 860




contact load max:
250V/AC/8A
max.2000VA
min.10 mA @ 10V
contact load max:
250V/AC/8A
max.2000VA
min.10 mA @ 10V
contact load max:
inductiv:220 V DC /42W
ohm:250 V AC/ 1500 VA
ohm: 24 V DC/144 W
-25K5
/25.10
-25K7
/25.14
-13K1
/13.11
-13K1
/13.11
11
12
14
43
44
51
52
-W
H07V-K
1 x 1.5 mm²
OG
-X100
21
22
23
24
25
26
27
28
29
30
PE
recommended
only 24 VDC max. 4A
tightening torque
0.4Nm-0.6 Nm
recommended
only 24 VDC max. 4A
tightening torque
0.4Nm-0.6 Nm
recommended
only 24 VDC max. 4A
tightening torque
0.4Nm-0.6 Nm
release external auxiliary
release ozone alarm fan
message
ozone concentration
ambient air

SMOevo^{PLUS} 910 and 960:




contact load max.:
250V/AC/8A
max. 2000 VA
min. 10V / 10mA
contact load max.:
250V/AC/8A
max. 2000 VA
min. 10V / 10mA
contact load max.:
inductiv: 220V/42W
ohm: 250VAC / 1500VA
-29K5
/29.10
-29K7
/29.14
-17K1
/17.12
-17K1
/17.12
H05V-K
1 x 1 mm²
-X100
PE
release external auxiliary
release ozone alarm fan
message
ozone concentration
ambient air

The ozone system can be started by an external dry contact (+ 24 V DC) if this operating mode is pre-selected on the touch panel.

A setpoint with a signal from 4 to 20 mA can be pre-set externally for one the following operating modes:

Operating mode: Power / Gas Flow

- Power setpoint converter (0…100 %) or gas flow setpoint generator (0…X Nm³/h)

Operating mode: Required Ozone Concentration:

- Required ozone concentration (0 … X g/Nm³)

Operating mode: Required Ozone Mass

- Required ozone mass (0…X g/h)

Operating mode: Dose Control

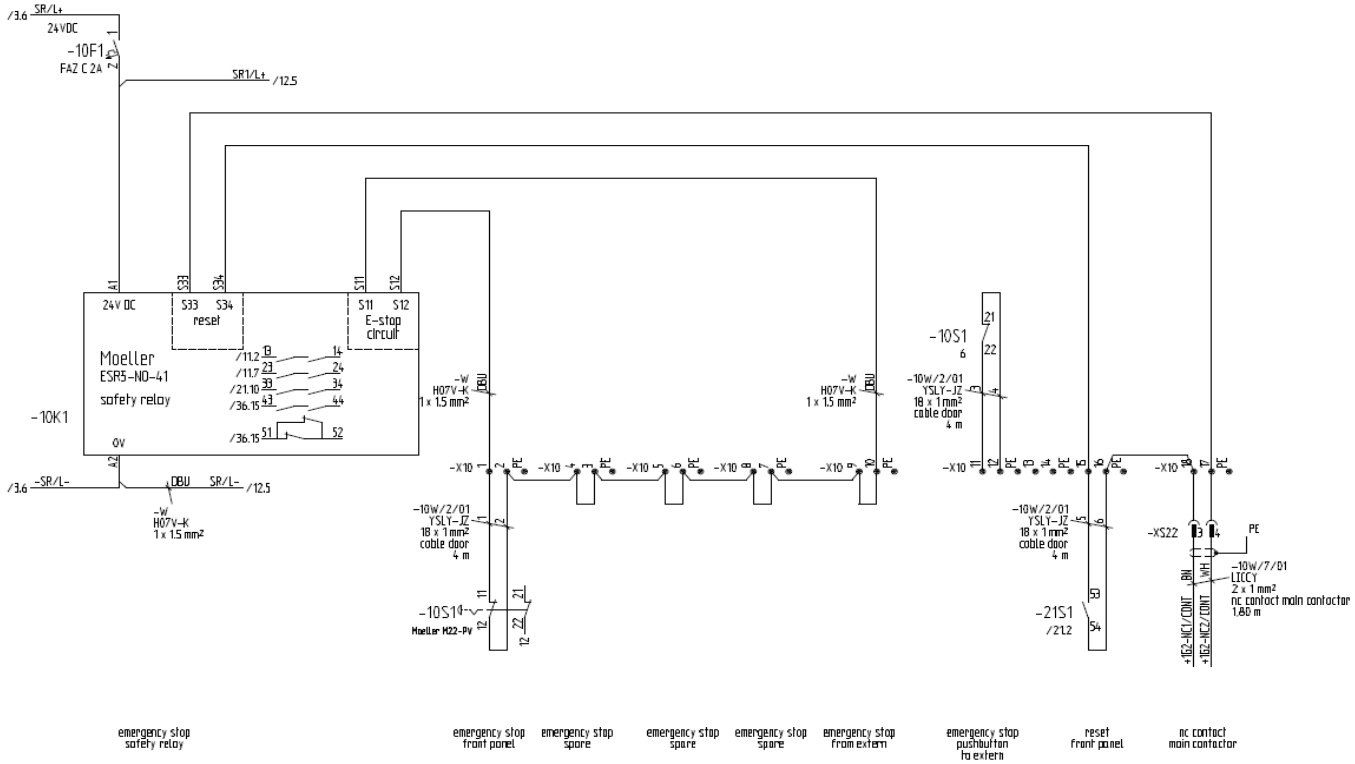
- Required ozone mass (0…X g/h) or reference value untreated water (0…X m³/h)

Additionally four signal / switch contacts with load capacity of 250V AC/DC / 6A are available.

These contacts are assigned to the following fixed signalizations:

- unit in operation
- malfunction
- ozone alarm
- Emergency push button activated

If necessary, four other Emergency push buttons/contacts can be included.



4.4 Vibrations

To reduce vibrations generated by the ozone system, various vibration damping components are included. Amongst others, the following components are installed:

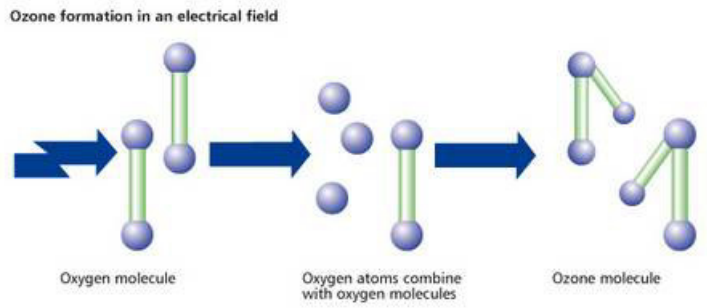
- Vibration damping adjustable feet below the skids
- Vibration damper elements on critical components within the PSU cabinet.

5 System Description

5.1 Ozone Generation Principle

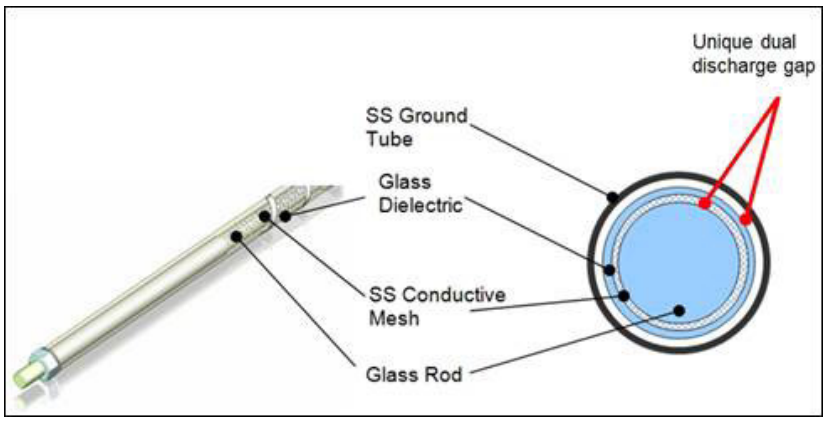
Besides fluorine, ozone is the strongest oxidizing agent, and if correctly applied, able to contribute enormously to improve the condition of our life and environment. When compared to other oxidizing agents, the advantage of ozone is that, aside from the reaction products, only oxygen develops - no toxic residue must be disposed. Ozone has been known for more than 100 years, and has proven itself as an environmentally friendly oxidizing agent in many areas of application.

Ozone is technically produced through silent electrical discharge from oxygenic feed gases, typically air or oxygen, by special ozone generators.

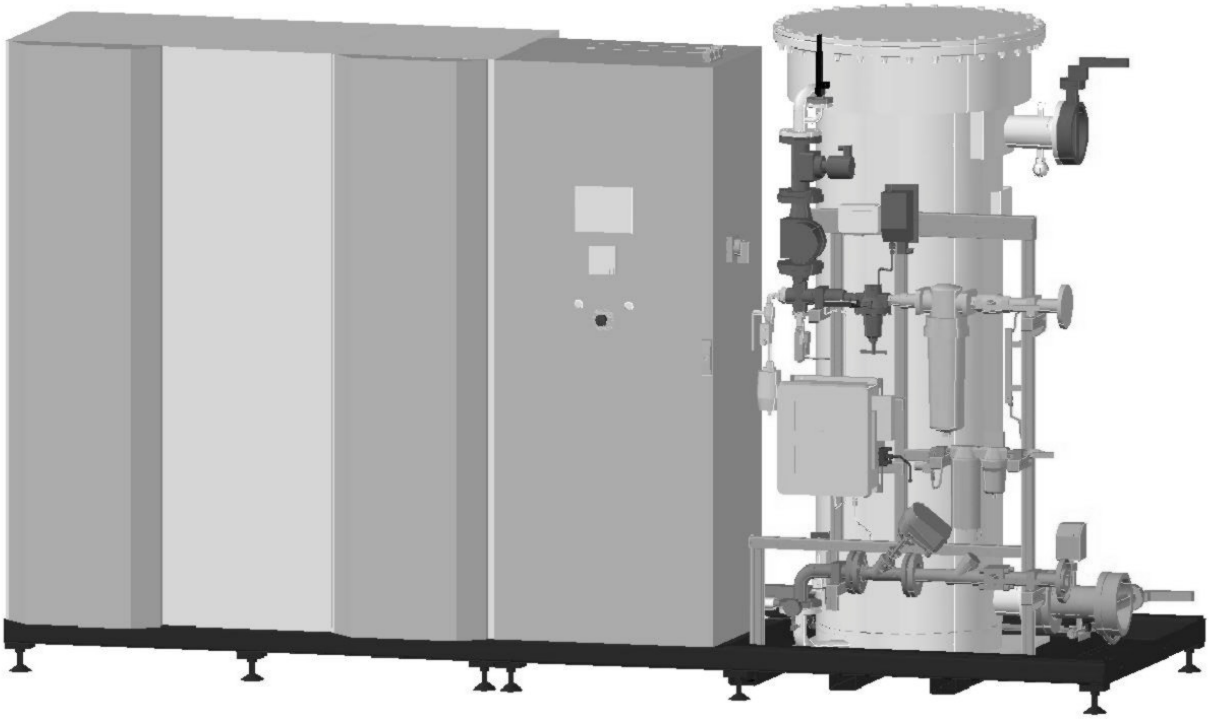


During the ozone synthesis process oxygen molecules are split through the supply of energy. The resulting oxygen atoms react with oxygen molecules to form ozone, whereby heat is released which has to be dissipated by cooling.

Ozone formation takes place between two electrodes, which are isolated from each other by a dielectric made of glass or ceramic and by a small gap. A high voltage, middle frequency, unilaterally grounded alternating current is applied to the electrodes. The oxygenic gas flows through the gap, resulting in ozone generation in the electrical field.



5.2 Ozone System Design



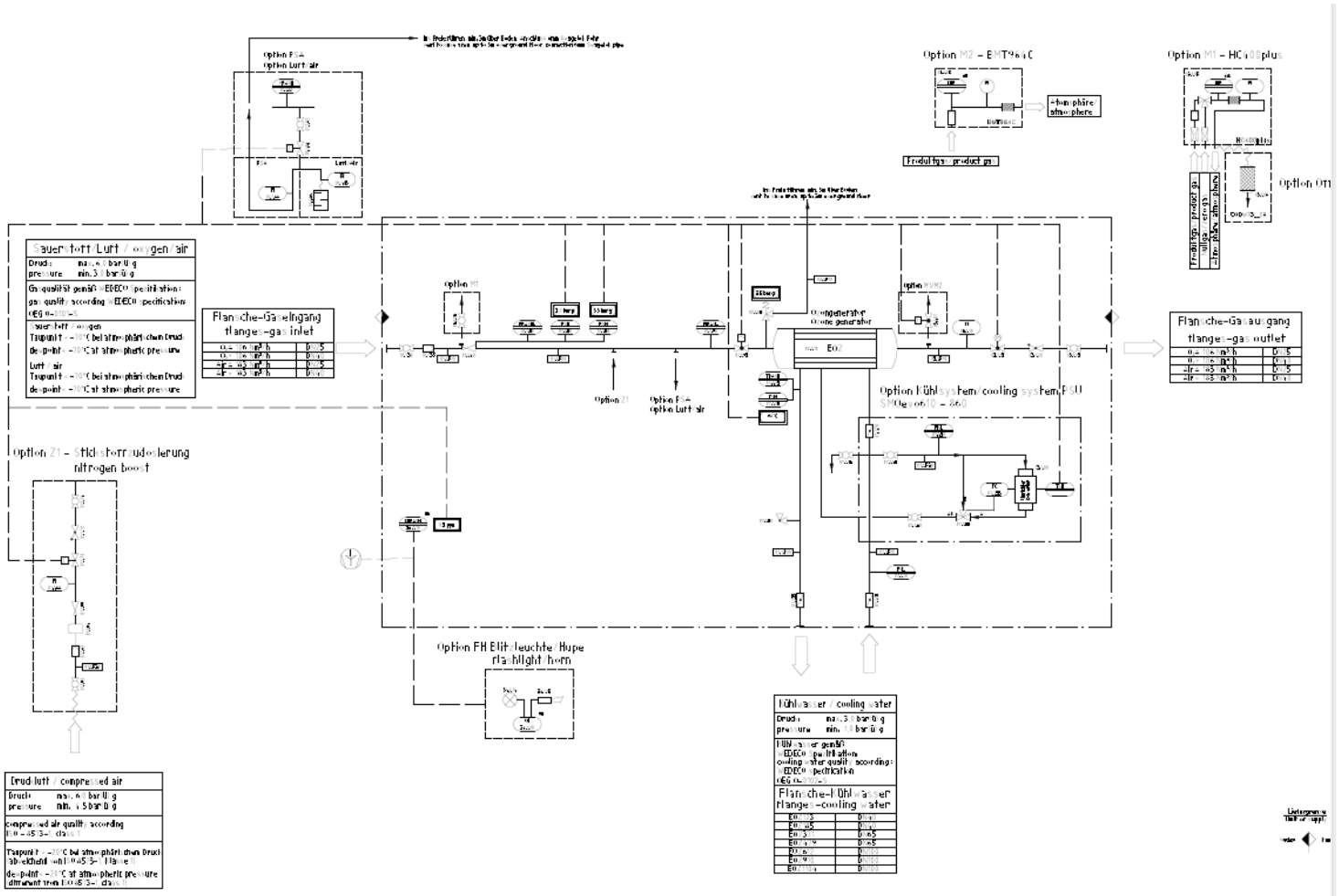
The ozone generating system consists of the following main components:

- ozone generator in which ozone is produced from oxygenic gas
- converter in which the medium voltage required for ozone production is generated
- system control
- process, measuring and safety controls
- self-supporting skid.
  In order to ease transport and installation, the skid construction consists of two parts from type SMOevo^{PLUS} 510 on.
  In this case, the complete converter unit is mounted on one of these skids.

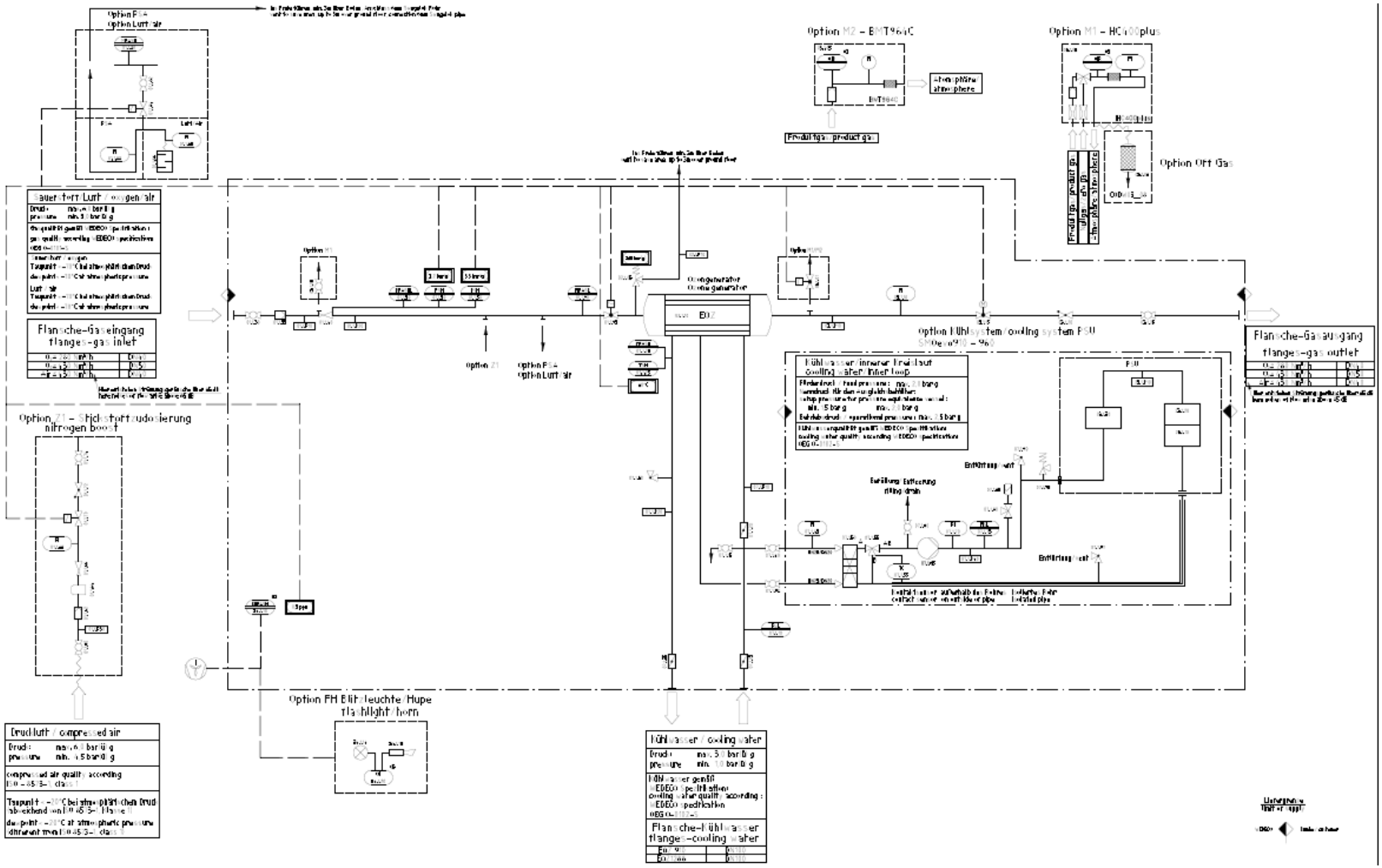
	The ozone generator of the Wedeco ozone generating system SMOevo^{PLUS} series produces ozone from oxygen according to the silent electrical discharge principle. *Refer to Chapter Ozone Generation Principle.*
Gas flow	The feed gas pressure is reduced to the required operation pressure of the ozone generator. While passing the ozone generator, ozone is generated by applying electrical energy to the feed gas. The generated ozonated process gas can then be fed to the relevant application.
Coolant	The ozone generator must be cooled with water in order to reduce the high temperature developing during the ozone generation process.
Ozone generator	The ozone generator is a water-cooled tubular heat exchanger made of stainless steel. The core of the ozone generating module is the Wedeco EFFIZON®evo technology.
Control	The local Programmable Logic Control (PLC) controls and monitors the ozone system.
Operating controls	The operating controls include - HMI (touch panel) - main switch - system switch - emergency push button - indicator lights The control unit comprises a hard wired interface enabling transmittal of commands and messages from higher level control systems. *Refer to Chapter Operation – X100 Customer Interface.*

5.3 Process Description of the System

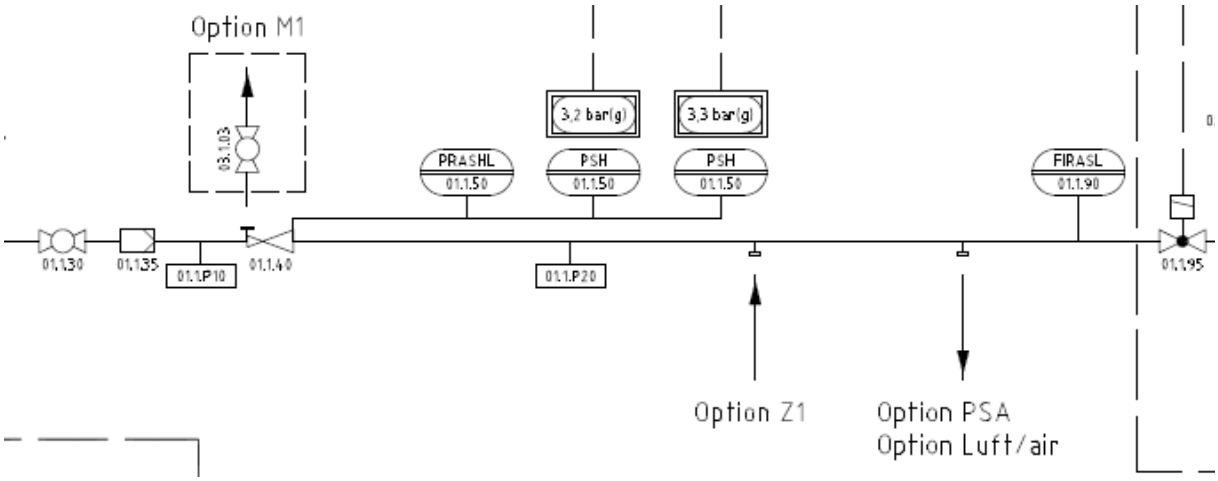
P&I Diagram complete: SMOevo^{PLUS} 410 – 860



P&I Diagram complete: SMOevo^{PLUS} 910 – 960



5.3.1 Subassembly 01: Gas Supply



01.1.30	Ball valve	Gas supply is carried out via a ball valve which must be fully open during normal operation.
01.1.35	Fine filter	Prevents particles >0.1 µm from entering and damaging the generator and the valves.
01.1.40	Pressure regulator	Keeps the operation pressure constant if feed gas pressure varies within a certain range.
03.1.03	Ball valve	Can be used for the option Ozone Monitor (M1).
01.1.50	Safety Pressure Limiter Combination	Two pressure limiters with integrated pressure transmitter. Via the analog signal of the pressure transmitter, the PLC receives the current pressure in the gas inlet. Warning and switch-off points for exceeding or falling below certain pressures are stored in the PLC. When the shutdown points are reached, the system will be switched off via the PLC. A message is displayed when the warning points are reached.

Pressure Gas Inlet	Description*	Delay Time
≥3.0 bar (g)	**Max. switch-off point** warning message disappears alarm message appears → after 1 sec: system shuts down	1 s
2.7 bar (g)	**Max. warning value** ≥ 2 .7 bar(g) and < 3 bar(g) warning message appears after 5 sec < 2.7 bar(g) warning message disappears	5 s

0.75 bar (g)	**Min. warning value** ≤ 0.75 bar(g) and > 0.5 bar(g) warning message appears after 5 sec > 0.75 bar(g) warning message disappears	5 s
≤ 0.5 bar (g)	**Min. switch-off point** warning message disappears alarm message appears → after 30 sec: system shuts down	30 s

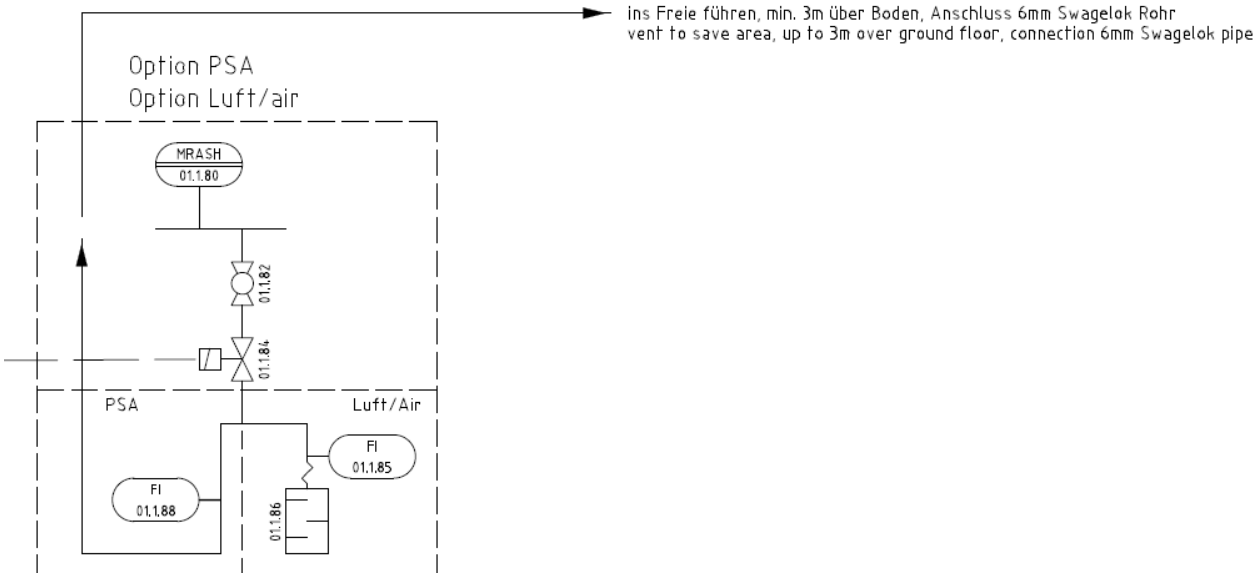
*project specific deviations are possible.

The redundant safety pressure limiters are hard-wired and switch off the system at preset pressures while simultaneously triggering a fault message.
Refer to section Operating Data.

- The safety pressure limiters are prescribed safety elements for the ozone generator. They switch off the system independently of the PLC when the set limit value of 3.2 bar (g) or 3.3 bar (g) is exceeded.
  Do not change the set values at any time!

01.1.90	Flow meter	Measures the gas volume flow in cubic meters with flowing conditions. The scale is designed from 0…100 %. The flow meter signal is pressure compensated in the PLC and converted to norm cubic meters.
01.1.95	Solenoid valve	Controlled by the PLC. Opens and closes the gas line to the ozone generator. In case of outage, the valve closes by spring load.

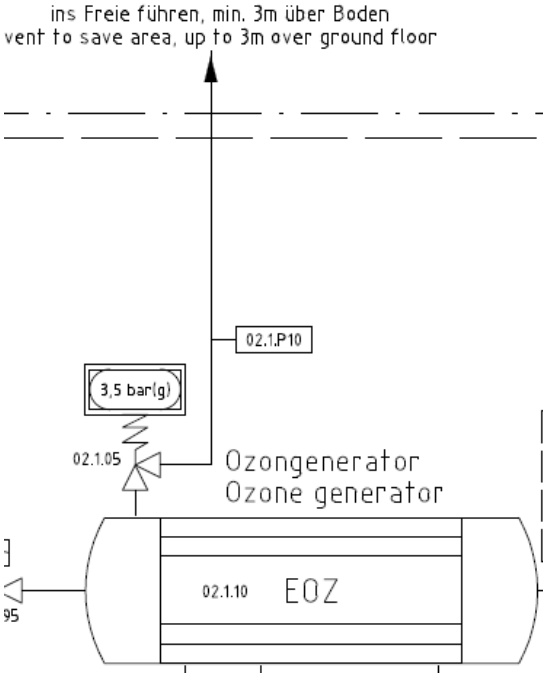
Option: Feed gas PSA and air



01.1.80	Dew point sensor	Monitors the dew point of the inlet air(set point -70°C atm)
01.1.82	Ball valve	To isolate valves for maintenance or service purposes.
01.1.84	Solenoid valve	In case of a bad dew point (> -56°C atm) the components upstream the dew point sensor are purged with the feed gas air via the solenoid valve until the correct dew point is reached.
01.1.85	Flow meter	Option Air: Measures the gas volume flow during purging phase until the correct dew point is reached
01.1.86	Silencer	Option Air: Reduces the noise of exiting feed gas during purging phase in case of bad dew point.
01.1.88	Flow meter	Option PSA: Measures the gas volume flow during purging phase until the correct dew point is reached

In contrast to option feed gas air, the feed gas PSA must not be discharged within the operating rooms. PSA must be discharged as far as to the open air, *refer to Chapter Responsibilities of the Owner / Operator, Safety Measures*. The position of the gas outlet must be at least 3 m above the ground level.

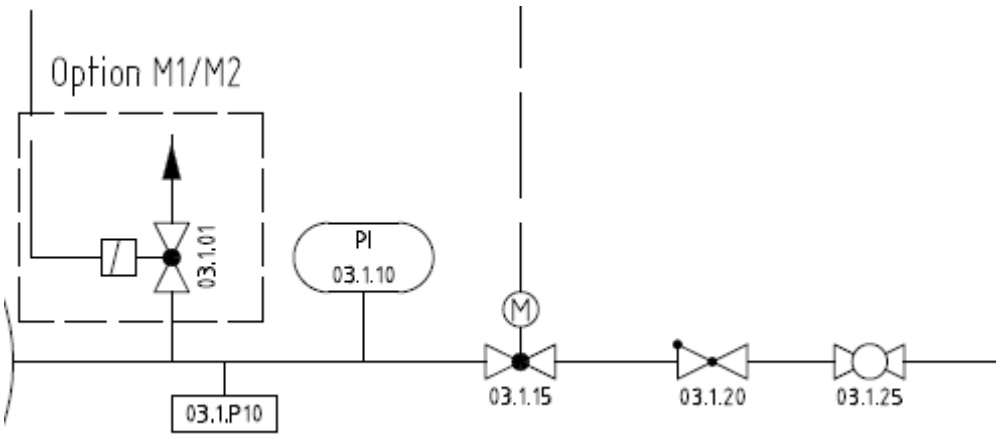
5.3.2 Subassembly 02: Ozone Generation



02.1.05	Safety valve	Opens in case of pressure rise to > 3.5 bar (g) in order to prevent excess pressure due to thermal expansion in the ozone generator during operation as well as during OFF state.
02.1.10	Ozone generator	In the ozone generator, the oxygenic gas is converted into ozone according to the silent electrical discharge principle. *Refer to Chapter Ozone Generation Principle.*

- The setting of the safety valve must not be changed at any time!

5.3.3 Subassembly 03: Process Gas Line



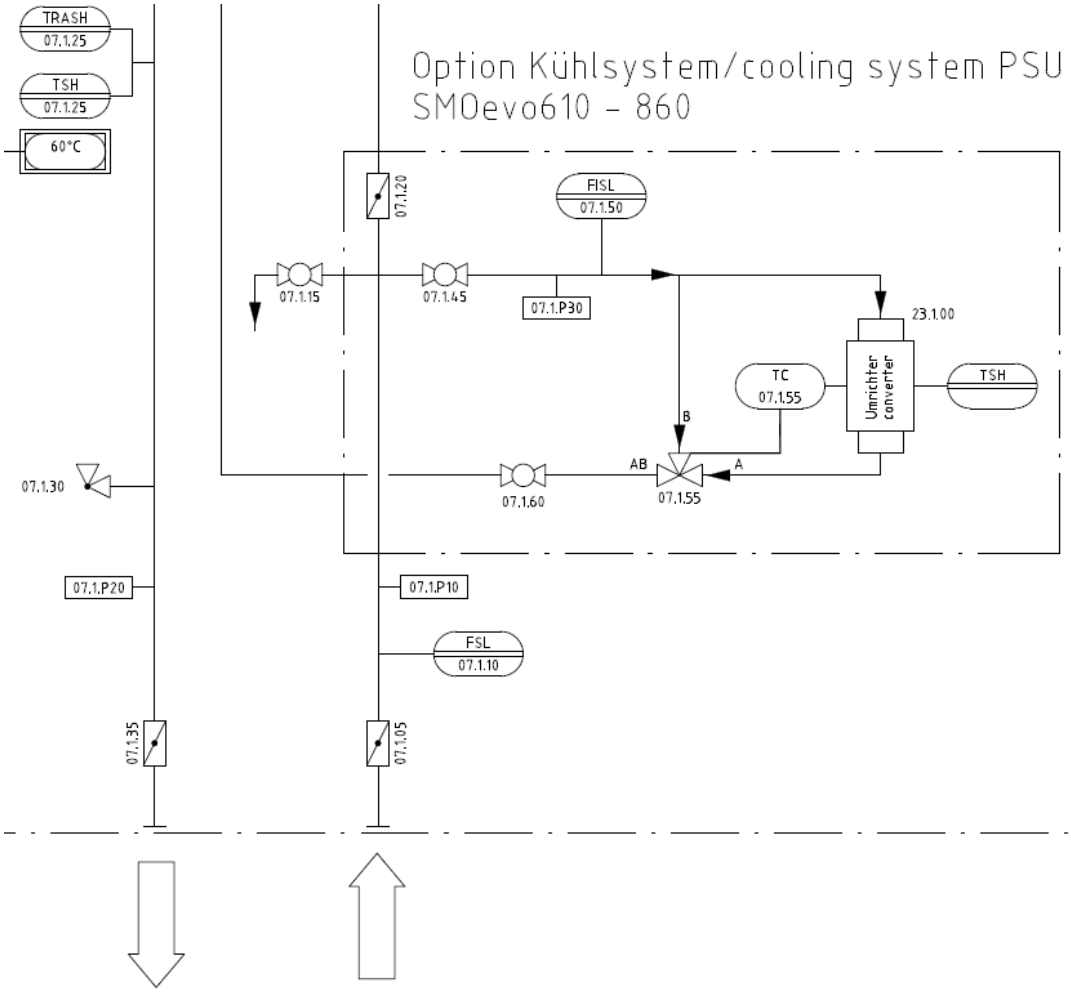
03.1.10	Pressure gauge	To read the operating pressure of the ozone generator. *Refer to the setpoints in Chapter Operating Data.*
03.1.15	Motor control valve with actuator	To set the gas volume flow of the ozone system via touch panel. *Refer to Chapter Operation.* In case of fault or outage the valve closes automatically.
03.1.20	Check valve	To secure the system against flow in opposite direction.
03.1.25	Ball valve	Open in normal operation. To be closed manually only in case of shutting down the system for a longer period of time, e. g. for maintenance purposes.

Option: Ozone Monitor M1 / M2

03.1.01	Solenoid valve	The branch for connection of the optional ozone monitor (M1, M2) is located downstream the ozone generator. An ozone monitor can calculate the produced ozone mass in a precise way. *Refer to Chapter Control Modes.* Optionally an automatic control for calculation of the required ozone mass can be included, e. g. in connection with an external setpoint device.

5.3.4 Subassembly 07: Cooling System

High temperatures would develop in the ozone generator if ozone was produced without any cooling. Since the energy consumption for generating ozone heavily depends on the cooling water temperature (among other factors), an efficient cooling of the ozone generator is of utmost importance. The specified water quantity and quality must be ensured by all means. *Refer to Chapter Technical Data.*



07.1.05	Butterfly valve	Customer interface for cooling water flow. Must be fully open during normal operation.
07.1.10	Flow meter	Indicates cooling water flow rate. A limit transducer makes the system shut down if the set flow value is underrun and triggers a fault message.
07.1.15	Drain valve	To drain water from the cooling water system.
07.1.25	Temperature transmitter (redundant)	Compulsory safety element for the ozone generator making the system shut down both via PLC and hard-wired if the temperature exceeds 60°C.

- The setting of the temperature transmitter must not be changed at any time!

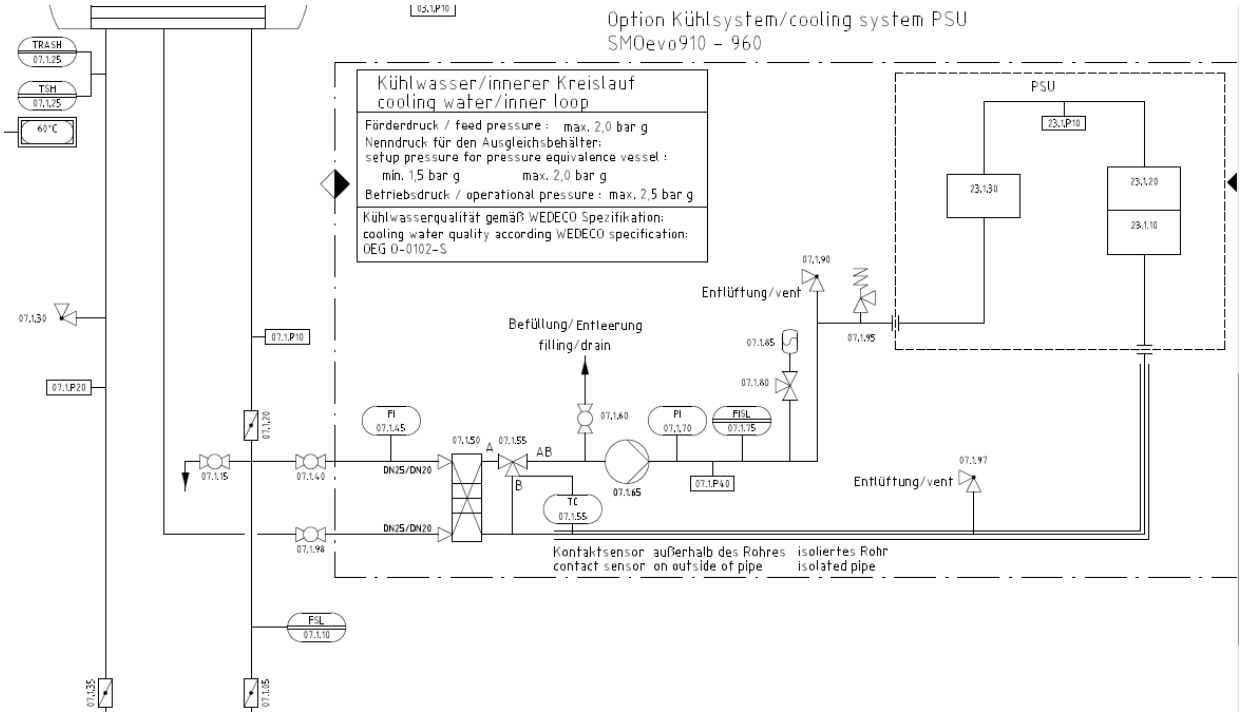
07.1.30	Drain valve	To vent all air from the water cooling system during commissioning or in case of maintenance or service. Must be fully closed during normal operation.
07.1.35	Butterfly valve	Customer interface for cooling water return.

Option: Converter Cooling SMOevo 610 - SMOevo 860

From type SMOevo^{PLUS} 610 on, in addition to the ozone generator, the converter is water cooled too.

07.1.20	Butterfly valve	To be throttled to the extent that a sufficient amount of cooling water is guaranteed for the converter cooling.
07.1.45	Ball valve	Must be fully open.
07.1.60	Ball valve	
07.1.50	Flow meter	To display the flow. The flow meter is equipped with a limit-indicating contact which switches off the system and triggers a fault message if the value falls below 2l/min (set point = 4l/min).
07.1.55	3- way mixing valve	The 3-way mixing valve allows a continuous flow through both cooling circuits, and thus a continuous temperature control.

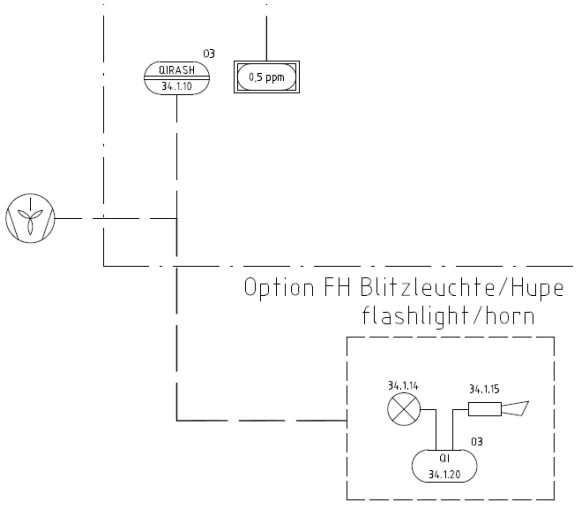
Option: Converter Cooling SMOevo 910 and SMOevo 960



07.1.20	Butterfly valve	To be throttled to the extent that a sufficient amount of cooling water is guaranteed for the converter cooling.
07.1.40	Ball valve	Both shut-off valves of the converter cooling circuit must be fully open.
07.1.98	Ball valve	
07.1.45	Flow meter	To display the flow. The flow meter is equipped with a limit-indicating contact which switches off the system and triggers a fault message if the value falls below 2l/min (set point = 4l/min).
07.1.50	Heat exchanger	The heat exchanger transfers the heat of the converter circuit to the coolant circuit.
07.1.55	3- way mixing valve with temperature control	The 3-way mixing valve allows a continuous flow through both cooling circuits, and thus a continuous temperature control.
07.1.60	Ball valve	The ball valve is used for draining and filling.
07.1.65	centrifugal pump	The pump circulates the coolant in the circuit between the heat exchanger and the PSU.
07.1.70	Pressure gauge	Pressure in the cooling circuit is approx. 1 bar (g) and is displayed via the pressure gauge.

07.1.75	Flow meter	The flow rate is indicated on the flow meter. It is equipped with a limit value contact which switches off the system if the flow falls below 2 L/min (setpoint = 4 L/min) and triggers a fault message.
07.1.80	Connection assembly to expansion tank with shut-off valve	For isolation with hose connection. Allows checking the primary pressure of the tank and replacing the tank without draining the system. The shut-off valve must be open during normal operation. The shut-off valve is sealed.
07.1.85 07.1.95	Expansion tank Safety valve	The safety valve and the expansion tank serve to protect against thermal expansion. The response pressure of the safety valve is 3.0 barg.
07.1.90 07.1.97	Drain valve	To vent all air from the water cooling system. Must be fully closed during normal operation.

5.3.5 Subassembly 34: Ambient air Monitoring



34.1.10 Ozone sensor

The safety equipment of the ozone system includes the ambient air monitor 34.1.10. The ambient air sensor is installed at a place where the highest ozone concentration is expected in case of a malfunction.

The ambient air sensor has a built in self test function for daily checking the functionality of the sensor. Sensor replacement is recommended every six months. *Refer to Chapter Maintenance Schedule and the Appentix*

Default limit values are as follows

0.1ppm: the PLC generates a warning message.

0.3 ppm: alarm message. The PLC shuts down the system, a visual and acoustic alarm is triggered, and the ventilation system is activated.

0.5 ppm: shutdown via relay contact.

Refer to Chapter Safety.

Option: FH Flashlight and Horn

The option FH includes the components flashlight, horn, and display.

The following PLC outputs are available for this option:

Digital	Flashlight	By a relay with two change-over contacts • an external flashlight is energized • the second contact can be used for alarm signalization and/or for activation of a technical ventilation.
Digital	Horn	In case of a malfunction, the PLC output energizes a relay for 30 seconds, which in turn activates an external acoustic alarm signal.
Analog	Ambient air concentration	For external display of the ambient air concentration.

5.3.6 Subassembly 23: Converter

The converter technology (FU – frequency converter) used in the system generates a medium-frequency, single-phase alternating voltage from 3-phase power supply with a fixed frequency of 50/60Hz. The generated single-phase AC voltage is transferred to a medium-voltage level by means of a step-up transformer.

A pulse converter with variable operating frequency with a dynamic range of 0.1% -100% is used. (corresponds to a frequency range of 1 Hz - 1000 Hz).

The following table shows an overview of the units in use.

Type	Technology	Allocation SMOevo^{PLUS} System	Remarks
VF A 15 IGBT	VF IGBT	SMOevo^{PLUS} 410/460	Forced air cooling of the power block
VF A 30 IGBT	VF IGBT	SMOevo^{PLUS} 510/560	Forced air cooling of the power block
VF W 60 IGBT	VF IGBT	SMOevo^{PLUS} 610/660	Water-cooled power block
VF W 80 IGBT	VF IGBT	SMOevo^{PLUS} 710/760	Water-cooled power block
VF W 100 IGBT	VF IGBT	SMOevo^{PLUS} 810/860	Water-cooled power block
VF W 160	VF 12puls	SMOevo^{PLUS} 910/960	Water-cooled power block

VF = variable frequency converter

IGBT = insulated-gate bipolar transistor

In order to ensure safe operation of the overall system, in a risk analysis certain process parameters have been classified as being critical. The parameters cooling water temperature (07.025), ambient air monitoring (34.0.20), and the redundant safety pressure combination device (01.0.50), are hard wired in addition to the PLC and are included in the shutdown sequence of the converter.

The FU is installed in one or several EMC-compliant electrical cabinet(s) (Rittal type) with door air conditioning units and is mounted on the self-contained framework construction. With systems from type SMOevo^{PLUS} 510 on, the framework construction is split and the complete converter unit is mounted on one half of the skid.

The electrical interfaces of the FU cabinets are designed in the form of two connector sets (type Harting) so that the two framework halves do not need to be wired.

FU units with water-cooled power electronics have a process technology interface in the form of Swagelok connections.

The FU consists of the following main function groups in all its design options:

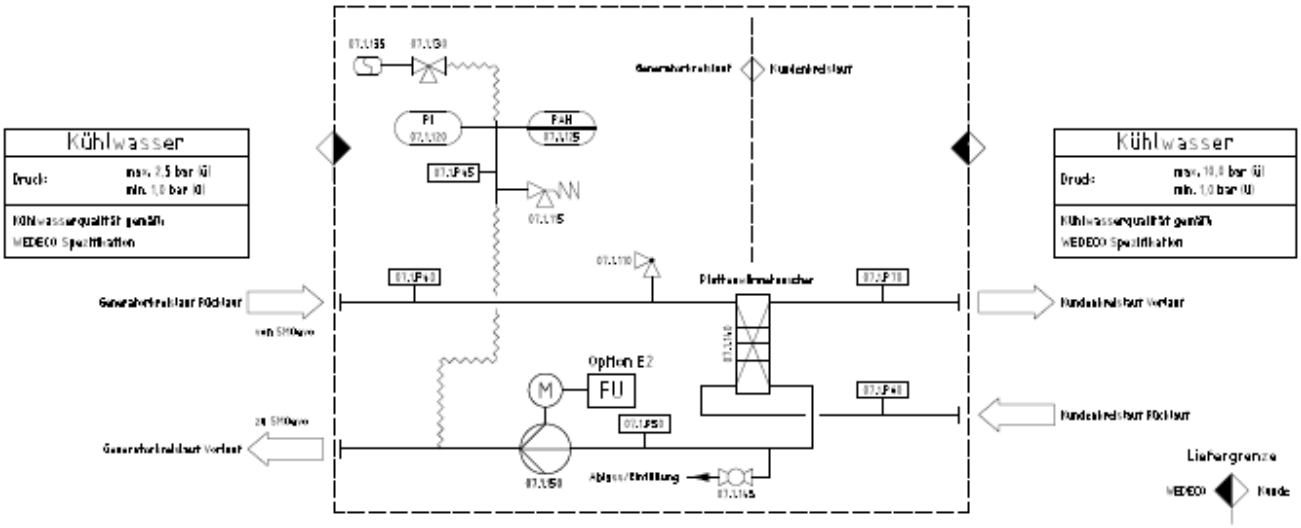
- Power semiconductor kit as a complete assembly with 6-pulse rectifier, designed as a network-driven bridge circuit and IGBT power block.
- DC-link
- Digital control unit (DICON)
- Winding material (medium-voltage transformer, intermediate circuit choke, network commutation choke).
- Locally acting measurement and control technology.
- Components for implementing the EMC concept.

The locally acting control technology monitors the FU operation and generates fault messages which are displayed as clear text messages on the HMI of the control cabinet.

5.4 Options

5.4.1 Option WCL (Closed Loop) Cooling Water System

The closed loop cooling water system is designed to separate the cooling water circuit provided by the customer from that of the ozone generator. With this option, the SMOevo^{PLUS} system features a close loop cooling water system with circulation pump.



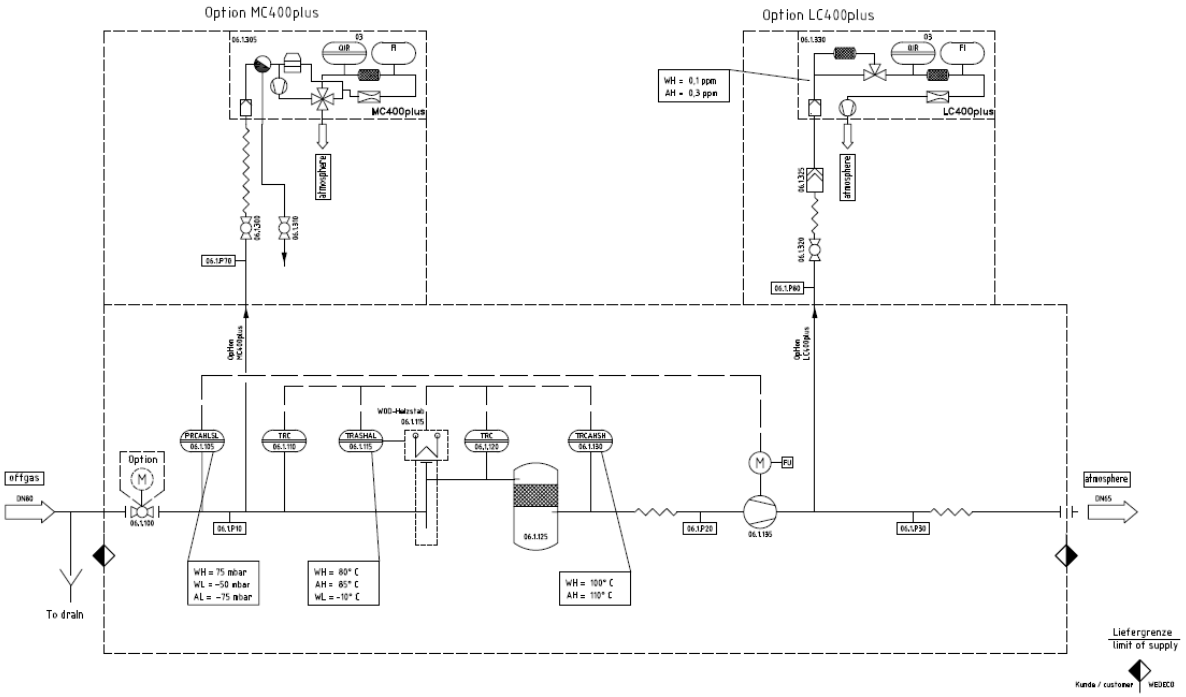
07.1.150	Centrifugal pump	The pump circulates the coolant between the heat exchanger and the ozone generator in the primary circuit. (Optionally with frequency converter).
07.1.140	Heat exchanger	The heat exchanger transfers the heat of the primary circuit (generator circuit) to the coolant circuit provided by the customer.
07.1.120	Pressure gauge	Pressure in the cooling circuit is approx. 1 bar (g) and is displayed via the pressure gauge.
07.1.125	Pressure switch	In the case of too high pressure, a safety shut down of the pump is initiated by the pressure switch (2.5 bar(g)).
07.1.115 07.1.135	Safety valve Expansion tank	The safety valve and the expansion tank are for protection against thermal expansion. The response pressure of the safety valve is 3.0 bar(g).
07.1.130	Connection assembly to expansion tank with shut-off valve	For isolation with hose connection. Allows checking the primary pressure of the tank and replacing the tank without draining the system. The shut-off valve must be open during normal operation. The shut-off valve is sealed.
07.1.110	Air relief valve	The valves for de-aeration purposes must be closed during normal operation.

07.1.145	Ball valve drain/fill	The ball valve is used for draining and filling the system.

5.4.2 Option WOD (Residual Ozone Destructor)

In order to ensure a hazard-free discharge of the off-gas, a residual ozone destructor (WOD) must be installed.

In order to prevent humidity from entering into the WOD and the blower, the customer must provide a demister unit to be mounted at the suction point. The demister unit consists of an internal diameter expansion in which a fine wire mesh is attached. Small drops carried along with the gas are segregated in this way.



06.1.125	Catalyst tank	The offgas from the ozone treatment stage is sucked through the catalyst tank by means of the blower. The catalyst tank contains the catalyst material, which catalytically decomposes the residual ozone in the offgas to oxygen.
06.1.135	Blower	The offgas is extracted from the reaction tank by means of the blower. The blower can be adjusted via a frequency converter.
06.1.115	Heater	The heater is adjusted via the temperature measuring points to ensure that the incoming gas is in an optimum temperature range to prevent condensation in the catalyst

		tank with the lowest possible energy consumption.
06.1.105	Pressure measurement	For adusting the blower.
06.1.300, 06.1.320	Ball valve	For isolating measuring devices.
06.1.310	Ball valve	Outlet for condensate that may develop in the MC 400+.
06.1.100	Ball valve	Manually, optionally also electrically operated ball valve for isolating the WOD.
06.1.305	Ozone measuring device	Option MC400+, for determining the amount of residual ozone in the offgas of the ozone treatment stage.
06.1.330	Ozone measuring device	Option LC400+, for determining the amount of residual ozone in the offgas of the residual ozone destructor.
06.1.325	Solid particles filter	For protecting the LC400+ from solid particles (e.g. abrasion of the catalyst material).
06.1.110, 06.1.115, 06.1.120, 06.1.130	Temperature sensor	For controlling the heater, and protecting the blower.

5.4.3 Option CP (Custom Positioning)

The option CP includes two skids on which the ozone system is mounted. The skids can be positioned separately with a maximum distance of 8 m.
This option applies to SMOevo^{PLUS} 510 up to SMOevo^{PLUS} 960.

5.4.4 Option FH (Flashing Light Horn)

Refer to Chapter Subassembly 34: Ambient Air Monitoring.

5.4.5 Option M1 and M2 Ozone Monitoring

The option Ozone Monitoring is available in two versions:

M1	Measurement and display of ozone concentration by ozone monitor HC-400 plus.
M2	Measurement, display, and control of ozone concentration by ozone monitor BMT 964 C. *Refer to Chapter Control of Required Ozone Mass*

5.4.6 Option Z1 Nitrogen Boost

The option Nitrogen Boost includes addition of a low quantity of air or nitrogen respectively to the pure oxygen.

This option allows a more efficient ozone generation in case of too high oxygen purity.
Refer to Chapter Subassembly 01: Gas Supply.

5.5 Process Control

5.5.1 Process Values

mO3=cO3 x VG

m_{O3}: Ozone mass(g/h)
The produced ozone mass is the product of the gas volume flow and the ozone concentration:

c_{O3} : Ozone concentration (g/Nm³ (NTP))
The ozone mass per norm cubic meter depends on the set converter output and the set gas volume flow.

V_G: Gas volume flow (Nm³/h (NTP))
The gas volume flow in norm cubic meter per hour is adjustable by the motor control valve. (03.0.15) via PLC.

5.5.2 System Control Modes

5.5.2.1 Control of Power / Gas Flow

The setpoints Converter Power (0 to 100%) and Gas Flow (0 to x Nm³/h) must be preset.

The Required Ozone Mass is then generated according to the nominal capacity of the SMOevo^{PLUS} system. *Refer to Chapter Operating Data.*

5.5.2.2 Control of Required Ozone Mass

This control option requires ozone concentration measurements (option M2):

In addition to the setpoint Required Ozone Mass another setpoint must be provided: Either the Ozone Concentration or Gas Flow Converter. The non-selected setpoint is calculated by the PLC. The selected setpoint is continuously retained. In the event of falling below or exceeding the minimum or maximum limit values of the Gas Flow or the maximum limit value of the Ozone Concentration respectively due to very low or very high ozone mass to be required, the PLC independently corrects the preset setpoints in order to ensure optimum operation of the Ozone System. The value correction is displayed by an event message on the HMI.

Monitoring of the limit values and, if necessary, correction of the setpoints is carried out with the Required Ozone Mass Control and with the Dose Control.

		Setpoint:	Variable Value
Setpoint: Required Ozone Mass (g/h) =	**Gas Flow (Nm³/h)**	*	**Ozone Concentration (g/Nm³)**

Or

Setpoint : Required Ozone Mass (g/h) =	**Ozone Concentration (g/Nm³)**	*	**Gas Flow (Nm³/h)**

5.5.2.3 Dose Control

The Required Ozone Mass for a given Ozone Dose in the Process Water Flow is calculated as follows:

mO3 = Q * dO3

m_{O3}:	Ozone Mass
Q :	Flow Volume Process Water (m³/h) Analog recorded 4-20 mA value,
d_{O3}:	Ozone Dose (g_{O3}/m³) Ozone Mass in Process Water

Based on the Ozone Mass calculated in this way, the Gas Flow or the Ozone Concentration can be defined as setpoint. *Refer to Chapter Control of Required Ozone Mass.*

5.5.2.4 Dose Control with Dose Trim Function

This option involves an additional value for optimizing the ozone generation, e. g. measuring the ozone content in the offgas, measurement of residual ozone in the process water, or measurement of the Redox potential in the process water.

When falling below or exceeding a certain limit value, the ozone production is reduced or increased in pre-defined stages in order to ensure a process optimized ozone production. *Refer to Chapter Dose Trim Settings.*

dO3 = c ± sO3

d_{O3}: Calculated Dose setpoint (g/m³)

c : Correction factor (± %)
Correction of the set Dose setpoint. Depending on the ratio setpoint / process value of the process variables of the Dose Trim, the set Dose setpoint is increased or reduced.

s_{O3}: Set Dose setpoint (g/m³)

The calculation of the Ozone Dose setpoint is carried out downstream the Dose Control, The Dose Trim function can only be used with the Dose Control mode, not with the Required Ozone Mass Control. *Refer to Chapter Dose Control.*

6 Transport and Storage

This section describes the safety measures, the requirements for the personnel and the procedures with regard to transport, packaging and storage of the ozone system.

6.1 Safety during Transport and Storage

6.1.1 Safety Instructions

⚠ WARNING!

Hazard due to falling loads!

Risk of serious injury or death.

- Only use lifting aids and slings permitted to the total weight.
- Never stand under suspended loads.
- Secure the ozone system against tilting.
- Make sure that nobody stands under suspended loads.
- Secure the hazard area against unauthorized access.

NOTICE!

Contamination by dust, shavings and similar from mild steel (C steel) or scratches!

Risk of corrosion of stainless steel (CrNi steel) components.

- Make sure that stainless steel parts are properly covered prior to transportation to the actual installation or storage place.

NOTICE!

Vibration of the ozone generator!

Risk of breakage of electrodes.

- Keep the ozone generator away from any possible vibration sources.

6.1.2 Personal Protective Equipment

To avoid injuries, wear the following protective equipment during transport, packaging and storage work:


Safety gloves


Safety shoes


Safety helmet

6.2 Requirements for Transport Staff

The ozone system may only be transported by persons who have sufficient experience in the field of transport and fastening of loads. The persons must have read and understand this manual.

6.3 Transportation of the Ozone System

To ensure safe transportation of the ozone system, observe the following instructions:

- Carry out the transportation only with transport means and lifting aids permitted for the total weight of the ozone system. This includes transportation by crane, forklift, and lift truck. The weight of the ozone system is indicated in *Chapter Technical Data*. *The weight of the separate packages is indicated in the Packing List.*
- Only use ropes and hang equipment ensuring sufficient safety and bearing capacity.
- Always use load beams when transporting the system by a crane to avoid damage of the components.
- Do not use eye bolts at the corners of the electrical cabinets.
- Observe the load center of the ozone system. Due to different weights of the components, the load center is not in the middle of the system.
- Secure the ozone system against tilting and shifting. In the case of transportation by truck, squared timbers must be fixed under the frame.
- Using the delivery note and accompanying documents, check whether the ozone system has been delivered completely and without being damaged. Observe the *Returned Goods Policy* which is included in every system consignment.
- Do not expose the ozone system to vibrations.

6.4 Packaging

6.4.1 Packaging on Delivery

The complete ozone generating system is sealed in foil in order to protect it from soil and rain. Desiccant additive protects the system from moisture.

After receipt of the ozone system, observe the following instructions:

- Unpack the ozone system according to the sequence of installation.
- Remove all packing material (desiccant) and dispose it of properly and in an environmentally sound manner observing locally applicable regulations.
- Remove any condensate which may have developed during transport.
- Prior to putting the system into operation, store it at least 24 hours in order to avoid malfunctions due to condensation.

6.4.2 Packaging during Transport and Storage

When packing the system for storage or transport purposes, observe the following instructions:

- In order to prevent damage, pack and unpack the different System Components according to their function and depending on their sensitivity with regard to damage.
- Protect the system from moisture.
- Protect the system from damage due to contact with other objects.
- Protect the system from frost if various parts of the system contain water.
- Protect the system from excessive air humidity (risk of corrosion due to condensation!).
- Seal the system in plastic foil and add desiccant as moisture protection.

6.5 Storage

Observe the following instructions in order to ensure safe storage:

- Store the ozone system in dry rooms only.
- Store the ozone system in such way that risk of damage is excluded.
- Store the complete system including all individual parts to make sure that all parts are available when the system is commissioned again.
- Completely remove the coolant from the ozone generators if the storage temperature is / is expected to be below 0°C.
- Protect the parts from corrosion.
- Ensure airtight closure of the gas inlets and outlets.

7 Installation and Initial Start Up

This section describes the safety measures, the requirements for the personnel, and the procedure with regard to installation and initial start up of the ozone generating system.

7.1 Installation

7.1.1 Safety Instructions

DANGER!

Live components!

Danger to life due to electric shock.

- Prior to installation work, ensure that the ozone system is disconnected from the power supply.
  (The main switch is set to **0/OFF**).

WARNING!

Risk of accident due to not sufficiently qualified personnel!

Danger to life or serious injury may result

- Work on live components may only be carried out by electrically qualified persons or by specially instructed personnel under the supervision of an electrically qualified person.

7.1.2 Personal Protective Equipment

To avoid injuries, wear the following protective equipment during installation work:

Safety gloves

Safety shoes

Ear protection

7.1.3 Requirements for the Installation Staff

The ozone generating system may be installed by qualified persons (*refer to Chapter Classification of Operating Staff*) only.

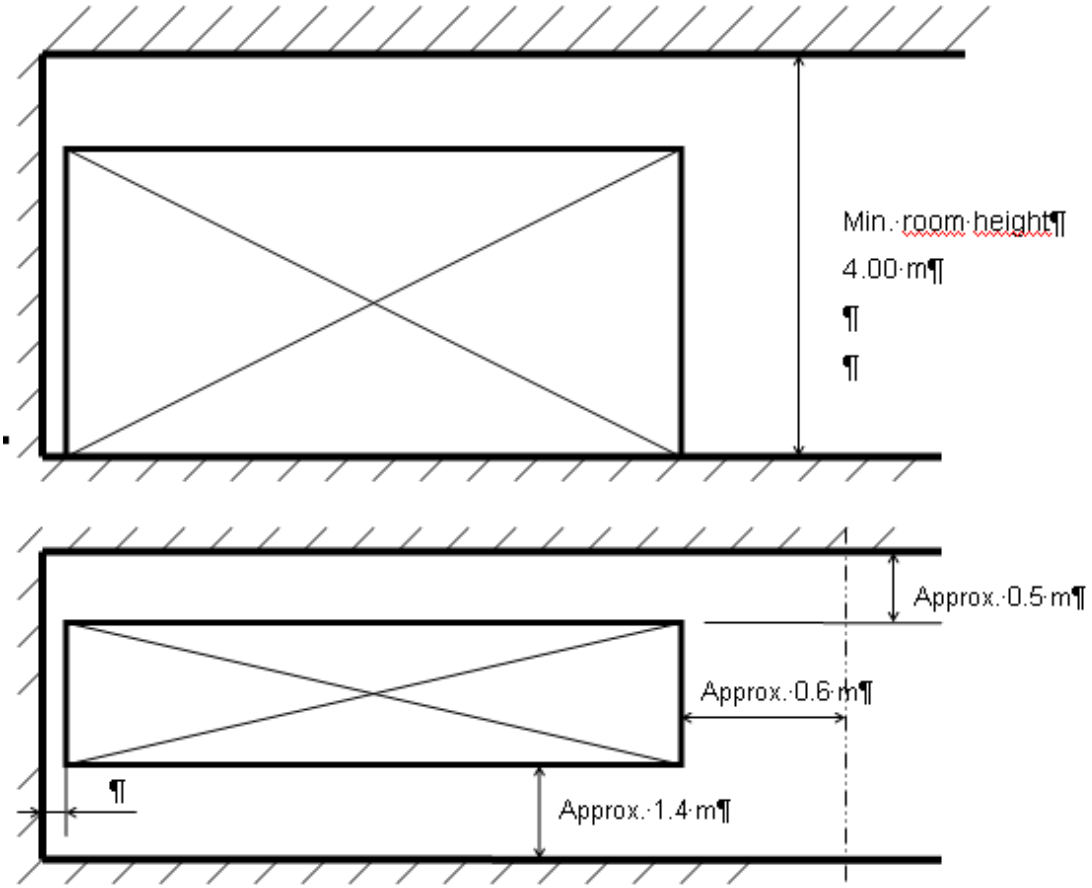
7.1.4 Requirements for Safe Installation

- Ensure the complete civil construction work is finished. Check all the ozone equipment related dimensions.
- Make sure that sufficient space is available to place the complete ozone system.
- The buildings and the ways from the material containers to the buildings must be freely accessible.
- The components to be installed are completely unpacked.
- For the commissioning date, electric power, oxygen, cooling water and process water has to be available.

7.1.5 Operating Room

- *Refer to Chapter Requirements for the Installation Place*
- *Refer to Chapter Safety,* particularly with regard to how to handle oxygen and ozone.

Closed room	Operating rooms for ozone generating systems must allow for service access. The installation surface must be straight and even.
Ventilation	In order to ensure good ventilation of the system, provide a free area around the system. Ensure sufficient room ventilation during normal operation and in case of a malfunction/hazardous incident. *Refer to Chapter Technical Ventilation System.*
Lighting	Only operate the system in an environment with sufficient lighting in accordance with the local work place regulations.
Space requirement	Ensure that the installation area is dimensioned such that operation, maintenance and repair work can be done without hindrances.



Barometric pressure	The manometers used in the generator indicate the pressure of the system in relation to the barometric air pressure in the operating room.
Temperature and humidity	Ensure that there is no inadmissible heating-up of the operating room due to the dissipated heat of the generator. *Refer to Chapter Operating Data.* Air-conditioned rooms are recommended. The following table shows the values admissible for the ozone system:

Ambient air conditions		
Ambient air temperature[1)]	10°C – 35°C[1)]	41°F – 95°F[1)]
Ambient air temperature, average	20°C	68°F
Humidity, rel.	< 90%	
Altitude, above sea level	< 500 m	<760 ft
Ambient air must be free from aggressive substances.		
1) Higher ambient temperatures are possible with special option. 2) For higher altitudes above sea level consulte Wedeco for assistance.		

- Ensure that the air humidity does not exceed 90% during continuous operation, higher values are possible for brief periods (<1h). Ensure that there is no condensation resulting from moisture (dew) in or on the system.

With regard to EMC emission standards, the system meets the protection requirements for the industrial sector without restrictions.

When operated in residential, office, business and small scale industrial sectors, special structural engineering shielding measures may have to be taken in order to prevent radio interference.

Contact your Wedeco Service for assistance.
Refer to Chapter Contact Addresses.

Special Safety	Openings to other rooms, e. g. pipe or cable channels must be gas tight or included in the monitoring process. Openings to rooms in lower levels or downward stairs are particularly at risk and therefore must imperatively be included in the safety concept and the monitoring process.

7.1.6 Installation of the Ozone System

- Ensure that no dirt particles get into the system when connecting the system.

Ensure that the ozone generating system is installed on a stable, vibration-free foundation.

The ozone systems SMOevo^{PLUS} 410 and 460 come with a single skid.

All other SMOevo^{PLUS} types are delivered on two skids.

Make sure to exactly align the two skids. Fix the two plug connectors on the rear side of the cabinet and lock them. *Refer to Chapter Dimensions and Weight.*

In order to ensure proper and safe operation of the ozone system, observe the following instructions:

- Pickle and passivate the welded piping containing ozone since otherwise ozone decays at the weld seams which are not treated.
- When installing the system in an in-house pipework system, make sure that only ozone resistant connecting parts like cables, fittings, and sealings are used.
- Use the materials listed in the table below for in-house connections:

Connections	Recommended Materials
Ozone (dry)	Stainless steel 1.4301 (AISI 304) or superior grade, perfluorinated plastics (PTFE)
Oxygen	Stainless steel 1.4301 (AISI 304) or superior grade, copper (soldered), brass, perfluorinated plastics (PTFE)
Air	Stainless steel 1.4301 (AISI 304) or superior grade, copper (soldered), brass, perfluorinated plastics (PTFE)
Cooling water	Stainless steel 1.4404 (AISI 316L) or superior grade, plastics (PVC, PE, PA)
Process water-ozone mixture	Depending on ozone concentration, process water quality, and temperature: Stainless Steel 1.4404 (316L) or superior grade, plastics (PTFE, PVDF, PVC)

- Observe general corrosion guidance and norms for all the parts coming into contact with water.

- Mark all pipes carrying ozone and oxygen with appropriate labels or coat of paint.
- Protect all lines against damage or tearing off.
- Keep all piping and mounting parts carrying oxygen or ozone free from oil and grease.

7.1.7 Connecting the Ozone System

- *Refer to Chapter Technical Data and the Wiring Diagrams in the Appendix.* All connections must be carried out according to the specifications.

Before putting the ozone system into operation, carry out the following steps:

1. Connect all system components.
2. Check the system for horizontal position and equal load distribution of all supporting points to avoid stress on the system.
3. Ensure stress-free connection of the system to in-house piping for the gas pipes.
4. Ensure stress-free connection of the system to in-house piping for the cooling water.
5. Carry out electrical connections in compliance with locally applicable regulations.
6. Retighten all contact screws.
7. Ground the ozone system.
8. Connect the ozone system to the in-house electrical lines.
9. Check the connected piping for leak tightness.

- The check of the ozone containing pipes must be carried out according to the Pressure Equipment Directive by a qualified person and documented in an appropriate report.

10. Ensure that no cooling liquid may flow back into the ozone system.
11. Activate the ambient air monitoring system.
12. Ensure that unused ozone or residual ozone is discharged by means of a residual ozone destruction system.

NOTICE!

Hazard due to improper operation!

Risk of damage to the system.

- It is absolutely necessary to ensure that neither any liquid nor humid gas of downstream reactors or ozone introduction systems is able to flow back into the ozone system. Make sure that appropriate equipment is available.
- Only introduce ozone into the mixing appliance if the minimum flow quantity of the cooling medium, as described in the manual, has been reached or exceeded and the ozone destructor is operational.

7.1.8 Purging the System for Drying Out Purposes

Prior to commissioning the ozone system for the first time, or after carrying out modifications to the connection lines, ensure that all moisture is removed from the gas lines.

Purge the gas flow circuit until an atmospheric dew point of -70 °C (~3 ppm) at the outlet of the ozone generator is ensured. Depending on the moisture load, the purging process with nominal gas flow may take between 4 and 24 hours.

- Only use dry air free of oil and grease, dry nitrogen or oxygen for the purging process. If purging the ozone system with oxygen, observe all the regulations concerning the handling of oxygen.
  Refer to Chapter Hazardous Substance Oxygen

- Make yourself familiar how to operate the touch panel.
  Refer to Chapter Operation.

After the purging phase is completed, the ozone system can be switched off.

The system is ready for initial start-up.

7.2 Initial Start-Up

7.2.1 Safety Instructions

⚠ WARNING!

Gas containing ozone in system components and pipes!

Even during the initial start-up ozone is generated. Hazard of toxic effects and breathing difficulties.

Fire hazard (strongly oxidizing.)

If you smell ozone:

- Immediately set the power switch to **0**.
- Leave the operating room while observing the safety measures.
- Do not smoke and avoid open flames.

- It is essential to follow the guidelines for handling ozone. *Refer to section Safety.*
- After thoroughly ventilating the operating room with the converter switched off (no ozone production), look for the cause of the leak. Maybe not all the connections are sufficiently tightened. Although the system was factory tested, connections might have loosened during transport.

⚠ WARNING!

Escaping oxygen!

Fire hazard (strongly oxidizing)

- Ensure sufficient room ventilation.
- Do not smoke and avoid open flames.
- It is essential to follow the guidelines for handling oxygen. *Refer to section Safety.*

- The initial start-up always takes place in manual mode.
- Make sure that the system has been given enough time to adapt to the climatic conditions of the location before it is activated for the first time.

7.2.2 Requirements for the Commissioning Staff

The ozone system may be commissioned by qualified persons only. *Refer to Chapter Classification of Operating Staff.*

7.2.3 Starting the Ozone System Initially

The following steps must be carried out before initial commissioning:

1. Check that all supply media for the system are available according to the technical data (gas, cooling water, power).
2. Check that the subsequent process technology for the ozone generated is ready to accept it and can process it according to its purpose.
3. Check that all safety equipment is available and enabled.
4. Set all manual valves to operating position.
5. Let the cooling water flow into the system and bleed the pipe work.
6. Set the cooling water flow according to the instructions given in *Chapter Technical Data*.

- The system was tested at the manufacturer's factory (Wedeco) and can be put into operation once it has been integrated on site. A test of the ambient air sensor must be carried out by Wedeco personnel or instructed staff before the system is switched on for the first time.

- Observe the initial starting up of the system carefully in order to be able to detect any potential hazardous situations at an early stage.
- Make yourself familiar how to operate the touch panel. *Refer to Chapter Operation*.

7. Switch on the ozone system.

8 Operation

8.1 Personal Protective Equipment

In order to avoid injuries, wear the following protective equipment when operating the system:

Ear protection

8.2 Requirements for the Operating Personnel

The ozone system may be operated by instructed persons (*refer to Chapter Classification of Operating Staff*) only.

8.3 Switching the System On/Off, Starting and Stopping the Ozone Production Process

This section describes the following:

1. Switching the ozone system on / off
2. Starting the ozone production
3. Stopping the ozone production

NOTICE!
Prior to switching on / starting the system, you must make sure that you know how to switch off the system. Read this section through to the end before switching on / starting the system. Only then you will be authorized to operate the system.

"Switching on" refers to preparing the system for production.

"Starting" refers to the actual ozone production of the system, e.g., after switching on the system or after a brief stop (break).

NOTICE!

Visually inspect the system for defects prior to starting it.

Make sure the ozone line is connected and the gas to be produced can be included into the production process and processed according to its intended use.

Make sure all safety elements are available and activated, and work properly.

NOTICE!

The gas containing piping and valves must be dry after purging and may not contain any dirt particles. If there is any uncertainty as far as the dryness of the piping and valves are concerned, carry out the purging process.

Refer to Chapter Purging the System for Drying Out Purposes.

8.3.1 Starting / Shutting Down the System

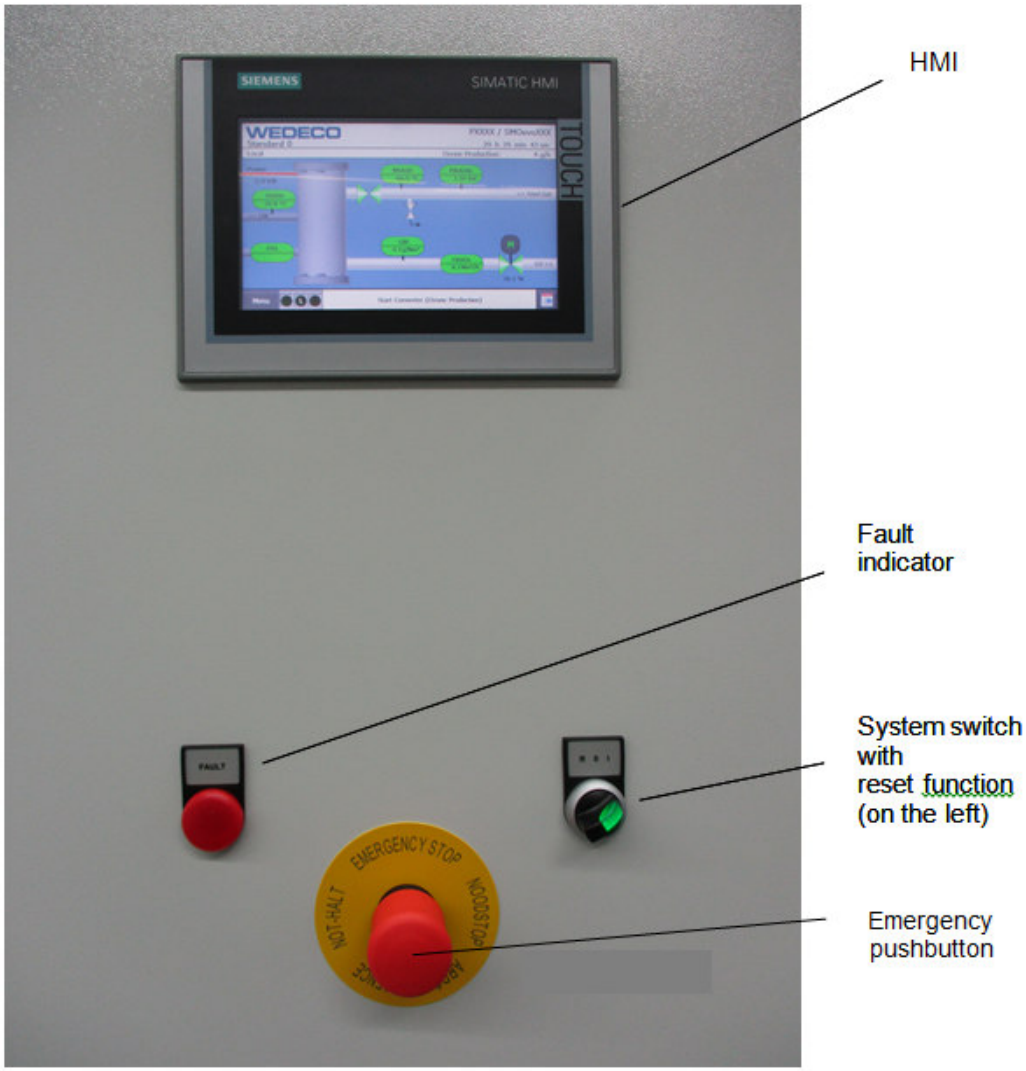
To start the ozone system, turn the main switch to position ON.

To shut down the ozone system, turn the main switch to position OFF.

- The main switch of the ozone system is located at the side panel of the control cabinet.
- By means of the main switch the complete power supply of the ozone generating system is turned on or off.

8.3.2 Starting the Ozone Production

The following picture shows the operating controls:



1. Identify the setting parameters before starting the ozone production.
2. Open the cooling water flow valve and set the flow according to the specifications in *Chapter Technical Data*.
3. Turn the system switch to position I.
4. The system carries out a system test.

GREEN	**flashing light**	The system is in start up, purging, or shutdown phase.
GREEN	**continuous light**	The system is in normal operation (ozone production).
RED	**flashing light**	A warning message is active.
RED	**continuous light**	A fault has occured.

A fault can be acknowledged by means of the system switch (turn to position R) or via the HMI. *Refer to Chapter Alarms / Events (Current).*

After successful acknowledgment, the system can be restarted.

8.3.3 Stopping the Ozone Production

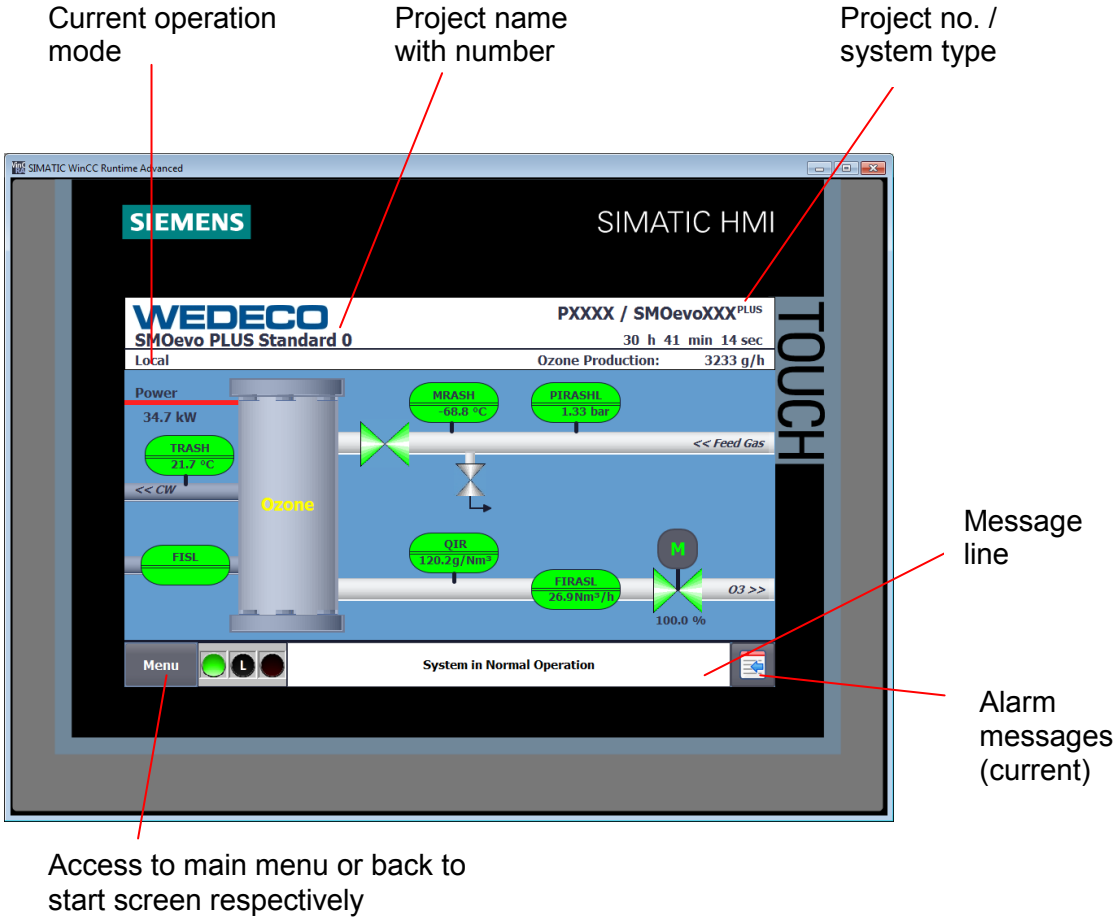
Turn the system switch to position 0 to initiate the stop sequence of the ozone system.

The system is purged with the relevant feed gas for 2 minutes.

Where applicable, the associated periphery shuts down.

After completion of the stop sequence, the ozone system is in stand-by state again.

8.4 Start Screen HMI (Screen 00.00)

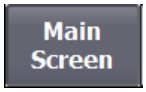
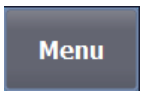
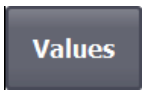
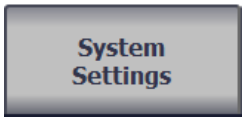
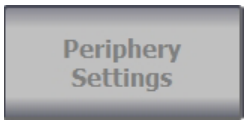
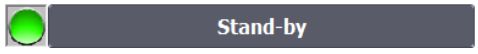
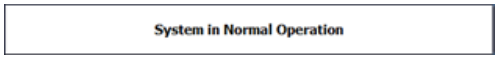


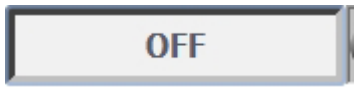
The main screen displays the system with all transmitters and measuring points. It may vary depending on the options included in the respective system.

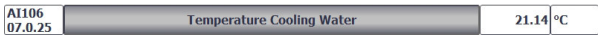
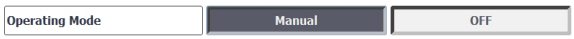
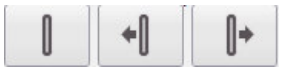
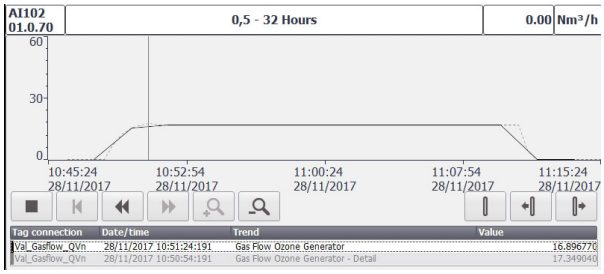
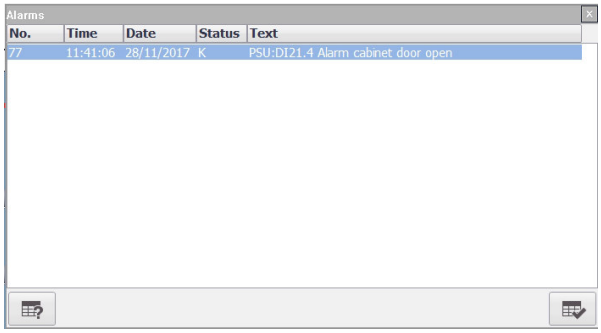
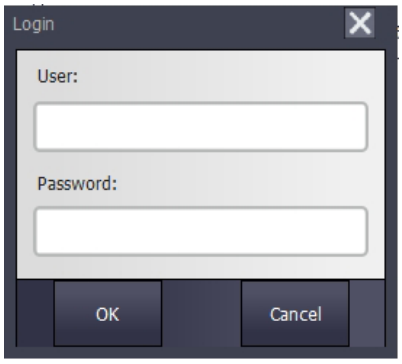
Message line

Every screen containing the message line navigates the operator to the screen Alarm messages (current) by pressing the pushbutton on the bottom right.

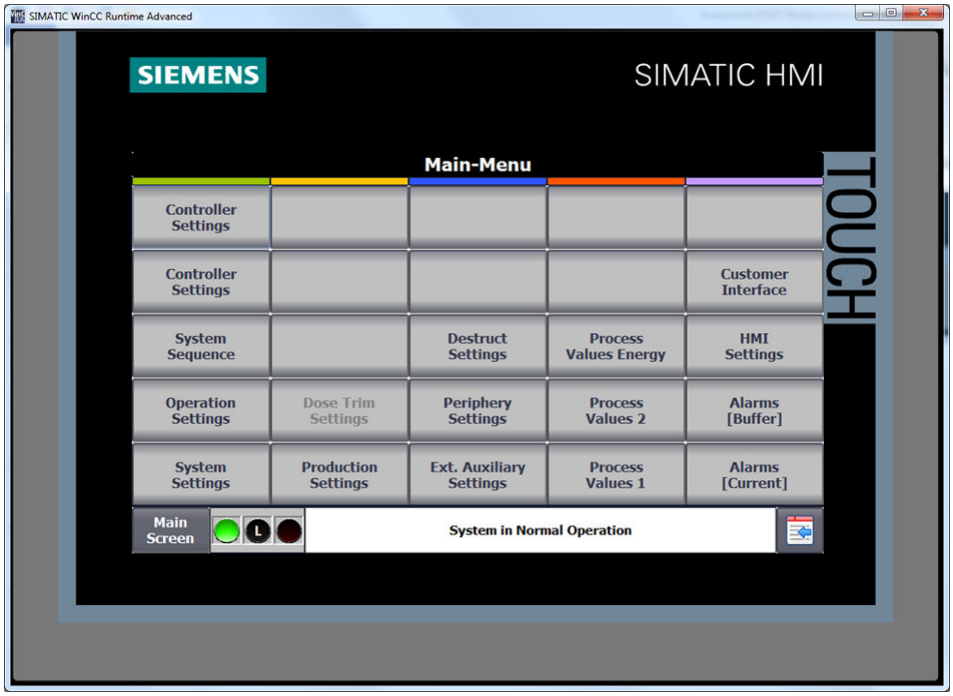
8.5 Function Buttons and Input Fields on the Touch Panel

	Category	Function	Symbol
1	Navigation	Opening start screen from main menu	
2	Navigation	Opening main menu from submenus	
3	Navigation	Opening Process Values from graphs	
4	Navigation	Opening submenus from main menu	
5	Navigation	Opening submenus from main menu (option not available)	
6	Navigation	Opening parameter settings of the Dose Trim from submenu	
7	Navigation	Opening display of current alarm messages	
8	Visualization	Object inactive	
9	Visualization	Object active / released	
10	Visualization	Object faulty	
11	Visualization	Start / Stop Sequence step currently inactive	
12.	Visualization	Start / Stop Sequence step currently active	
13.	Visualization	Message, ozone system is OK / status indication of periphery	
14	Visualization	Message ozone system faulty	

	Category	Function	Symbol
15	Visualization	Status indication: OFF	
16	Visualization	Status indication: Ready for operation	
17	Visualization	Status indication: Starting / Stopping	
18	Visualization	Status indication: Normal Operation / Manual Mode	
19	Visualization	Status indication: Ozone system faulty	
20	Visualization	Status indication: Local mode	
21	Visualization	Status indication: Remote mode	
22	Visualization	Status indication: Service mode (PID)	
23	Visualization	Status indication of Ozone system	
24	Operation	Button not activated	
25	Operation	Button activated	
26	Operation	Input field - setpoints	
27	Operation	Output field - process values	
28	Operation	Output field - time indication	
29	Operation	Selection list (selecting operation mode)	
30	Operation	Input / Output combination	

	Category	Function	Symbol
		[SP] setpoint [PV] actual value	
31	Operation	Display process values [AI] Analog input P&ID number	
32	Operation	Periphery settings	
33	Operation	Process value graph time axis	
34	Operation	Process value graph ruler	
35	Operation	Status indication: Dose Trim stage	
36	Screens	Process values	
37	Screens	Current alarms	
38	Screens	Login	

8.6 Main Menu (Screen 01.00)



The main menu shows all screens required for operating the system.

Every screen is accessed by pressing the relevant pushbutton.

Buttons with grey font indicate inactive screens.

8.7 System Settings (Screen 02.00)

In the System Settings screen, general system options can be selected as follows:

Operating Mode

The ozone production can be started locally or externally.

Depending on the operating mode, the system can be started or stopped externally via the terminal block, a network connection or via a Wedecontrol process control system connection.

The status of the external commands can be checked in the Customer Interface screen.

Local	The system is switched on or off via the system switch only.
Remote (Hardwired)	The system switch must be in position I. The system is switched on via remote start contact
Remote (Network)	The system switch must be in position I. The system is switched on via remote network command.
Remote (Wedecontrol)	The system switch must be in position I. The system is switched on via remote Wedecontrol command.

The system can be stopped at any time by deactivating the remote signal or turning the system switch to position 0.

Setpoints

Selection of setpoint source.

The input / selection fields depend on the current operating mode. Some fields are not always available.

Local	All setpoints are entered manually via the HMI
Remote (Hardwired)	All setpoints are set by analog 4…20mA signals (depending on control mode) *Refer to Chapter System Control Modes*.
Remote (Network)	All setpoints are set via network connection (depending on control mode) *Refer to Chapter System Control Modes.*
Remote (Wedecontrol)	All setpoints are set via Wedecontrol process control system (depending on control mode) *Refer to Chapter System Control Modes.*

Converter (Ozone prPruction)

Release of the Converter including status indication.

The converter can be turned on / off at any time when in normal operation.
The system can be operated without converter. Here gas flows through the generator, the energy supply is switched off and thus the manual purge mode is carried out.

OFF	The converter is not released; the ozone generation process is not in operation. When the system is started, the system is automatically started up to the "Start converter (ozone production)" start step. The current operating status is indicated by the message "Converter waiting for release signal. Manual purge mode is carried out"
ON	The converter is released, the ozone generation process is in operation. When the system is started, the complete start sequence is carried out automatically up to the step “System in normal operation”

Dew Point Purge Mode (Option)

Release of the Purge Mode including status indication.

If the system is not switched on, the dew point can be kept at the start level for a longer period of time. This means that a partial flow is continuously discharged via the dew point purge valve. (start level < -56°C atm.), Purging only takes place if the inlet pressure is above start level (> operating pressure EOZ).

OFF	When the system is out of operation, no partial flow is discharged via the dew point purge valve. The dew point is not continuously maintained at the start level. Recommended for longer periods of system shutdown!

ON	When the system is out of opertion, a partial flow is continuously discharged in order to keep the dew point stable at the start level. Recommended for shorter periods of system shutdown or in the case of required high uptime.

Nitrogen Boost (Option)

Release of the Nitrogen boost including status indication.

Once the gas line to the generator is opened, the nitrogen boost solenoid valve opens too and air is added to the oxygen. This measure is taken to achieve a more efficient ozone production in the event of too high oxygen purity (> 2.5 quality, from 3.0 quality on).

OFF	The nitrogen boost solenoid valve remains closed, no air is added to the feed gas.
ON	With the valve opened, air is added too in order to reduce the purity of the oxygen. If the overall system is equipped with a dosing compressor and a fault message is shown, the valve closes immediately. The entire system remains in operation.

Automatic Restart (Option)

Release of the Automatic Restart including status indication.

When the system is in operation and mains fluctuations of the main supply line are detected by the phase monitor during operation, the system can carry out an Automatic Restart when the voltage returns. The supply voltage of the PLC and the safety relays is buffered by a 24V UPS to enable Automatic Restart.

OFF	If mains fluctuations are detected, no Automatic Restart is carried out, the system remains in fault condition.
ON	The system has stopped automatically due to a detected mains fluctuation and is in fault condition. As soon as the phase monitor reports a stabilisation of the supply voltage, the system tries to acknowledge the existing fault messages automatically in order to initialise an Automatic Restart. This process is signalled on the touch panel via the operating message "Automatic Restart in progress".

The following table shows the possible control signals for system and converter start.

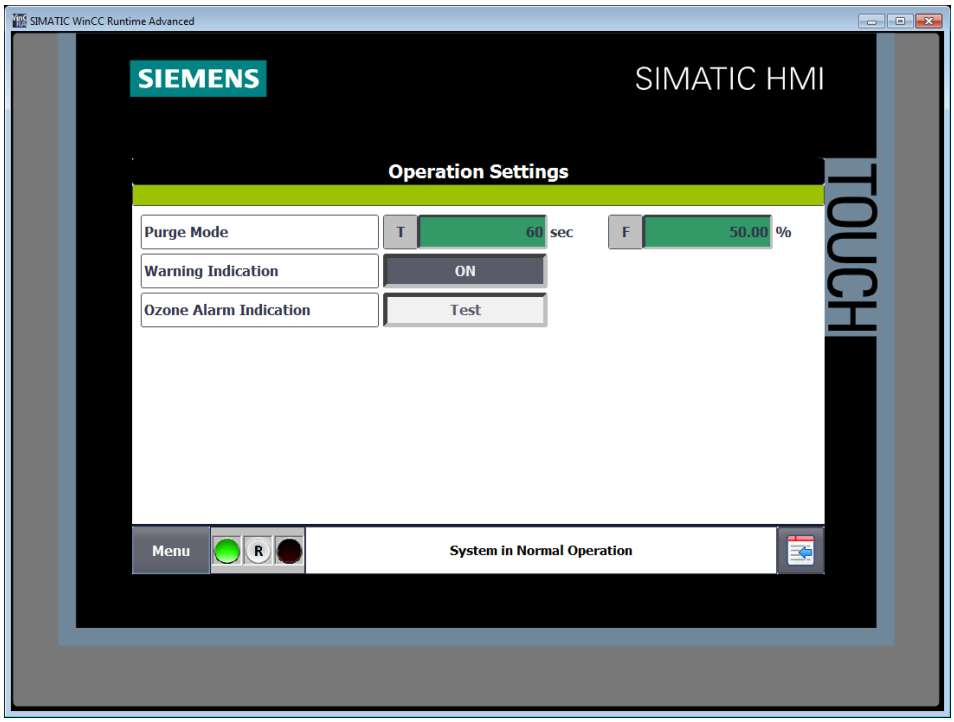
Signal (Control)	Local	Remote (Hardwired)	Remote (Network)	Remote (Wedecontrol)
Release System	x	x	x	x
Release Converter	x		x	x

The following table shows the possible setpoint settings depending on the control mode *Refer to Chapter System Control Mode* and selected operating mode.

Signal (Setpoint)	Submenu	Local	Remote (Hardwired)	Remote (Network)	Remote (Wedecontrol)
Converter Power	Production Settings (03.00.01)	X	X 4…20 mA = 0…100 % Converter Power	X	X
Gas Flow Generator		X	X 4…20 mA = 0…X Nm³/h Gas Flow	X	X
Ozone Concentration	Production Settings (03.00.02)	X	X 4…20mA = 0…Xg/Nm³ Ozone Concentration	X	X
Ozone Concentration	Production Settings (03.00.03)	X	-	X	X
Gas Flow Generator		X	-	X	X
Required Ozone Mass		X	X 4…20mA = 0…Xg/h Ozone Production	X	X
Ozone Dose	Production Settings (03.00.04)	X	-	X	X
Process Water Flow		X	X 4…20mA = 0…Xm³/h Process Water Flow	X	X
Dose Trim		X	-	X	X

8.8 Operation Settings (Screen 02.01)

In the Operation Settings screen, general system options can be selected as follows:



Purge Mode

When turning the system switch from Normal Operation (position I) to position 0, the system stops via the automatic stop sequence.

The Purge Mode, in which the system is purged with the feed gas in order to remove residual ozone from the system, can be parameterized via the input fields.

T = Time	Time during which the Purge Mode is active.
F = Flow	Percentage flow value in relation to the maximum flow rate of the system.

Warning Indication

Information about system status: Warning or Breakdown

ON	If a warning status occurs, the fault indicator flashes.
OFF	The fault indicator goes on only if a fault status resulting in a breakdown occurs.

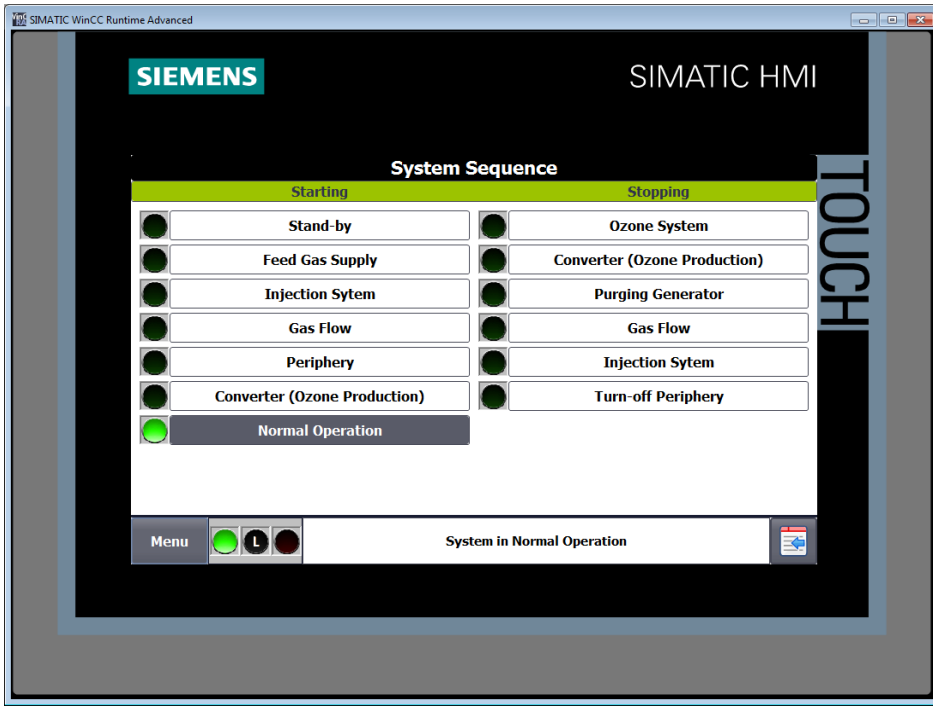
Ozone Alarm Indication

A function test of all ozone alarm devices can be carried out via the button (horn, flashlight, fan).

Test	Activates ozone alarm devices as long as the button is pressed.

8.9 System Sequence (Screen 02.02)

Visualization of the Start und Stop Sequence of the ozone system



Start Sequence

Stand-by

- No fault is present.
  The system is waiting for local or remote start signal.

Feed Gas Supply

- Start of the air preparation system (optional).
- The system is waiting for required inlet feed gas pressure.
  If the pressure is not higher than the start level after 30 minutes, the system stops and a fault message is generated.
- The system is waiting for feed gas dew point (option).
  If the dew point is above start level, the system purges feed gas via the dew point purge valve (dew point > -56 °C atm).

  If the dew point is not lower than the start level after 90 minutes, the system stops and a fault message is generated.
- The system is waiting for generator pressure.
  After the system has been switched on for the first time or after a fault in the safety chain, the system carries out the process: pressure build-up generator.

Injection System (optional)	• Start of the injection system. Check for stable suction pressure on injector. If not sufficient suction pressure develops on the injector within 1 min, the system stops and a fault message is generated.
Gas Flow	• Start gas flow The gas inlet valve opens, the flow control valve is activated. Release signal to external device.
Periphery (optional)	• Start ozone destructor The residual ozone destructor is started to extract the gas out of the process.
Converter (Ozone Production)	• Start Converter (Ozone Production) The converter is started and the ozone generator is supplied with energy. The ozone production starts. The converter is not switched on if the converter button in the screen System Settings is in position OFF. A manual purge mode is carried out. The converter switches on if the converter button in the screen System Settings is in position ON. • Start of the cooling system (option). The cooling water flow is initialized by the ozone generator.
Normal Operation	• The system in in normal operation.

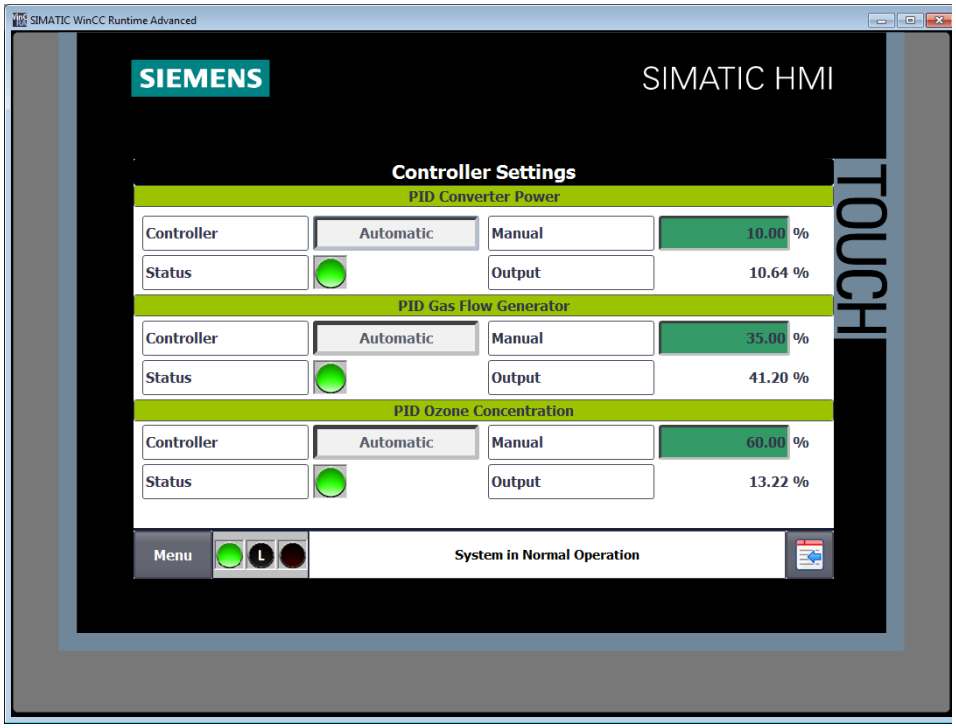
Stop Sequence

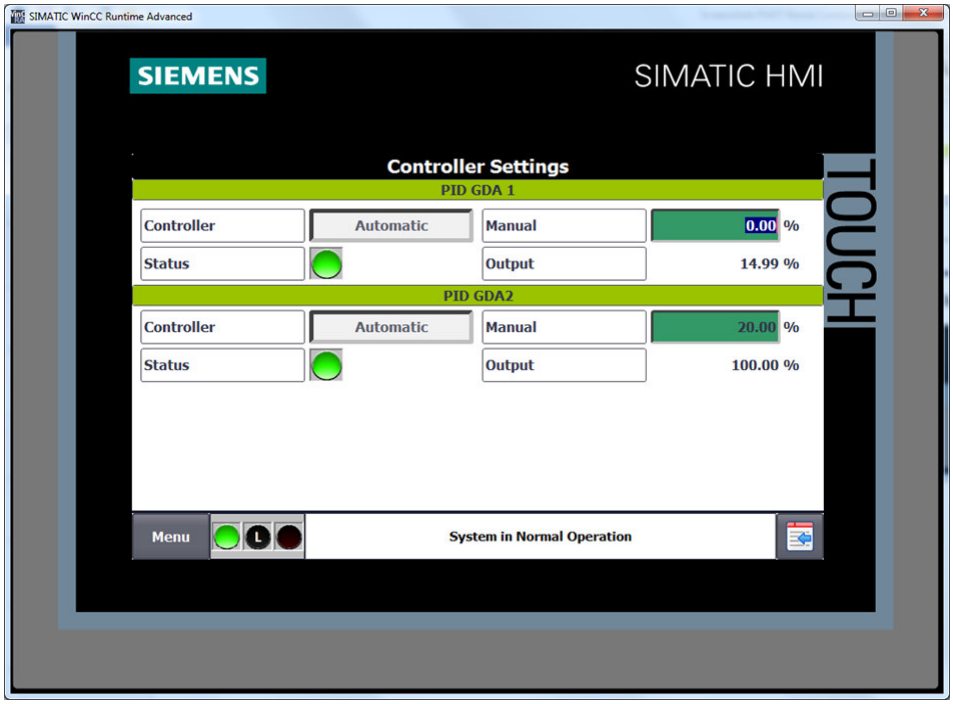
Ozone System	• Ozone system stops The system is shut down via the automatic stop sequence.
Converter (Ozone Production)	• Converter stops ozone production The converter shuts down, ozone production is stopped.
Purging Generator	• System is purged ozone-free The system is purged with feed gas in order to remove residual ozone from the entire system. The remaining purge time is shown in the message line.
Gas Flow	• Gas flow stops The flow control valve is closed. The gas inlet valve is closed with a time delay. External auxiliary stops after set Turn-off Delay.
Injection System (optional)	• The injection system stops (optional) Gas introduction to process water is stopped.

Turn-off Periphery (optional)

- The air preparation system turns off after a preset Turn-off Delay (optional).
- The cooling water system turns off after a preset Turn-off Delay (optional).
- The residual ozone destructor turns off after a preset Turn-off Delay (optional).

8.10 Controller Settings (Screen 02.03)





The following settings are available for the PID Controllers Converter Power, Gas Flow Generator and Ozone Concentration (option):

Operating Mode Controller

Automatic
- The PID Controller operates in Automatic-Mode and controls independently the controller output as per the present input parameters and the setpoint.
- Normal operation condition of the controller.

Manual
- The PID-Controller operates with a fixed setpoint for the controller output. Input parameters and setpoint are not taken into account.
- The manual setpoint for the controller output is indicated via the input field.
- Service password required!

Status Controller

Status
- Status indication of the controller.

Output
- The current setpoint of the controller output (4..20mA signal in %) is displayed.

8.11 Production Settings (Screen 03.00.01) Power / Gas Flow Control

Production Settings screen in system control mode Power / Gas Flow Control

With this control mode, the setpoints Converter Power and Gas Flow Generator must be preset.

Signal (Setpoint)	Local	Remote (Hardwired)	Remote (Network)	Remote (Wedecontrol)
Converter Power	X	X 4…20 mA = 0…100 % Converter Power*	X	X
Gas Flow Generator	X	X 4…20 mA = 0…X Nm³/h Gas Flow*	X	X

* only one signal is transferable via the external customer terminal block, depending on the selected setpoint presetting.

Setpoint (Hardwired)

If the setpoint source is Remote (Hardwired), the operator can decide which setpoint to provide via the 4…20 mA signal. The locally set setpoint thus remains a constant value and ozone production can be varied via the external setpoint.

Gas Flow Generator
- The external setpoint via the 4…20 mA signal corresponds to 0…100 % Gas Flow of the Generator.

Refer to System Specification.

Converter Power
- The external setpoint via the 4…20 mA signal corresponds to 0…100 % Converter Power.

Converter Power

The Converter Power is displayed as follows:

SP
- Setpoint in % referred to Converter Power 0…X kW.

PV
- Actual value in kW, showing the actual Process Value.

Gas Flow Generator

The Gas Flow Generator is displayed as follows:

SP
- Setpoint in Nm³/h.

PV
- Actual value in Nm³/h, showing the actual Process Value.

8.12 Production Settings (Screen 03.00.02) Ozone Concentration

Production Settings screen with control mode Ozone Concentration

With this control mode, the setpoint for the ozone concentration in the gas must be specified. The system automatically modulates the converter power according to the required ozone concentration. The gas flow control valve on the ozone generator opens completely. The gas flow for the ozone generator is controlled remotely.

Signal (Setpoint)	Local	Remote (Hardwired)	Remote (Network)	Remote (Wedeontrol)
Ozone Concentration	X	X 4…20 mA = 0…X g/h Ozone Concentration	X	X

Ozone Concentration

The Ozone Concentration in the gas is displayed as follows:

SP	Setpoint in Nm³/h.
PV	Actual value in Nm³/h, showing the actual Process Value.

Gas Flow Generator

The gas flow is controlled remotely. The gas flow control valve on the ozone generator opens completely.

The resulting Gas Flow is displayed as follows:

PV	Actual value in Nm³/h, showing the actual Process Value.

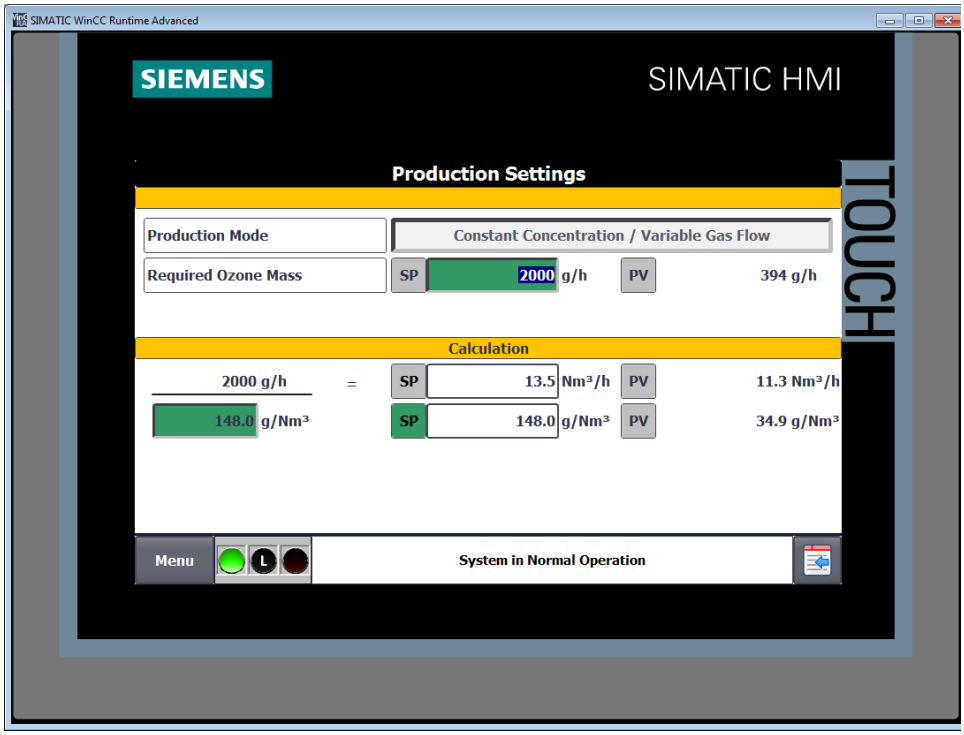
Ozone Mass

The ozone mass produced results from the setpoint Ozone Concentration multiplied by the gas flow through the generator resulting from the external control and is displayed as follows:

PV	Actual value in g/h, showing the actual Process Value.

8.13 Production Settings (Screen 03.00.03) Required Ozone Mass

Production Settings screen with control mode Required Ozone Mass



With this control mode, in addition to the main setpoint Required Ozone mass, a further constant setpoint must be specified: the Ozone Concentration or the Gas Flow Generator. Depending on the ozone requirement, the non-constant setpoint is changed variably in order to produce the Required Ozone Mass.

Signals (Setpoint)*	Local	Remote (Hardwired)	Remote (Network)	Remote (Wedecontrol)
Gas Flow	x	-	x	x
Ozone Conzentration	X	-	X	X
Required Ozone Mass	X	X 4…20 mA = 0…X g/h Ozone production	X	X

*the main setpoint is the Required Ozone Mass. The constant setpoint must be set accordingly depending on the production mode. In the Remote mode (Hardwired), only the main setpoint is set via a 4...20 mA signal. The constant setpoint must be entered locally on the touch panel. In the Remote mode (Network), the main setpoint and the constant setpoint must be specified via the network signal depending on the production mode. The variable parameter is automatically calculated by the ozone system.

Production Mode

In concentration or gas flow controlled systems, it must always be decided which parameter should be the constant setpoint and which the variable parameter. The setpoint highlighted in gray is always the calculated value (variable).

Constant Concentration / Variable Gas Flow	The ozone concentration is the constant setpoint: Depending on the required ozone mass, the gas flow is changed variably.
Constant Gas Flow / Variable Concentration	The gas flow is the constant setpoint: depending on the required ozone mass, the ozone concentration is changed variably.

Example calculations:

Variable Gas Flos	= Required Ozone Mass /		Constant Concentration
49.02 Nm³/h	= 5000 g/h	/	102.0 g/Nm³
39.22 Nm³/h	= 4000 g/h	/	102.0 g/Nm³

Variable Concentration	= Required Ozone Mass /		Constant Gas Flow
148.0 g/Nm³h	= 5000 g/h	/	33.8 Nm³/h
118.3 g/Nm³	= 4000 g/h	/	33.8 Nm³/h

Required Ozone Mass

The Required Ozone Mass is displayed as follows:

SP	Setpoint in g/h, according to the design data oft he system.
PV	Actual value in g/h, showing the actual Process Value in g/h.

Calculation

In the calculation, the required ozone mass is divided by the constant setpoint (green). The result is the variable parameter (gray) that must be set to produce the required ozone mass.

Formula	See calculation basis.
SP	Setpoint in g/Nm³, Nm³/h. Gray highlighted value = calculated value or correction value Green highlighted value = default setpoint
PV	Actual value in g/Nm³, Nm³/h, showing the actual Process Value.

- If too little or too much ozone is required, the variable system setpoint remains at a fixed minimum or maximum parameter.

  Depending on the required ozone mass, the constant setpoint is automatically corrected to produce the required ozone mass.

  After about 30 seconds, a warning message is displayed in the HMI:

  Warning setpoint corrected due to limits

8.14 Production Settings (Screen 03.00.04) Dose Control with Dose Trim Function

Production Settings screen with control mode Dose Control with Dose Trim Function.

Production Mode

Ozone Mass	Direct specification of the required ozone mass, no internal calculation depending on the process water flow. In this operating mode it is not possible to correct the dose using the trim function (if available). See section Production settings (screen 03.00.03) Required Ozone Mass.

Required Ozone Mass (Production Mode: Ozone Mass*)

Die benötigte Ozonmenge wird wie folgt angezeigt:

SP	Setpoint in g/h, according to the design data of the system
PV	Actual value in g/h, showing the actual Process Value.

* See Production Mode (Constant Setpoint)

Production Mode

Dose Control

With the Dose Control, an Ozone Dose per m³/h process water flow is specified as the main setpoint.

By multiplying the Ozone Dose by the process water flow, the Required Ozone Mass is obtained.

With this control mode, in addition to the main setpoint Ozone Dose, another constant setpoint must be specified: Ozone Concentration or Gas Flow Generator.

Depending on the Required Ozone Mass, the non-constant setpoint is changed variably in order to produce the Required Ozone Mass. The Process Water Flow is the reference variable for determining the required mass.

Signal (Setpoint)	Local	Remote (Hardwired)	Remote (Network)	Remote (Wedecontrol)
Gas Flow Generator	X	-	X	X
Ozone Concentration	X	-	X	X
Ozone Dose	X	-	X	X
Process Water Flow	X	X 4…20 mA = 0…X m³/h Process Water Flow	X	X

Signal (Setpoint)	Local	Remote (Hardwired)	Remote (Network)	Remote (Wedecontrol)
Ozone Dose Trim	X	-	X	X

Ozone Dose (Production mode: Dose Control)

The Ozone Dose is displayed as follows:

SP	Setpoint in g/m³ process water
PV	Actual value in g/m³ showing the calculated Process Value

Example Calculations:

Ozone Mass		Setpoint Ozone Dose		Water Flow
1500 g/h	=	1.50 g/m³	*	1000 m³/h
1000 g/h	=	1.50 g/m³	*	666.67 m³/h

Production Mode (Constant Setpoint)

In concentration or gas flow controlled systems, it must always be decided which parameter should be the constant setpoint and which the variable parameter. The setpoint highlighted in green is always the constant setpoint. The setpoint highlighted in gray is always the calculated value (variable).

Constant Concentration	The ozone concentration is the constant setpoint: Depending on the required ozone mass, the gas flow is changed variably.
Constant Gas Flow	The gas flow is the constant setpoint: Depending on the required ozone mass, the ozone concentration is changed variably.

Example Calculations:

Constant Concentration

Variable Gas Flow	= Ozone Mass /		Constant Concentration
14.07 Nm³/h	= 1500 g/h	/	102.0 g/Nm³
9.80 Nm³/h	= 1000 g/h	/	102.0 g/Nm³

Constant Gas Flow

Variable Gas Flow	= Ozone Mass /		Constant Gas Flow
120.0 g/Nm³	= 1500 g/h	/	12.5 Nm³/h
80.0 g/Nm³	= 1000 g/h	/	12.5 Nm³/h

Calculation

In the calculation, the required ozone mass is divided by the constant setpoint (green). The result is the variable parameter (gray) that must be set to produce the required ozone mass.

Formula	See calculation basis.
SP	Setpoint in g/Nm³, Nm³/h. Gray highlighted value = calculated value or correction value Green highlighted value = default setpoint
PV	Actual value in g/Nm³, Nm³/h, showing the actual Process Value.

- If too little or too much ozone is required, the variable system setpoint remains at a fixed minimum or maximum parameter.

  Depending on the required ozone mass, the constant setpoint is automatically corrected to produce the required ozone mass.

  After about 30 seconds, a warning message is displayed in the HMI:

  Warning setpoint corrected due to limits

Ozone Dose Trim (Option)

The correction value of the Ozone Dose results from the Ozone Dose Trim function, based on the measurement of the process feedback variable. Possible process feedback variables are dissolved ozone in the water / ozone in the exhaust gas or redox value in the water.

The correction value is determined from the Trim function. Depending on the Setpoint/Actual value of the given value, the Ozone Dose is corrected upwards or downwards in a specified range with different increments. (See screen 03.01 Dose Trim Setting).

Example Calculations

Dose Control

Ozone Mass=		Setpoint Dose [=Setpoint Ozone Dose +/- correction value Dose Trim (Option)]	* Water Flow
1500 g/h	=	1.45 g/m³ [=1.5g/m³ +/-0.0%]	* 1000 m³/h
1650 g/h	=	1.65 g/m³ [=1.5g/m³ +10.0]	* 1000 m³/h

8.15 Dose Trim Settings (Screen 03.01)

Dose Trim Settings screen, ozone dose correction via specific process feedback variable (ozone in water correction / ozone in offgas correction/ Redox value correction).

The Trim function can be operated in the main operating moe “Time Control Mode – Intrerval” (fixed defined time between setpoint / actual value comparison) or in the operating mode “Volume Control Mode – Interval” (setpoint/actual value comparison (setpoint / actual value comparison after exchange of the reaction volume depending on the process water flow).

The operating mode and trim parameters of the function can be adapted to the respective process. The parameter submenu (screen 03.01.01) can be accessed via the button (+/- on the right-hand side of the screen). The submenu is protected by the operator password.

User: ope / password: 100

Ozone Dose Trim

Release of the Ozone Dose Trim **f**unction

The Trim function starts once the start sequence is completed and the converter is in operation (ozone production and ozone introduction).

The Trim function can be turned off at any time. The Trim function is not active in the production mode “Required Ozone Mass”.

OFF	Ozone Dose correction is not carried out. Dose Trim output = 0.0%
ON	The Trim function starts once the start sequence is completed and the converter is in operation.

Status

Status indication of the Trim function

Disabled	Function is off.
Stand-by	Function is ready for operation (ozone production is off).
Normal Operation	Function in normal operation, calculation of the correction factor.
Fault	Refer to Fault Messages.
Start-up Delay	Start time not elapsed, see current time (T).

Start-up Delay (T = Time)

Measuring the ozone in the process is possible after a certain introduction time only. The start of the Trim function must be delayed by this time. After this delay time, the Trim function starts the Dose correction.

The start-up delay is set via the input field. When the Trim function is in operating status “start-up delay”, the remaining start time can be read in the output field.

Operating Mode

Time Control Mode – Interval

After the start delay time, the timer for the control interval starts. The setpoint / actual value comparison is not carried out continuously, only after the control interval is completed. After the comparison the interval starts again. The control inverval is set via the input field.

When the Trim function is in operating status “Normal Operation”, the remaining time until the next setpoint / actual value comparison can be read in the output field.

Volume Control Mode – Interval

After the start-up delay has elapsed, the Trim function starts summing up the current process water flow at intervals of one minute. Depending on the set reaction volume (Trim parameter), the time is calculated how much time remains until the reaction volume is completely exchanged. As soon as the reaction volume is completely exchanged, the interval starts again.

The calculated time until the next setpoint / actual value comparison can be read in the output field.

Process Value (Ozone in water / ozone in offgas / Redox value)

SP	Setpoint in ppm,g/Nm³,mV of the process feedback variable
PV	Actual value in ppm,g/Nm³,mV

Ozone Dose Trim Output

After every control interval, a setpoint / actual value comparison is carried out by the Dose Trim function. Depending on the difference determined, there are changes in the trim output. The correction level is displayed graphically via the correction bar.

The correction value is added to the Ozone Dose and thus forms the process feedback variable in order to achieve an optimized ozone introduction. *Refer to screen 03.00.04 Production Settings.*

8.15.1 Dose Trim Parameters (Screen 03.01.01)

Dose Trim Parameter setting. The submenu is protected by the operator password.

User: ope / password: 100

The operating mode of the Trim function can be defined in the Trim Parameter screen. A distinction is made between percentage and absolute comparison levels. Furthermore, the main operating mode of the setpoint/actual value comparison interval is defined.

Operating Mode Percent

The setpoint/actual value comparison is based on a percentage level calculation depending on the default setpoint. Example calculation based on the setpoint 1.0 ppm.

Example calculations:

PV >> SP 25.0% = 1.25 ppm	• Actual value 0.80 ppm	• -> Level -2.5%
PV > SP 10.0% = 1.10 ppm	• Actual value 0.80 ppm	• -> Level -1.0%
PV < SP -10.0% = 0.90 ppm	• Actual value 0.80 ppm	• -> Level +1.0%
PV << SP -25% = 0.75 ppm	• Actual value 0.80 ppm	• -> Level +2.5%

Under the given conditions a setpoint / actual value comparison is carried out after completion of the Time Control Mode / Volume Control Mode interval with the result that the Dose Trim output must be increased by +1.0% in this interval.

Correction of the Dose is carried out until the actual value approaches the setpoint (actual value > 0.90 ppm / actual value < 1.10 ppm) or the minimum / maximum limit of the output is reached. The limit deviation is signalled by a warning message:
Warnung dose trim out of range. Check settings.

Operating Mode Absolute

The setpoint/actual value comparison is based on an absolute level calculation depending on the default setpoint. Example calculation based on the setpoint 1.0 ppm.

Example Calculations:

PV >> SP 1,0 ppm = 2,00 ppm	• Actual value 0,80 ppm	• -> Level -2,5%
PV > SP 0,50 ppm = 1,50 ppm	• Actual value 0,80 ppm	• -> Level -1,0%
PV < SP -0,50 ppm = 0,50 ppm	• Actual value 0,80 ppm	• -> Level +1,0%
PV << SP -1,0 ppm = 0,00 ppm	• Actual value 0,80 ppm	• -> Level +2,5%

Under the given conditions a setpoint / actual value comparison is carried out after completion of the Time Control Mode / Volume Control Mode interval with the result that the Dose Trim output needs not to be corrected since the actual value is in the dead zone of the controller. The Trim function restarts the increase / decrease of the controller output if the actual value is < 0.5 ppm or actual value > 1.5 ppm.

Correction of the Dose is carried out until the actual value approaches the setpoint (actual value > 0.50 ppm / actual value < 1.50 ppm) or the minimum / maximum limit of the output is reached. The limit deviation is signalled by a warning message:
Warnung dose trim out of range. Check settings.

Operating Mode Time Control

The setpoint / actual value comparison is not carried out continuously, only after the control interval is completed. After the comparison the interval starts again. The control inverval is entered in the screen Dose Trim (screen 03.01).

Operating Mode Volume Control

Depending on the reaction volume set, the control interval is calculated. How much time is required between the setpoint / actual value comparison to completely exchange the reaction volume depends on the process water flow. The process water flow is summed up every minute. The corresponding sum is compared with the reaction volume. As soon as the reaction volume is completely exchanged, the interval starts again. The calculated time until

the next setpoint / actual value comparison can be read in the output field Interval in the Dose Trim screen (screen 03.01).

SP	• Reaction volume in m³
PV	• Current process water flow in m³/h, automatic summation in the PLC every minute.

8.16 External Auxiliary Settings (Bild 04.00)

The ozone system offers the possibility to connect an external device which is operated with the ozone system. The external device starts and stops automatically depending on the system sequence of the ozone system.
The start signal is given with the sequence step: Start gas flow.
The stop signal is given with the sequence step Stop gas flow.

The basic settings of the external auxiliary can be changed in this menu level. Basic settings are Operating Mode, Status and Turn off Delay after stopping the ozone production.

Operating Mode

Automatic	The external auxiliary may always be operated in Automatic Mode, i.e. start and shutdown is carried out automatically via the start and stop sequence. If the external auxiliary is stopped in Automatic Mode, it turns off not before the preset delay time has elapsed.
Manual	The Manual Mode is a kind of maintenance function. In Manual Mode, an On/Off switch appears allowing to start or shut down the external auxiliary manually. Starting and stopping is immediate and without a delay time .

The ozone system cannot be operated if at least one external auxiliary is in Manual Mode. This state is indicated by the operating message:
"System not ready for operation. At least one device not in Automatic Mode"

Status

The operational status of the external auxiliary is displayed.

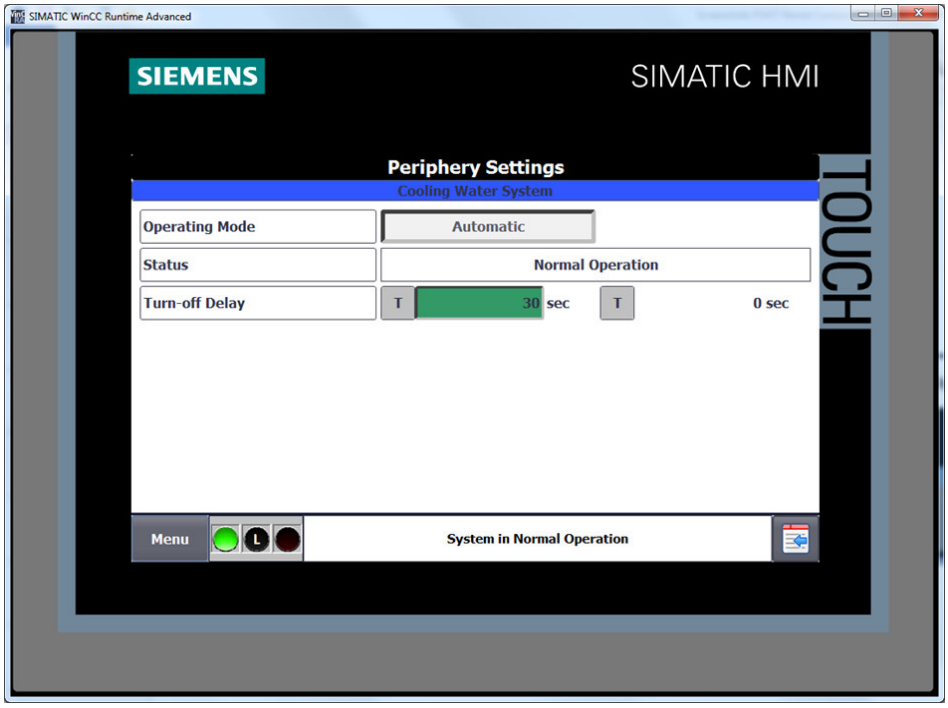
Disabled	Is turned off
Stand-by	is ready for operation and waiting for the start signal
Manual Operation	is operated in Manual Mode
Normal Operation	is operated in Automatic Mode
Fault	General periphery or System Fault
Start-up Delay	starts after delay time
Turn-off Delay	stops after delay time (Turn-off Delay)

Turn-off Delay (T = Time)

Delay time after the stop sequence is initiated in Automatic Mode
The remaining time until stopping is displayed in the output field.

8.17 Periphery Settings: Cooling System (Option) and Air Preparation System (Option) (Screen 04.01)

The basic settings of the periphery can be changed in this menu level. Basic settings are Operating Mode and Turn off Delay after ozone production is stopped.



Operating Mode

Automatic	The periphery may always be operated in Automatic Mode, i.e. start and shutdown is carried out automatically via the start and stop sequence. If the periphery is stopped in Automatic Mode, it turns off not before the preset delay time has elapsed.
Manual	The Manual Mode is a kind of maintenance function. In Manual Mode, an On/Off switch appears allowing to start or shut down the periphery manually. Starting and stopping is immediate and without a preset delay time.

The ozone system cannot be operated if at least one periphery is in Manual Mode. This state is indicated by the operating message:
"System not ready for operation. At least one device not in Automatic Mode"

Controller Output (Option WCL: Wedeco Closed Loop)

If the system is equipped with a Wedeco Closed Loop cooling water system, the speed of the cooling water pump is set automatically via the PLC. The controller output is controlled depending on the power consumption of the converter. For operating data, *refer to the data sheet.*

Status

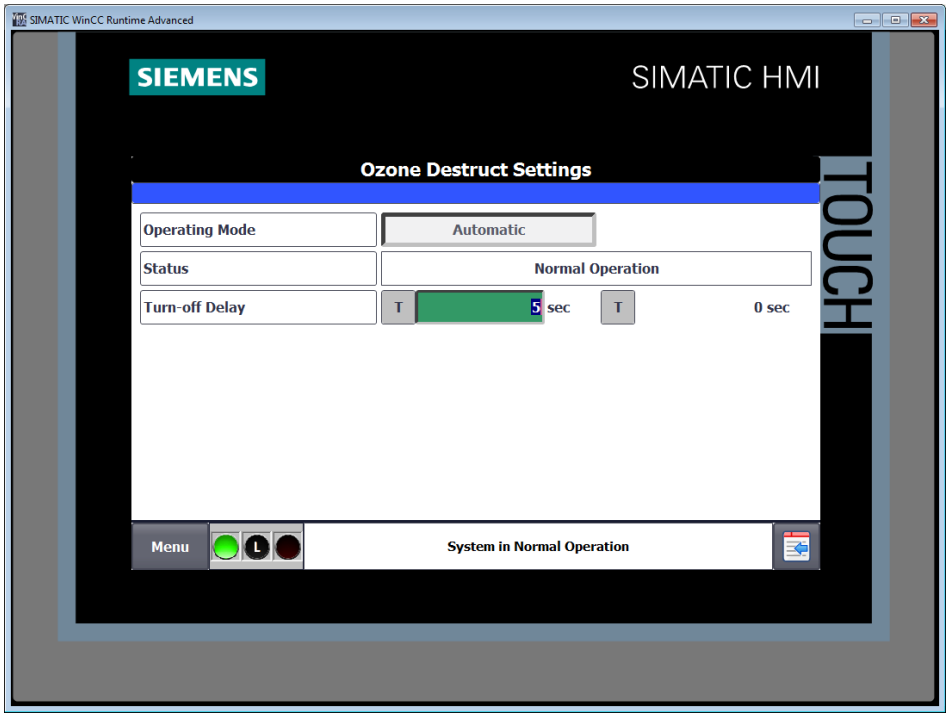
The operational status of the periphery is displayed.

Disabled	Is turned off
Stand-by	is ready for operation and waiting for the start signal
Manual Operation	is operated in Manual Mode
Normal Operation	is operated in Automatic Mode
Fault	General periphery or System Fault
Start-up Delay	starts after delay time
Turn-off Delay	stops after delay time (Turn-off Delay)

Turn-off Delay (T = Time)

Delay time after the stop sequence is initiated in Automatic Mode
The remaining time until stopping is displayed in the output field.

8.18 Ozone Destructor Settings (Option WOD) (Screen 04.00)



The basic settings of the WOD can be changed in this level. Basic settings are the Operating Mode, Status and the Turn off Delay after ozone production is stopped.

Operating Mode

Automatic	The ozone destructor may always be operated in Automatic Mode, i.e. start and shutdown is carried out automatically via the start and stop sequence. If the ozone destructor is stopped in Automatic Mode, it turns off not before the delay time has elapsed.
Manual	The Manual Mode is a kind of maintenance function. In Manual Mode, an On/Off switch appears allowing to start or shut down the ozone destructor manually. Starting and stopping is immediate and without a preset delay time.

The ozone system cannot be operated if at least one periphery is in the Manual operating mode. This state is indicated by the operating message: "System not ready for operation. At least one device not in Automatic Mode"

Status

The operational status of the ozone destructor is displayed.

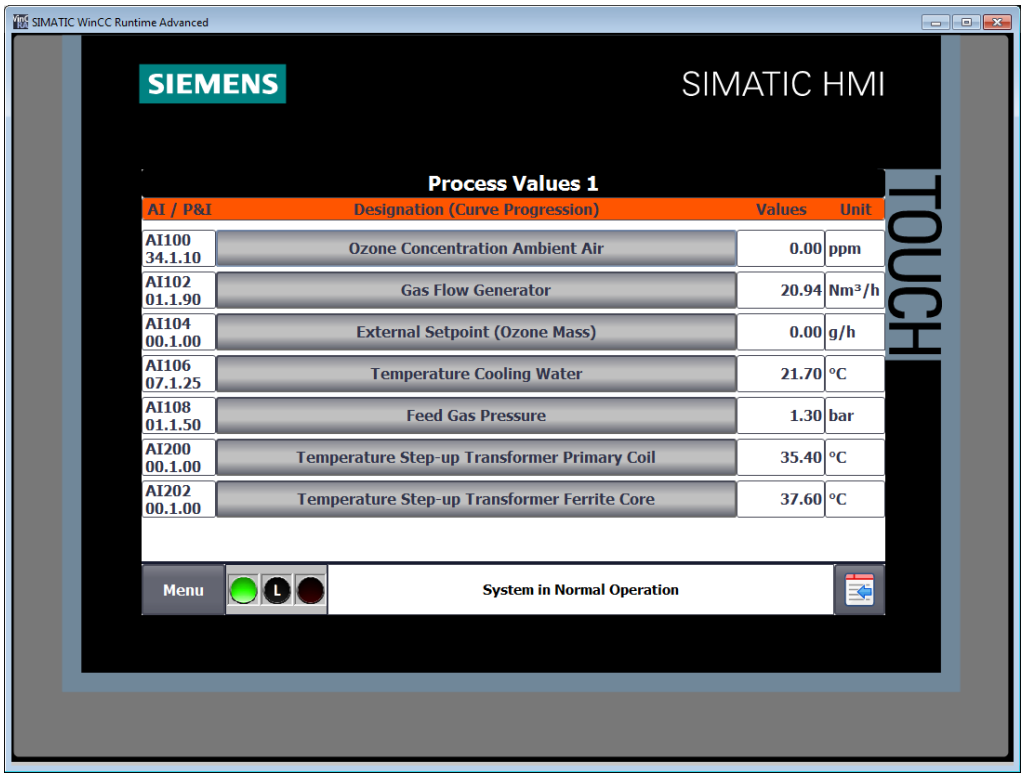
Disabled	is turned off
Stand-by	is ready for operation and waiting for the start signal
Manual Operation	is operated in Manual Mode
Normal Operation	is operated in Automatic Mode
Fault	General periphery or System Fault
Start-up Delay	starts after delay time
Turn-off Delay	stops after delay time (Turn-off Delay)

Turn-off Delay (T = Time)

Delay time after the stop sequence is initiated in Automatic Mode.
The remaining time until stopping is displayed in the output field.

8.19 Process Values 1 (Screen 05.00)

Display of the following Process Values with PLC address and P&ID number:

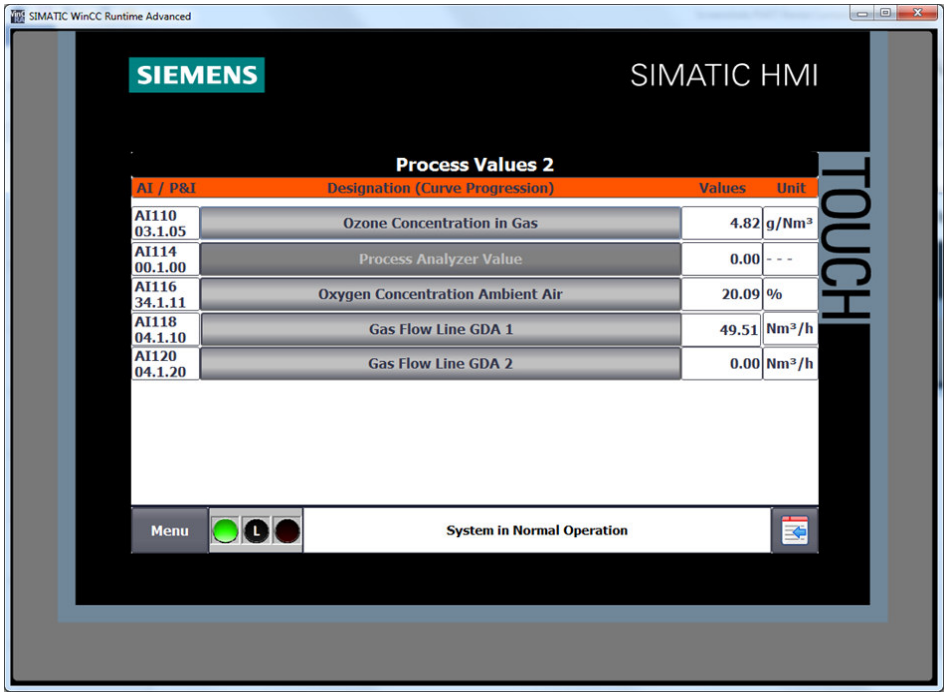


Press the Process Values field to access the curve progression graph (Screen 05.03).

Ozone Concentration Ambient Air	0…1 ppm
Gas Flow Inlet Generator	0…X Nm³/h
External Setpoint (system specific depending on control mode)	0…X (%,Nm³/h,g/h,m³/h)
Temperature Cooling Water	0…X °C
Feed Gas Pressure (calculated value)	0…4 bar
Temperature Step-up Transformer Primary Coil	0…X °C
Temperature Step-up Transformer Ferrite Core	0…X °C

8.20 Process Values 2 (Screen 05.01)

Display of the following current Process Values with PLC address and P&ID number:

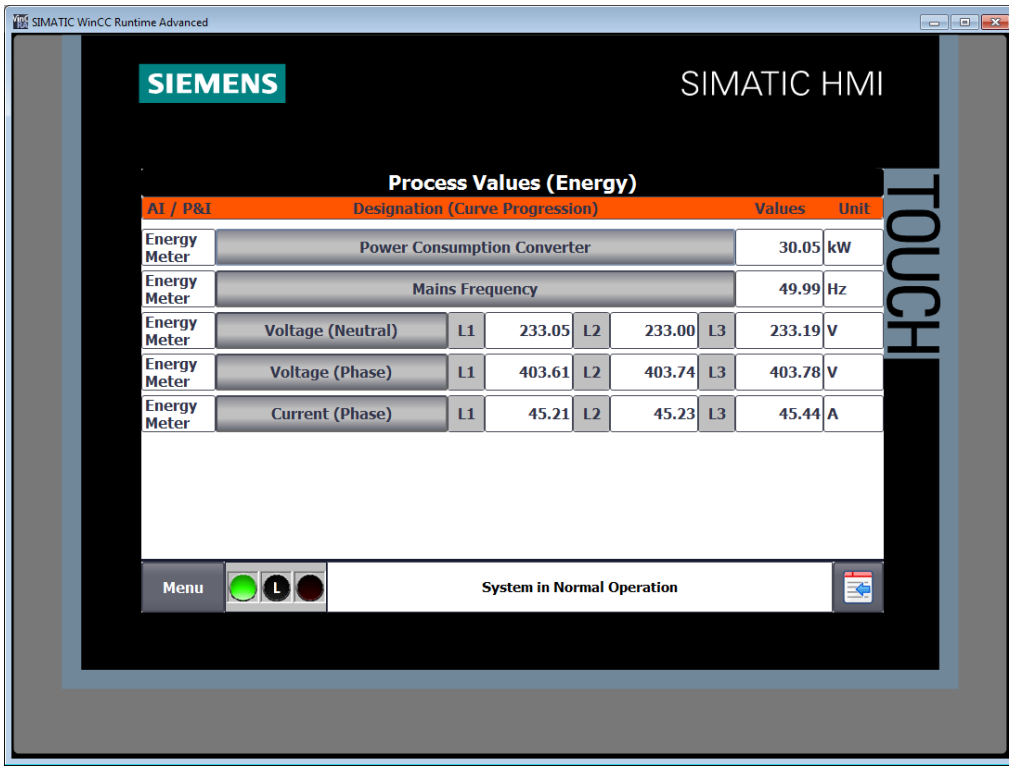


Press the Process Values field to access the curve progression graph (Screen 05.03).

Ozone Concentration in Gas (optional)	0…X g/Nm³
Feed Gas Dew Point (optional)	-100…20 °C
Process Analyzer Value (system specific depending on control mode)	0…X (ppm, g/Nm³/h, mV)

8.21 Process Values 3 (Energy) (Screen 05.02)

Display of the current enery values

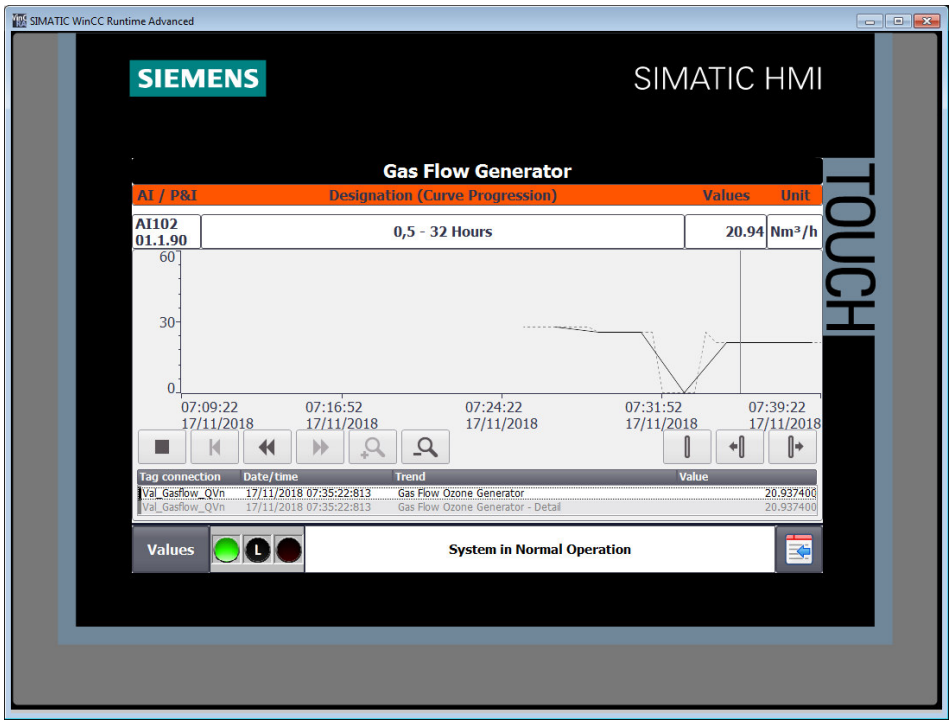


Press the Process Values field to access the curve progression graph (Screen 05.03).

Power Consumption Converter	0…X kW
Mains Frequency	0…X Hz
Voltage (Neutral)	L1-N: 0…X V L2-N: 0…X V L3-N: 0…X V
Voltage (Phase)	L1-L2: 0…X V L2-L3: 0…X V L3-L1: 0…X V
Current (Phase)	L1: 0…X A L2: 0…X A L3: 0…X A

8.22 Curve Progression Graph (Bild 05.03)

Display of the curve progression of meassured values.



Display of the current process values with PLC address and P&ID number.

The curve progression graph shows the process values over a period of 0.5 - 32 h.
The recording of the measured values can be stopped and started via the buttons.
The resolution of the graphic can be increased and reduced.
Detailed process values with time stamp can be taken from the diagram using the ruler function.

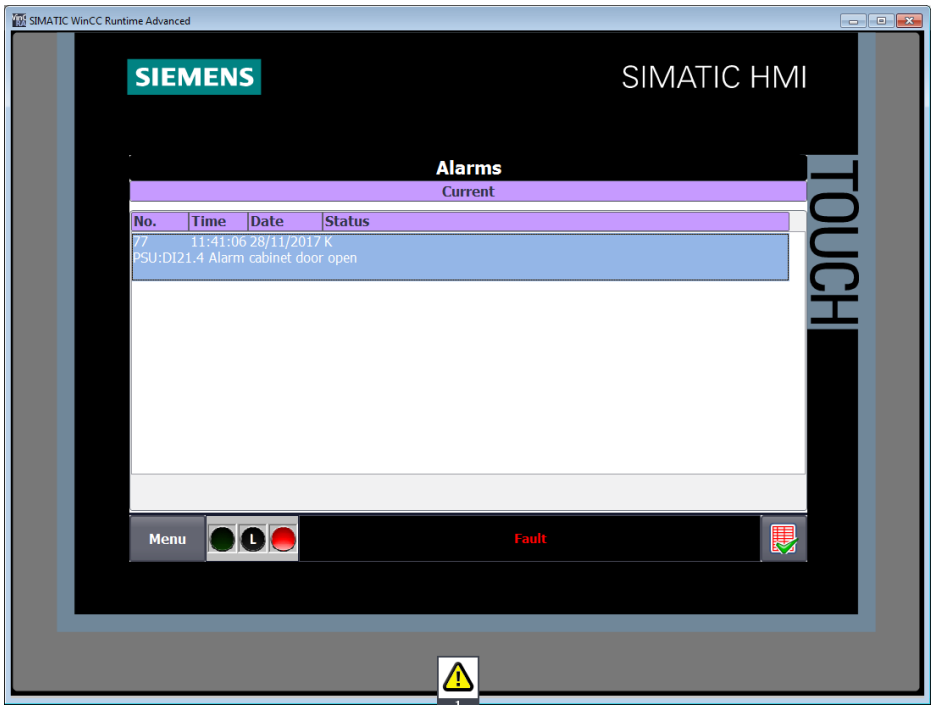
------- line: corresponds to 32h with a 2 min acquisition interval

- - - - line: corresponds to 8h with a 30 sec acquisition interval

8.23 Alarms [Current] (Screen 06.00)

Display of the current fault messages incl. acknowledgment button.

Every HMI screen containing the message line allows accessing this screen by pressing on the bottom right push button.



Fault messages are diplayed including PLC address, date, and status.

Status K:	Fault message appears. Fault is present.
Status (K)Q:	After successful remedy of the fault, the fault message has been acknowledged
Status (KQ)G:	Fault message has successfully been acknowledged. The fault has been rectified

Press the acknowledgment button to acknowledge current alarms.

Signalization of a fault message. The push button will appear in every HMI screen.
By pressing the push button, a pop up window will open automatically showing the currently present fault messages.

Pop up window:

The pop up window can be closed by pressing x in the top right corner of the pop up window.

8.24 Alarms [Buffer] (Screen 06.01)

Display of long term Alarms buffer.

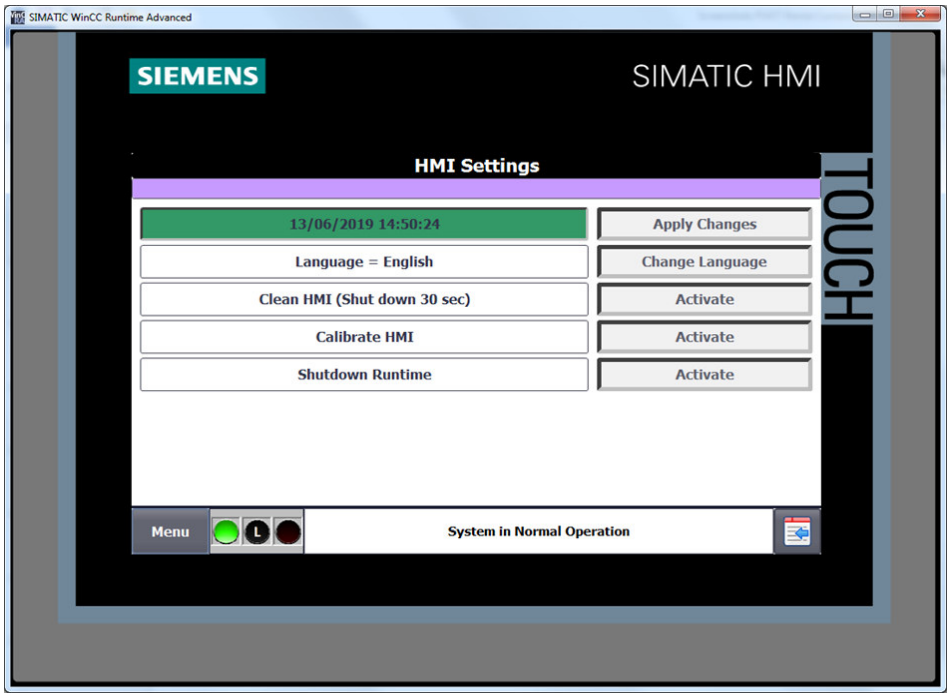
Fault messages are always displayed in clear text including PLC address. All messages are provided with a time stamp.

Press the Delete button to delete the messages from the buffer.
Password required!

- The buffer is a circular archive. When the maximum capacity is reached, the oldest messages are automatically deleted from the buffer.

8.25 HMI Settings (Screen 06.02)

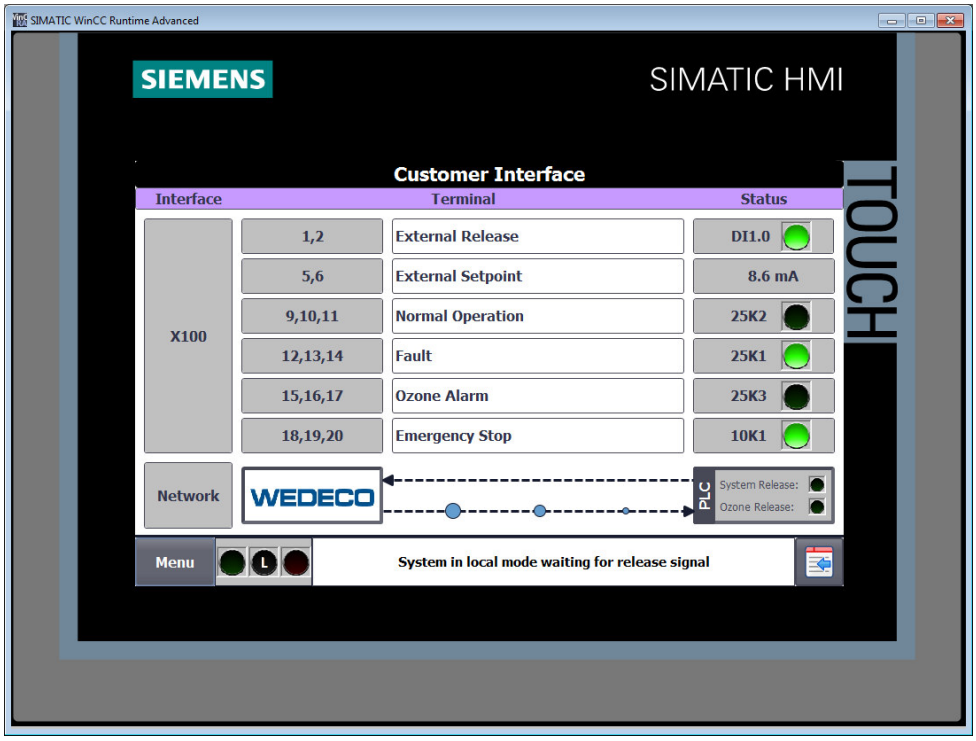
Touch panel settings of functions and parameters.



Date / Time	Date and Time synchronization with control
Change Language	Available languages: German, English, Italian, French, Spanish and Chinese
Clean HMI (Shut down 30sec)	The Runtime of the HMI is stopped for 30 sec. allowing cleaning of the screen.
Calibrate HMI	Calibrating the touch panel.
Shutdown Runtime	The Runtime system of the HMI will be shut down and the operating system of the HMI will be accessed.

8.26 X100 Customer Interface (Screen 06.03)

Visualization of the Customer Interface including Interface, Terminal, and Status (relay).



Interface X100

Name	Terminal	Status (Relay)	Information
External Release	1,2	DI1.0	External release signal of the system.
External Setpoint	5,6	4…20 mA	External setpoint for controlling the system
Normal Operation	9,10,11	25K2	Display of the system status, as per indicator light.
Fault	12,13,14	25K1	Display of the fault status, as per indicator light
Ozone Alarm	15,16,17	25K3	Display if an ozone alarm is initiated.
Emergency Stop	18,19,20	10K1	Status display of the emergency stop relay

Interface Network (option)

The network interface is visualized.

blue	communication bit (heartbeat) by the Wedeco system
green	communication bit from the higher-level controller to the Wedeco system (5s true / 5s false)

This provides a simple visualization whether the communication connection exists.

Addionally it can be checked if the network signals system release, as well as the ozone release (converter ON / OFF) is sent to the Wedeco system.

9 Troubleshooting

This section describes possible causes of a fault occurring during operation of the system and possible measures how to rectify the fault.

9.1 Safety Instructions

WARNING!

Risk of accident due to not sufficiently qualified personnel!

Danger to life or serious injury may result.

- Troubleshooting may only be carried out by authorized personnel.
- Work on live components may only be carried out by electrically qualified persons or by specially instructed personnel under the supervision of an electrically qualified person.

WARNING!

Risk of accident due to removed and deactivated protective devices!

Danger to life or serious injury may result.

- Some work may require temporary removal or deactivation of protective devices.
- Re-install and re-activate all removed protective devices immediately after completion of the troubleshooting work.

WARNING!

Ozone-containing gas in system components and pipes!

Hazard of toxic effects and breathing difficulties.

Fire hazard (strongly oxidizing).

- Prior to opening ozone-containing System Components, purge the system until no more ozone can be detected, however at least 4 hours with nominal gas flow.
- Work in which the ozone generator must be opened may only be carried out by qualified persons.

- Ensure sufficient room ventilation.
- Do not smoke and avoid open flames.
- It is essential to follow the guidelines for handling ozone. *Refer to section Safety.*

WARNING!

Escaping oxygen!

Fire hazard (strongly oxidizing)

- Ensure sufficient room ventilation.
- Do not smoke and avoid open flames.
- It is essential to follow the guidelines for handling oxygen. *Refer to section Safety.*

9.2 Fault Rectification

The system is equipped with a control unit generating the fault messages. These messages allow the user to localize non-complex faults and promptly rectify them.

Proceed as follows:

- Prior to starting any work on ozone generating components, electrically discharge them in a safe manner.
- Prior to troubleshooting on the system, disconnect the power cable from the power supply and wait 30 minutes before starting any troubleshooting work.

In the event of a fault message, the ozone production is stopped.

- Read the fault message displayed on the HMI.
- Rectify non-complex faults promptly.
- Prior to fixing more complex faults, read the pertaining technical documents.
- After fixing the fault, acknowledge the fault message by means of the system switch or the pushbutton on the HMI. *Refer to Chapter Alarms / Events (Current).*

- Re-start the converter (the ozone production). *Refer to Chapter Switching on the system, Starting and Stopping the Ozone Production.*

9.3 Messages

The message line can show the following messages.

Message	Description
Fault	At least one fault is present. The system cannot be operated.
System in local mode waiting for release signal	No fault is present. The system can be started locally via system switch (Reset - 0 – I).
System in remote control waiting for release signal	No fault is present, the system switch (Reset - 0 – I) is in position I: the system can be started from remote.
Reset Fault	The fault message acknowledgment function is activated.
Automatic Restart in progress	The ozone system is restarting automatically after detecting a voltage drop (optional).
System not ready for operation. At least one device not in Automatic Mode	The system cannot be started because at least one device assigned to the system is not in Automatic Mode. Check the devices / peripheral settings
System not ready for operation. Remote mode selected and system switch not in position I	The converter (ozone production) cannot be started externally because an external operating mode has been selected but the system switch is not in position (I).
Converter waiting for release signal Manual purging in progress	The system has started. The converter (ozone production) is not released via HMI. The system is in Manual purging process
Converter Fault: Gas flow still active	A converter fault is present. No ozone can be produced. The gas flow is active to purge the system ozone free (optional).-
System in Stand-by	Start Step Chain: 1 The Start step chain has been initialized. The system starts automatically
Start Air Preparation System	Start Step Chain: 2 (optional): Start signal for air preparation.
System waiting for feed gas pressure	Start Step Chain: 3: System is waiting until feed pressure is above start level.
System waiting for feed gas purity	Start Step Chain: 4 (optional): System is waiting until feed gas concentration is above the starting level. Gas is discharged via purge valve.

Message	Description
System waiting for feed gas dew point	Start Step Chain: 5 (optional): System is waiting until the feed gas dew point is above start level. Gas is discharged via purge valve.
System waiting for generator pressure	Start Step Chain: 6 The system opens and closes the gas inlet valve at short intervals to build up the generator pressure. (After the system has been switched on for the first time or after a fault in the safety chain, the system carries out the process: pressure build-up generator.)
Start Step 7	Start Step Chain: 7 (spare):
Start Injection System	Start Step Chain 8 (optional) Injection system is started.
Step_on_9	Start Step Chain: 9
Start Gas Flow	Start Step Chain: 10 Opening the gas inlet valve and release to PID controller.
Start Ozone Destruct	Start Step Chain: 11 (optional): Residual Ozone Destructor is started.
Start Converter (Ozone Production)	Start Step Chain: 12 Converter is started. Start of ozone production.
Start Cooling Water System	Start Step Chain: 13 (optional): Cooling water system is started.
Start Step 14	Start Step Chain: 14 (spare):
System in Normal Operation	Start Step Chain: 15: Start Step Chain completed. The system is in normal operation.
Stop Step 1	Stop Step Chain:1
Stop Ozone System	Stop Step Chain: 2: Stop sequence has been initialized, the system stops automatically
Stop Step 3	Stop Step Chain: 3 (spare):
Stop Converter (Ozone Production)	Stop Step Chain: 4: Converter is shut down. Ozone production is stopped.
Stop Step 5	Stop Step Chain: 5 (spare):
Stop Step 6	Stop Step Chain: 6 (spare):
Purge Ozone Generator with Gas: xx sec	Stop Step Chain: 7: Ozone generator is purged with gas at X% of maximum gas flow for X sec. The remaining purging time is displayed.

Message	Description
Stop Gas Flow	Stop Step Chain: 8: Stop the gas flow control and close the gas inlet valve with a time delay.
Stop Step 9	Stop Step Chain: 9 (spare):
Stop Injection System	Stop Step Chain: 10 (optional): Injection system is stopped.
Stop Step 11	Stop Step Chain: 11 (spare):
Stop Air Preparation System	Stop Step Chain: 12 (optional): Air preparation is stopped with turn-off delay.
Stop Cooling Water System	Stop Step Chain: 13 (optional): Cooling water system is stopped with turn-off delay
Stop Ozone Destruct	Stop Step Chain: 14 (optional): Ozone destructor is stopped with turn-off delay
Stop Step 15	Stop Step Chain:15: (spare)-

9.4 Fault Messages

In the event of an alarm, a pop-up window opens automatically in every HMI screen. The window shows current alarms in clear text including PLC address. The pop-up window closes by pressing “X”.

Message No.	Message shown on the display	Description / Possible Cause	Countermeasures
3	SYS:DI0.2 Alarm line monitor	Fuse mains voltage defective. Rotating field not connected correctly. Symmetry fault > +/- 10%. Overload fuse activated. Short circuit in line monitor.	Check mains fuse. Check rotating field. Check symmetry of current supply. Check fuses.
4	SYS:DI0.3 Alarm cooling water temperature generator high	Water temperature >50°C downstream ozone generator.	Check cooling water supply Check cooling water temperature. Check cables and connections. De-aerate cooling water line.
5	SYS:DI0.4 Alarm emergency stop activated	Emergency Stop activated. Cable break.	Investigate cause and rectify. Unlatch Emergency Stop. Acknowledge by turning the system switch twice to R (RESET function). Check cables and connections.
6	SYS:DI0.5 Alarm cabinet temperature high	Cabinet temperature too high. Cable break. Ambient temperature too high.	Check cabinet temperature. Check temperature sensor. Check cables and connections. Check function of cooling unit.

Message No.	Message shown on the display	Description / Possible Cause	Countermeasures
7	SYS:DI0.6 Alarm ozone ambient air sensor	Ozone concentration in ambient air too high. Ambient air sensor defective. Sensor not in measuring operation. Sensor in warm-up operation. Sensor close to end of lifetime (check sensor) Sensor has reached the end of lifetime (change sensor)	Search for leakage and rectify. Calibrate ambient air sensor. Replace, if necessary. *Refer to manufacturer's manual*.
8	SYS:DI0.7 Alarm feed gas pressure high	Inlet pressure too high. Incorrect wiring. Cable break.	Pressure reducer defective or set incorrectly. Acknowledge pressure switch. Check cables and connectionss.
10	SYS:DI1.1 Alarm cooling water flow generator low	Insufficient cooling water supply. Cooling water supply / discharge not ensured. Cable break. Incorrect wiring. Air accumulation in cooling water line. Flow meter not parameterized	Check settings of flow monitor. *Refer to manufacturer's manual*. Check for blockage of cooling water side of ozone generator. Check cables and connections De-aerate cooling water line. Parameterize the flow meter
11	SYS:DI1.2 Alarm fault power supply 24V	PSU 24V internal fault message. Automatic circuit breaker upstream mains unit triggered. Decrease at the power supply output too high.	*Refer to manufacturer's manual*. Check cables and connections. Check automatic circuit breaker. Check mains voltage. Measure output current

Message No.	Message shown on the display	Description / Possible Cause	Countermeasures
12	SYS:DI1.3 Alarm overload PSU	Current consumption too high. Incorrect limit value. Motor protective circuit breaker defective.	Check input voltage. Check limit value. Check motor protective circuit breaker. Contact regional Wedeco Service. *Refer to Chapter Contact Addresses.*
13	SYS:DI1.4 Alarm overload PSU / Overload air condition	Current consumption too high. Incorrect limit value. Motor protective circuit breaker defective. Overload Rittal air condition units. Eco mode activated on the Rittal air-condition unit.	Check input voltage. Check limit value. Check motor protective circuit breaker. Check air condition. Activate Eco mode on the Rittal air-condition unit, *refer to manufacturer manual*. Contact regional Wedeco customer service. *Refer to Chapter Contact Addresses.*
14	SYS:DI1.5 Alarm fault external auxiliary	Fault message from external auxiliary. Cable break. Incorrect wiring.	Check cables and connections. *Refer to manufacturer's manual*.

Message No.	Message shown on the display	Description / Possible Cause	Countermeasures
15	SYS:DI1.6 Alarm cooling water flow PSU low	Insufficient cooling water supply. Cooling water supply / discharge not ensured. Cable break. Incorrect wiring. Air accumulation in cooling water line. Cooling water circuit dirty/blocked	Check settings of flow monitor. *Refer to manufacturer's manual*. Check position of ball valves and hand butterfly valves. Check for blockage of cooling water side of ozone generator. Check cables and connections. De-aerate cooling water line. Clean cooling water circuit. Use suitable cooling medium
16	SYS:DI1.7 Alarm fault UPS 24V	Fault message from UPS. Cable break. Incorrect wiring.	Check cables and connections. *Refer to manufacturer's manual*.
17	SYS:DI2.0 Alarm overload surge suppressor	Fault message from overload surge suppressor (overvoltage protection). Cable break. Incorrect wiring.	Check cables and connections. Check input voltage. *Refer to manufacturer's manual*.
18	SYS:DI2.1 Alarm fault cooling water pump	Fault message from frequency inverter cooling water pump. Cable break. Incorrect wiring.	Check cables and connections. Check the fault message on the frequency inverter display, according to the operating instructions of the frequency inverter, *refer to manufacturer's manual.*

Message No.	Message shown on the display	Description / Possible Cause	Countermeasures
19	SYS:DI2.2 Alarm cooling water pressure high / Overload cooling water pump	Overload cooling water pump. Current consumption too high. Incorrect limit value. Motor protective circuit breaker defective. Too high pressure in cooling water system.	Check input voltage. Check limit value. Check motor protective circuit breaker Reduce pressure in the system. Check cooling water flow and temperature (by customer), reduce pressure if necessary.
20	SYS:DI2.3 Alarm fault ozone destructor	Main switch at WOD turned to Off. Overload motor protective circuit breaker in WOD cabinet. Heating defective.	Turn main switch of WOD to On. Check input voltage. Check limit value. Check motor protective circuit breaker. Check connections in WOD cabinet. Check resistance of the heating.
21	SYS:DI2.4 Alarm fault air preparation system	Fault message from air preparation system. Cable break. Incorrect wiring.	Check cables and connections. Check input voltage. Check the fault message on the display, take countermeasures according to the operating instructions of the unit, *refer to manufacturer's manual.*

Message No.	Message shown on the display	Description / Possible Cause	Countermeasures
22	SYS:DI2.5 Alarm fault chiller	Fault message from chiller. Cable break. Incorrect wiring.	Check cables and connections. Check input voltage. Check the fault message on the display, take countermeasures according to the operating instructions of the unit, *refer to manufacturer's manual.*
23	SYS:DI2.6 Warning fault nitrogen boost compressor	Fault message from compressor. Cable break. Incorrect wiring.	Check cables and connections. Check input voltage. Check the fault message on the display, take countermeasures according to the operating instructions of the unit, *refer to manufacturer's manual.*
24	SYS:DI2.7 Alarm fault ambient air fan	Fault message from ambient air fan. Cable break. Incorrect wiring.	Check cables and connections. Check input voltage. Check the fault message on the display, take countermeasures according to the operating instructions of the unit, *refer to manufacturer's manual.*

Message No.	Message shown on the display	Description / Possible Cause	Countermeasures
27	SYS:DI3.2 Alarm fault injection pump	Fault message from injection pump. Cable break. Incorrect wiring.	Check cables and connections. Check input voltage. Check the fault message on the display, take countermeasures according to the operating instructions of the unit, *refer to manufacturer's manual.*
28	SYS:DI3.3 Alarm pressure injection system high	Too high suction pressure in injection system. Process water in/outlet blocked. Injector dirty	Check process water pre-filter (provided by customer). Check process water in/outlet. Check injector for dirt. Contact regional Wedeco Service *Refer to Chapter Contact Addresses.*
29	SYS:DI3.4 Alarm gas inlet valve injection system not closed	No control compressed air. Valve activation defective. Valve blocked.	Check control compressed air for pneumatic valves. Check valves. Contact regional Wedeco Service. *Refer to Chapter Contact Addresses.*
30	SYS:DI3.5 Alarm gas inlet valve injection system not open	No control compressed air. Valve activation defective. Valve blocked.	Check control compressed air for pneumatic valves. Check valves. Contact regional Wedeco Service. *Refer to Chapter Contact Addresses.*

Message No.	Message shown on the display	Description / Possible Cause	Countermeasures
31	SYS:DI3.6 Alarm process water valve injection system not closed	No control compressed air. Valve activation defective. Valve blocked.	Check control compressed air for pneumatic valves. Check valves. Contact regional Wedeco Service. *Refer to Chapter Contact Addresses.*
32	SYS:DI3.7 Alarm process water valve injection system not open	No control compressed air. Valve activation defective. Valve blocked.	Check control compressed air for pneumatic valves. Check valves. Contact regional Wedeco Service. *Refer to Chapter Contact Addresses.*
65	PSU:DI20.0 Alarm no operation message from DICON	Door electrical cabinet open. Cable break. Connection plug between cabinets not fixed. 24V supply of Dicon missing. Dicon defective	Close door / check door switch. Check cables and connections. Check 24V DC supply. Contact regional Wedeco Service. *Refer to Chapter Contact Addresses.*
66	PSU:DI20.1 Alarm fault PSU / Vessel	Operating pressure ozone generator. Overload power element Insulation fault on secondary side. Insulation fault in ozone generator. Water in ozone generator. Electronics fault in Dicon. Primary electronic fault. Converter input voltage too low. Step-up transformer defective.	Check ozone generator. Check dew point of the feed gas. Water flowing back from injection system to ozone generator, contact Wedeco Service / Fault rectification only by qualified staff. *Refer to Chapter Contact Addresses.*

Message No.	Message shown on the display	Description / Possible Cause	Countermeasures
67	PSU:DI20.2 Alarm fault DICON	Fault message from Dicon. Cable break. Incorrect wiring. 24V supply of Dicon missing. Primary electronic fault. Converter input voltage too low. Step-up transformer defective.	Check cables and connections. Check the fault message on the display, contact Wedeco Service / Fault rectification only by qualified staff. *Refer to Chapter Contact Addresses.*
68	PSU:DI20.3 Alarm capacitor bank temperature high	Temperature capacitor too high. Ambient temperature too high. Cable break.	Check air cooling. Check chiller. (cleaning) Check cables and connections.
69	PSU:DI20.4 Alarm powerblock temperature high	Power element too warm. Ambient temperature too high. Cable break. Cooling water inlet temperature too high. Scale or dirt deposits. Too low cooling water flow.	Check air cooling. Check chiller. Check cables and connections. Check cooling water temperature. Clean system. Check cooling water flow.
70	PSU:DI20.5 Alarm fault DC circuit	Cabinet door open. Main contactor defective. Rectifier defective. Converter input voltage not OK.	Close door. Check door switch. Check current paths of main contactor. Replace power element PSU, contact Wedeco Service / Fault rectification only by qualified staff. *Refer to Chapter Contact Addresses.*

Message No.	Message shown on the display	Description / Possible Cause	Countermeasures
73	PSU:DI21.0 Alarm cabinet temperature high	Temperature in cabinet too high. Cable break. Ambient temperature too high.	Check cabinet temperature. Check temperature probe. Check function of chiller. *Refer to manufacturer's manual.*
74	PSU:DI21.1 Alarm fault air condition 1	Fault message from air condition. Cable break. Incorrect wiring. Eco mode activated on Rittal air-condition.	Check cables and connections. Check the fault message on the display, take countermeasures according to the operating instructions of the unit, *refer to manufacturer's manual.*
75	PSU:DI21.2 Alarm fault air condition 2	Fault message from air condition, Cable break, Incorrect wiring. Eco mode activated on Rittal air-condition.	Check the fault message on the display, take countermeasures according to the operating instructions of the unit, *refer to manufacturer's manual.*
76	PSU:DI21.3 Alarm fault air condition 3	Fault message from air condition, Cable break. Incorrect wiring Eco mode activated on Rittal air-condition.	Check the fault message on the display, take countermeasures according to the operating instructions of the unit, *refer to manufacturer's manual.*
77	PSU:DI21.4 Alarm cabinet door open	Cabinet door open. Cable break.	Close door. Check door switch. Check cables and connections.

Message No.	Message shown on the display	Description / Possible Cause	Countermeasures
78	PSU:DI21.5 Alarm fault power supply 24V	PSU 24V internal fault message. Automatic circuit breaker upstream mains unit triggered.	*Refer to manufacturer's manual.* Check cables and connections. Check automatic circuit breaker. Check mains voltage.
97	Alarm communication fault to Remote-IO SYS	PLC internal fault message. Cable break, Incorrect wiring. 24 V power supply to Remote-IO is missing.	Check cables and connections. Check input voltage. Contact Wedeco Service / Fault rectification only by qualified staff. *Refer to Chapter Contact Addresses.*
98	Alarm communication fault to Remote-IO PSU	PLC internal fault message. Cable break, Incorrect wiring. 24 V power supply to Remote-IO is missing.	Check cables and connections. Check input voltage. Contact Wedeco Service / Fault rectification only by qualified staff. *Refer to Chapter Contact Addresses.*
103	Alarm communication fault to MOCP	Communication problems. Communication processors defective. Cables defective.	Contact regional Wedeco Service. *Refer to Chapter Contact Addresses.*
104	Alarm shutdown by MOCP	Fault message from main control.	Investigate customer problem and rectify. Acknowledge fault.

Message No.	Message shown on the display	Description / Possible Cause	Countermeasures
105	Warning ozone ambient air sensor lifetime critical - Replace sensor	Lifetime of the ambient air sensor has elapsed. Sensor must be replaced to ensure system operation.	Order and replace new sensor. Time to exchange approx. 4 weeks Check the error message on the display and take countermeasures in accordance with the operating instructions of the unit. *Refer to manufacturer's manual.*
109	Warning feed gas dew point out of range - Replace sensor	Dew point sensor defective.	Order and replace new sensor.
113	Warning setpoint corrected due to limits.	The calculated setpoints are not within tolerance. The system corrects to min / max setpoints.	Check Required Ozone Mass setting. Change setpoint, if necessary, to operate the system with more reasonable setpoints.
117	Warning dose trim out of range. Check settings	The trim frunction has reached its min / max correction value and does not operate within operation range.	Check Dose setpoint. Change Dose setpoint, if necessary, to operate the system with more reasonable setpoints.
121	Warning fault heater element ozone destructor	Overload of heater elements. Current relay energized.	Contact regional Wedeco Service. *Refer to Chapter Contact Addresses.*
129	SYS:AI100 Alarm signal fault ozone concentration ambient air	Signal < 4 mA or signal > 20 mA. Cable breakage. Measuring device or transducer input to PLC defective.	Calibrate ambient air sensor. Replace, if necessary. Check cables and connections.

Message No.	Message shown on the display	Description / Possible Cause	Countermeasures
130	SYS:AI102 Alarm signal fault gas flow generator	Signal < 4 mA or signal > 20 mA. Cable breakage. Measuring device or transducer input PLC defective.	Check signal. Check flow meter. Check cables and connections.
131	SYS:AI104 Alarm signal fault external setpoint	Signal < 4 mA or signal > 20 mA. Cable breakage. Measuring device or transducer input PLC defective.	Check signal. Check signal output at the customer. Check cables and connections.
132	SYS:AI106 Alarm signal fault temperature cooling water generator	Signal < 4 mA or signal > 20 mA. Cable breakage. Measuring device or transducer input PLC defective.	Replace sensor. Check signal. Check cables and connections.
133	SYS:AI108 Alarm signal fault feed gas pressure	Signal < 4 mA or signal > 20 mA. Cable breakage. Measuring device or transducer input PLC defective.	Replace sensor. Check signal. Check cables and connections.
134	SYS:AI110 Alarm signal fault ozone concentration in gas	Signal < 4 mA or signal > 20 mA. Cable breakage. Measuring device or transducer input PLC defective.	Calibrate sensor, replace, if necessary. Check signal. Check cables and connections.
135	SYS:AI112 Alarm signal fault feed gas dew point	Signal < 4 mA or signal > 20 mA. Cable breakage. Measuring device or transducer input PLC defective.	Calibrate sensor, replace, if necessary. Check signal. Check cables and connections.

Message No.	Message shown on the display	Description / Possible Cause	Countermeasures
136	SYS:AI114 Alarm signal fault process analyzer	Signal < 4 mA or signal > 20 mA. Cable breakage. Measuring device or transducer input PLC defective.	Check signal. Check cables and connections.
137	SYS:AI116 Alarm signal fault oxygen concentration ambient air	Signal < 4 mA or signal > 20 mA. Cable breakage. Measuring device or transducer input to PLC defective.	Calibrate ambient air sensor. Replace, if necessary. Check signal Check cables and connections.
138	SYS:AI118 Alarm signal fault gas flow line 1	Signal < 4 mA or signal > 20 mA. Cable breakage. Measuring device or transducer input PLC defective.	Replace sensor. Check signal. Check cables and connections.
139	SYS:AI120 Alarm signal fault gas flow line 2	Signal < 4 mA or signal > 20 mA. Cable breakage. Measuring device or transducer input PLC defective.	Replace sensor. Check signal. Check cables and connections.
145	PSU:AI200 Alarm signal fault temperature step-up transformer primary coil	Resistance signal PT100 not correct. Cable breakage. Measuring device or transducer input PLC defective.	Replace sensor. Check signal. Check cables and connections.
146	PSU:AI202 Alarm signal fault temperature step-up transformer ferrite core	Resistance signal PT100 not correct. Cable breakage. Measuring device or transducer input PLC defective.	Check signal. Check cables and connections.

Message No.	Message shown on the display	Description / Possible Cause	Countermeasures
161	SYS:AI100 Alarm ozone concentration ambient air high	Ozone concentration in ambient air too high. Ambient air sensor defective.	Search for leakage and rectify. Calibrate ambient air sensor. Replace, if necessary.
162	SYS:AI100 Warning ozone concentration ambient air high	Ozone concentration in ambient air too high.	Search for leakage and rectify. Calibrate ambient air sensor. Replace, if necessary.
167	SYS:AI102 Warning gas flow inlet generator low	Gas flow volume too low. Measuring device defective.	Check gas flow volume. Check manual valve setting. Check gas supply. Check introduction system: back pressure too high? Check pressure reducer.
168	SYS:AI102 Alarm gas flow inlet generator low	Gas flow volume too low. Measuring device defective.	Check gas flow volume. Check manual valve setting. Check gas supply. Check introduction system: back pressure too high? Check pressure reducer.
173	SYS:AI106 Alarm temperature cooling water generator high	Water temperature >45°C downstream ozone generator.	Check cooling water supply. Check cooling water inlet temperature.
174	SYS:AI106 Warning temperature cooling water generator high	Water temperature >40°C downstream ozone generator.	Check cooling water supply. Check cooling water inlet temperature.

Message No.	Message shown on the display	Description / Possible Cause	Countermeasures
177	SYS:AI108 Alarm feed gas pressure high	Inlet pressure too high.	Pressure reducer defective or incorrectly set. Acknowledge pressure switch.
178	SYS:AI108 Warning feed gas pressure high	Inlet pressure too high.	Pressure reducer defective or incorrectly set.
179	SYS:AI108 Warning feed gas pressure low	Inlet pressure too low.	Check valve setting. Check gas supply.
180	SYS:AI108 Alarm feed gas pressure low	Inlet pressure too low.	Check valve setting. Check gas supply.
185	SYS:AI112 Alarm feed gas dew point high	Feed gas has bad dew point quality > -50°C. Start-up time dryer / compressor.	Check feed gas. Check gas supply lines. Check sensor. Replace, if necessary. Check dryer / compressor.
186	SYS:AI112 Warning feed gas dew point high	Feed gas has bad dew point quality > -55°C. Start-up time dryer / compressor.	Check feed gas. Check gas supply lines. Check sensor. Replace, if necessary. Check dryer / compressor.
189	SYS:AI114 Alarm process analyzer value high	Process value of the feedback variable too high	Check settings
190	SYS:AI114 Warning process analyzer value high	Process value of the feedback variable too high	Check settings

Message No.	Message shown on the display	Description / Possible Cause	Countermeasures
191	SYS:AI114 Warning process analyzer value low	Process value of the feedback variable too low	Check settings
192	SYS:AI114 Alarm process analyzer value low	Process value of the feedback variable too low	Check settings
193	SYS:AI116 Alarm oxygen concentration ambient air high	Oxygen concentration in ambient air too high. Ambient air sensor defective.	Search for leakage and rectify. Calibrate ambient air sensor. Replace, if necessary.
194	SYS:AI116 Warning oxygen concentration ambient air high	Oxygen concentration in ambient air too high. Ambient air sensor defective.	Search for leakage and rectify. Calibrate ambient air sensor. Replace, if necessary.
195	SYS:AI116 Warning oxygen concentration ambient air low	Oxygen concentration in ambient air too low. Ambient air sensor defective.	Ventilate room. Check air preparation system (optional). Calibrate ambient air sensor. Replace, if necessary.
196	SYS:AI116 Alarm oxygen concentration ambient air low	Oxygen concentration in ambient air too low. Ambient air sensor defective	Ventilate room Check air preparation system (optional) Calibrate ambient air sensor. Replace, if necessary.
199	SYS:AI118 Warning gas flow line 1 low	Gas flow rate too low, Measuring device defective	Check gas flow volume. Check manual valve setting. Check gas supply. Check introduction system: back pressure too high?

Message No.	Message shown on the display	Description / Possible Cause	Countermeasures
200	SYS:AI118 Alarm gas flow line 1 low	Gas flow rate too low, Measuring device defective	Check gas flow volume. Check manual valve setting. Check gas supply. Check introduction system: back pressure too high?
203	SYS:AI120 Warning gas flow line 2 low	Gas flow rate too low, Measuring device defective	Check gas flow volume. Check manual valve setting. Check gas supply. Check introduction system: back pressure too high?
204	SYS:AI120 Alarm gas flow line 2 low	Gas flow rate too low, Measuring device defective	Check gas flow volume. Check manual valve setting. Check gas supply. Check introduction system: back pressure too high?
225	PSU:AI200 Alarm temperature step-up transformer primary coil high	Temperature step-up transformer >120 °C Temperature in control cabinet too high Temperature Ambient too high	Check transformer fan Check function of cooling unit Check cables and connections Check transformer Contact regional Wedeco customer service. *Refer to Chapter Contact Addresses*

Message No.	Message shown on the display	Description / Possible Cause	Countermeasures
226	PSU:AI200 Warning temperature step-up transformer primary coil high	Temperature step-up transformer >120 °C Temperature in control cabinet too high Temperature Ambient too high	Check transformer fan Check function of cooling unit Check transformer Contact regional Wedeco customer service. *Refer to Chapter Contact Addresses*
229	PSU:AI202 Alarm temperature step-up transformer ferrite core high	Temperature step-up transformer >120 °C Temperature in control cabinet too high Temperature Ambient too high	Check transformer fan Check function of cooling unit Check cables and connections Check transformer Contact regional Wedeco customer service. *Refer to Chapter Contact Addresses*
230	PSU:AI202 Warning temperature step-up transformer ferrite core high	Temperature step-up transformer >120 °C Temperature in control cabinet too high Temperature Ambient too high	Check transformer fan Check function of cooling unit Check transformer Contact regional Wedeco customer service. *Refer to Chapter Contact Addresses*

- If the alarm message occurs again after restarting the ozone system, contact your regional Wedeco Service. *Refer to Chapter Contact Addresses.*

10 Cleaning

This section describes the precautions, the requirements for the personnel and how to proceed with regard to cleaning the ozone system.

10.1 Safety

10.1.1 Safety Instructions

DANGER!

Live components!

Danger to life due to electric shock.

- Do not use water for cleaning live components.
- Do not spray rooms housing ozone generating systems with water.

DANGER!

Live components!

Danger to life due to electric shock.

After switching off the system, it may have stored energy.

- Set the main switch to **0/OFF**.
- Disconnect the power cable from the power supply.
- Secure the system against unintended restart.
- Wait 30 minutes prior to opening the system.

WARNING!

Ozone-containing gas in system components and pipes!

Hazard of toxic effects and breathing difficulties.

Fire hazard (strongly oxidizing).

- Prior to opening ozone-containing System Components, purge the system until no more ozone can be detected, however at least 4 hours with nominal gas flow.
- Work in which the ozone generator must be opened may only be carried out by qualified persons.

- Ensure sufficient room ventilation.
- Do not smoke and avoid open flames.
- It is essential to follow the guidelines for handling ozone. *Refer to section Safety.*

WARNING!

Escaping oxygen!

Fire hazard (strongly oxidizing)

- Ensure sufficient room ventilation.
- Do not smoke and avoid open flames.
- It is essential to follow the guidelines for handling oxygen. *Refer to section Safety.*

NOTICE!

Dust on circuit boards and electrical components!

Malfunctions and short circuits may occur..

- Use a vacuum cleaner for cleaning the system
- Avoid using compressed air to clean the system. Dust particles would get on the circuit boards leading to malfunctions and short circuits.

10.1.2 Personal Protective Equipment

In order to prevent injuries, wear the following protective equipment during cleaning work:

Ear protection

Safety gloves

10.2 Requirements for the Cleaning Personnel

The ozone system may be cleaned by instructed persons (*refer to Chapter Classification of Operating Staff*) only.

Work on live components may only be carried out by persons who

- are qualified electricians or electrically instructed personnel under the supervision of an electrically qualified person according to the applicable rules of electrical engineering only.
- are electrically instructed and under the supervision of an electrically qualified person.
- have read and understood this manual.

10.3 Requirements for Safe Cleaning

- When using cleaning agents, abide by the instructions indicated on the packing.
- Avoid skin and eye contact with chemicals.
- Do not use water to clean live components.

10.4 Cleaning the Ozone System

Cleaning the system is divided into two categories:

- Cleaning during operation
- Cleaning with the system switched off

- Do not reach into the running system.
- Clean parts inside the system with the system disconnected from power supply only.

10.4.1 Cleaning during Operation

Keep the system always clean during operation. Only a clean ozone system guarantees proper operation:

- Keep the exterior of the system clean (do not open the system).
- Keep the floor clean.
- Avoid tools, packing material, chemicals etc. lying around.

10.4.2 Cleaning with the System Disconnected form Power Supply

Preparation	• Ensure the system is isolated from the power supply. • Secure the system against unintended restart. • Close all openings to prevent cleaning agent from ingressing into the system. • Cover all system components which are not allowed to contact cleaning agent.
Cleaning	• Use a lint free cloth moistened with alcohol or a soft brush. • Use a vacuum cleaner to remove dust. • Do not remove any safety devices when cleaning the system.
After cleaning	• Check all cables for loose connections and damage. • If necessary, retighten loose connections. • Remove the protective covers or lockings from the openings previously covered for cleaning purposes.

11 Maintenance

This section describes the precautions, the requirements for the personnel and how to proceed with regard to maintenance work on the ozone system.

In order to ensure a long lifetime and low wear of the ozone system, regular maintenance is required.

We recommend concluding a maintenance and inspection agreement based on maintenance "on demand" and annual inspection of the ozone system.

- The ozone systems of the SMOevo^{PLUS} series (except for SMOevo^{PLUS} 410) are subject to the German Ordinance on Industrial Safety and Health (BetrSichV).
  The owner / operator of the ozone system is obliged to have a “periodic test” carried out for the container by an approved accreditation body (zugelassene Über-wachungsstelle, ZÜS) 5 years after commissioning the system.
  If the periodic test does not detect any defects, the test time for the ozone generator can be extended to 10 years (Ordinance on Industrial Safety and Health (BetrSichV), appendix 5, article 8, pressure equipment with additional installations)
- The pipe work must also be classified in accordance with BetrSichV and, if necessary, inspected periodically.

11.1 Safety Instructions

DANGER!

Live components!

Danger to life due to electric shock.

After switching off the system, it may have stored energy.

- Set the main switch to **0/OFF**.
- Switch off all external voltages.
- Check the system for absence of voltage.
- Secure the system and its components against unintentional restart.
- When working on the ozone generator or step-up transformer, make sure that the secondary connections are grounded in accordance with local regulations.

WARNING!

Risk of accident due to not sufficiently qualified personnel!

Danger to life or serious injury may result.

- Work on live components may only be carried out by electrically qualified persons or by specially instructed personnel under the supervision of an electrically qualified person.

WARNING!

Ozone-containing gas in system components and pipes!

Hazard of toxic effects and breathing difficulties.

Fire hazard (strongly oxidizing).

- Prior to opening ozone-containing System Components, purge the system until no more ozone can be detected, however at least 4 hours with nominal gas flow.
- Work in which the ozone generator must be opened may only be carried out by qualified persons.

- Ensure sufficient room ventilation.
- Do not smoke and avoid open flames.
- It is essential to follow the guidelines for handling ozone.
  Refer to section Safety.

WARNING!

Escaping oxygen!

Fire hazard (strongly oxidizing)

- Ensure sufficient room ventilation.
- Do not smoke and avoid open flames.
- It is essential to follow the guidelines for handling oxygen.
  Refer to section Safety.

WARNING!

Storage tanks, piping, and ozone generators are pressurized!

Risk of crushing due to moving parts.

Water hammer due to pressure release.

- Depressurize the complete ozone system prior to starting any maintenance or repair work on the equipment.

CAUTION!

Hot surfaces on solenoid valves!

Risk of burns.

- Allow the components to cool before starting any maintenance work.

NOTICE!

Formation of nitric acid due to condensation

Damage to the ozone system

- The ozone generator must cool down to ambient temperature (+/- 3 K) prior to opening.

- If using wrong or substandard spare parts, proper operation of the ozone generating system cannot be guaranteed and voids the warranty!
- Only use spare and wear parts approved by Wedeco.

11.2 Personal Protective Equipment

In order to avoid injuries, wear the following protective equipment during maintenance and repair work:

Ear protection

Safety gloves

11.3 Requirements for Maintenance Staff

Maintenance work on the ozone system may be carried out by qualified persons (*refer to Chapter Classification of Operating Staff*) only.

11.4 Requirements for Safe Maintenance

- Read and observe the instructions in Chapter Cleaning prior to starting any maintenance or repair work.
- Observe the product-related precautions when handling oil, grease and other chemical substances!

Prior to maintenance work

- Purge all lines to remove residual ozone.
- Attach a clearly visible maintenance tag to the ozone system informing about the duration of the maintenance work.
- Ensure the complete ozone system is depressurized.
- Make sure that the main switch is set to **0/Off.**
- Isolate the system from the power supply and disconnect the power cable from the socket. Wait 30 minutes before starting any work.
- Secure the system against unintentional restart.
- Secure all upstream and downstream devices and operating media., e. g. feed gas supply, against unintentional activation.

During maintenance work

- Use slip-resistant climbing aids or working platforms when carrying out work above head-height.
- Never climb up on system components!
- Wear safety harnesses when performing maintenance work at heights!
- Replace the specified wear and safety parts in the event of damage.
- If the system must be started during maintenance work (test run), the responsible personnel must ensure that no persons or objects are within the hazardous area.

After maintenance work

- Check all loosened screw connections for tightness and retighten, if necessary.
- Check all gas lines for leakages.
- Check all protective equipment.
- Carry out a test run of the ozone system.

11.5 Maintenance Schedule

Some maintenance and inspection work is required to be carried out at certain intervals. The following table gives an overview of the relevant intervals and the work to be done.

Maintain an operation and maintenance log.

P&ID No.	Component	What to do	Interval
Complete ozone generating system			
	All components	Checking all components and piping for tightness.	annually
	Piping	Checking for leakages	annually
Assembly: Gas inlet			
01.1.35	Microfilter	Visual inspection	weekly
01.1.40	Pressure reducer	Visual inspection, Adjusting required operating pressure, if necessary. *Refer to Chapter System Description Assembly 01: Gas Inlet.*	weekly
01.1.50	Safety Pressure Switch Combination	Settings check	every 6 months
01.1.70	Flow meter	Visual inspection	monthly
01.1.75	Dew point sensor	Visual inspection of measured dew point (Trend) Sensor replacement	weekly annually
01.1.85, 01.1.90	Solenoid valve Silencer	Visual inspection	annually
01.1.95	Solenoid valve	Visual inspection	every 6 months
	Piping	Visual inspection	weekly
Assembly: Ozone generator			
02.1.10	Ozone generator	Visual inspection	weekly
Assembly: Process gas line			
03.1.10	Pressure gauge	Visual inspection	weekly

P&ID No.	Component	What to do	Interval
03.1.15	Motor control valve with actuator	Visual inspection	monthly
03.1.20	Check valve	Visual inspection	every 6 months
03.1.01	Solenoid valve	Visual inspection	every 6 months
	Piping	Visual inspection	weekly
Assembly: Cooling system			
07.1.15	Flow meter	Visual inspection	every 6 months
07.1.25	Temperature sensor	Visual inspection	every 6 months
07.1.50	Flow meter	Visual inspection	monthly
07.1.55	Solenoid valve	Visual inspection	monthly
	Piping	Visual inspection	weekly
Assembly: Ambient Air Monitoring			
34.1.10	Ozone Sensor	Check Sensor replacement	every 6 months every 6 months 2)
Assembly: Electrical Components / Electrical Cabinet			
	Fan	Visual inspection	weekly
	Filter mat	Filter mat cleaning, replacing filter mats, if necessary	at least every 6 months[1)]
	Electrical components	Checking all connections for tightness.	annually
Assembly: Safety equipment			
	Warning signs, pictographs	Visual inspection	weekly

1) dependent on ambient conditions

2) The ozone sensor includes a self-test. If an earlier sensor change is necessary, this is shown in the display of the instrument ("Check sensor"), *refer to the manual of the manufacturer*.

11.6 Disposing of Components and Materials

Dispose of all the components and materials which have been replaced in a proper and environmentally friendly way.

Observe applicable local regulations.

12 Shutdown and Disposal

This section describes the precautions, the requirements for the personnel and what to do with regard to final shutdown and disposal of the ozone system.

12.1 Safety Instructions

DANGER!

Live components!

Danger to life due to electric shock.

- Make sure that the ozone system is disconnected from all available power supplies and external voltages prior to starting any work on it.

WARNING!

Hazard due to not sufficiently qualified personnel!

Danger to life or serious injury may result.

- Work on electrical system components may only be carried out by electrically qualified persons.

WARNING!

Escaping ozone!

Hazard of toxic effects and breathing difficulties.

Fire hazard (strongly oxidizing).

- Purge all lines to remove the ozone. Extract the off-gas containing ozone to the outside via an effective residual ozone destruction system.
- Ensure sufficient room ventilation.
- Do not smoke and avoid open flames.
- It is essential to follow the guidelines for handling ozone. *Refer to section Safety.*

WARNING!

Escaping oxygen!

Fire hazard (strongly oxidizing)

- Ensure sufficient room ventilation.
- Do not smoke and avoid open flames.
- It is essential to follow the guidelines for handling oxygen. *Refer to section Safety.*

WARNING!

Falling load!

Danger to life or serious injury may result.

- Only use lifting aids and slings permitted to the total weight.
- Never stand under suspended loads.
- Secure the ozone system against tilting.
- Make sure that nobody stands under suspended loads.
- Secure the hazard area against unauthorized access.

WARNING!

Storage tanks, piping and ozone generators are pressurized!

Crushing hazard due to moving parts.

Steam hammer due to pressure release.

- Depressurize the complete ozone system prior to starting any work on the equipment.

12.2 Requirements for the Personnel

Shutdown of the ozone system may be carried out by instructed persons (*refer to Chapter Classification of Operating Staff*) only.

12.3 Temporary System Shutdown

If the ozone system is temporarily to be shut down or if the system is to be employed at another place, proceed as follows:

1. Purge the ozone system with dry oxygen or nitrogen until the lines are free of ozone and an atmospheric dew point of -70°C has been reached.
2. Set the main switch to **0/Off**. Depressurize all the piping and system components.
3. Close the feed gas inlets.
4. Seal the gas lines.
5. Discharge the cooling water.
6. Disconnect the system from the media supply connections. Make sure that no leakages occur when disconnecting the connections.
7. Disconnect all electrical connections from the system. Ensure that loosened cable connections remain with the ozone system.
8. Make sure that there is no way to activate any switches or to confuse any connections.
9. Protect lines and connections from damage during transport and storage.
10. Loosen all fixings located on the wall and floor.
11. Separate the components.
12. Ensure the ozone system is protected from frost.

12.4 Final System Shutdown

If the ozone system is finally to be shut down, proceed as follows:

1. Purge the ozone system with dry oxygen or dry air until the lines are free of ozone.
2. Set the power switch to **0/Off**. Depressurize all the piping and system components.
3. Ensure the external voltage is switched off.
4. Disconnect all electrical connections from the system.
5. Disconnect the system from the media supply connections.
6. Discharge the cooling water of the ozone generator and converter.
7. Loosen all fastening devices on the wall and floor.

12.5 Disposal of Materials

To protect the environment and for your own safety, observe the following instructions:

- Observe all local regulatory requirements regarding the environment.
- Dispose of materials in a safe and environmentally friendly manner.
- Separate materials by material types.

The following table gives an overview of the materials used for the construction of the ozone system.

Materials	Uses in
Galvanized steel	Skids of the ozone system, electrical cabinet, metal sheets in the electrical cabinet
Stainless steel	Ozone generator, piping, electrodes, valves
Copper	Electronic components
Glass	Electrodes, inspection window
Aluminum	Metal sheets in the electrical cabinet, particle filter
PTFE	Seals, hose lines
Synthetic material	Cable sheaths, high voltage duct, electronic components, housing of measuring devices, particle filter, pipe clamps

Take the hazardous waste to a local hazardous waste site.

Against payment, disposal can also be done by the Wedeco Service.

Refer to Chapter Contact Addresses.

13 Appendix

13.1 Confirmation of Briefing

I hereby confirm that I have completely read and understand the manual related to the ozone generating system SMOevo^{PLUS} series.

Surname, First Name	Place, Date	Signature

13.2 Operating Directives

Operating Directives must be issued by the owner / operator of the ozone system. The Directives must be attached well visible for the personnel in the operation room. The following example directive shows the necessary contents.

Example Directive "Handling of Oxygen"

Environment, Safety & Health

Directive

acc. to §14 GefStoffV
(Hazardous Substances Ordinance – German Law)

Company logo

No.:

Issued:

Validity: Range: factory premises

Hazardous substance designation

Oxygen, compressed

Danger to man and environment

Danger

- Oxygen is an oxidizing agent and may cause or intensify fire.
- The gas cylinder contains gas under pressure and may explode if heated.
- May react violently with combustible substances or reducing agents.
- Possible danger of toxic combustion products due to the presence of chlorinated or fluorinated polymers in high pressure (>30 bars) oxygen lines in case of combustion.

Protective measures and behavioral rules

- Refer to in-house trainings on how to handle oxygen / ozone.
- Do not use oil or grease for valves and equipment parts.
- Keep away and segregate from clothes and flammable materials when storing.
- Keep in a well ventilated place.
- Keep away from ignition sources, do not smoke.
- Wear safety gloves cat. 2 4131/EN388.
- Secure compressed air tank against toppling.

Behavior in case of danger | Call: Fire brigade

- Evacuate and block off hazard areas, notify superior.
- Ensure adequate air ventilation.
- Eliminate ignition sources.
- In case of fire, eliminate leak if safe to do so.
- Move away from the tank and cool with water from a protected position.
- Observe alarm, escape, and rescue plans.

First aid | Emergency call:

First aider: refer to overview on the bulletin board or first-aid kit.

For each first aid measure: **Ensure your own safety!**

Remove victim to uncontaminated area and keep the victim calm.

Continuous inhalation: of concentrations higher than 75% may cause nausea, dizziness, respiratory difficulty and convulsion. Provide for fresh air supply.

Contact with skin: Take off contaminated clothing immediately. Observe fire hazard.

Seek medical / ophthalmologic help immediately.

Proper disposal

- discharge to atmosphere in a well ventilated place.
- Do not discharge into any place where its accumulation could be dangerous (basement, canalization)
- Return compressed gas tanks to supplier.

Reference Regulations

		TRGS 900 occupational exposure limit values	M051 Hazardous chemicals

Example Directive "Handling of Ozone"

Environment, Safety & Health

Directive

Company logo

No. 05

Issued:

Validity Range:

Hazardous substance designation

Ozone

Danger to man and environment

Danger

- May cause fire or explosion, strong oxidiser.
- May intensify fire.
- Fatal if inhaled. (Higher ozone contents result in death).
- Suspected of causing cancer.
- Irritation of mucous membranes, deadening of the sense of smell.

Protective measures and behavioral rules

- Do not handle until participating in a special advanced training of safety regulations for ozone/oxygen offered by WEDECO.
- Ozone is identifiable by smelling below the MAC (maximum allowable concentration) safety limit. If a penetrating smell appears, switch off the ozone generator immediately!
- Keep away from heat/sparks/open flames/hot surfaces – No smoking.
- Keep reduction valves free from grease and oil.
- Avoid contact with eyes, skin or clothing.
- Avoid release to the environment.
- Use only in a close loop.

Behavior in case of danger | **Call: Fire brigade**

ozone resistant full mask gas filter: DIN 3181 NO or CO

- On alert from gas detectors: Interrupt ozone production immediately!
- Interrupt oxygen feed.
- Evacuate area.
- Check the venting system for fresh air.
- Enter rooms only with ozone resistant full mask to rescue an injured person or to avert acute danger.

First aid | **Emergency call:**

First aid measures: Only rescue an injured person under self-protection (fully personal protective equipment)

→ **Provide fresh air, keep calm and avoid heat loss.**

→ **Immediately call a Poison Centre or physician!**

If inhaled: → Remove victim to fresh air and keep at rest in a position comfortable for breathing →

→

If in eyes: → Rinse cautiously with water for several minutes. Remove contact lenses, if present. →
Continue rinsing.

If on skin: → Remove/take off immediately all contaminated clothing. Rinse skin with water.

If experiencing respiratory symptoms: → Breathing arrest – give artificial respiration
→ → → Breathlessness – provide oxygen

Proper disposal

→ Residual ozone removal system (catalytic converter)

→ Reference Regulations

Material Safety Data Sheet: Ozone

13.3 Swagelok – Installing Instructions for External Connections

Swagelok Tube Fitting Instructions for 1 in. / 25 mm and Smaller Fittings

Fig. 1

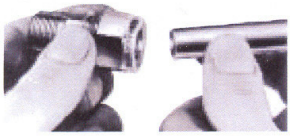
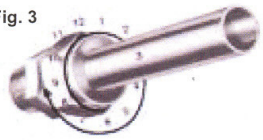


Fig. 2

Fig. 3



Installation Instructions

Note:: These instructions apply to traditional fittings and fittings with the advanced back-ferrule geometry.

1. Insert tubing into the Swagelok tube fitting (Fig. 1).
2. Make sure that the tubing rests firmly on the shoulder of the tube fitting body and that the nut is finger-tight.
3. Scribe the nut at the 6 o'clock position (Fig. 2).
4. While holding fitting body steady, tighten the nut 1 1/4 turns to the 9 o'clock position. (Fig. 3)

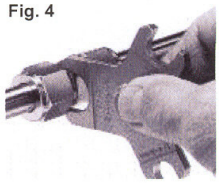
Note: For 1/16, 1/8, and 3/16 in.; 2, 3, and 4 mm tube fittings, tighten the nut 3/4 turn to the 3 o'clock position.

Installation in High-Pressure Applications and High Safety-Factor Systems

1. Insert tubing into the Swagelok tube fitting.
2. Make sure that the tubing rests firmly on the shoulder of the tube fitting body.
3. Due to the variations of tubing diameters, a common starting point is desirable. Therefore, tighten the nut until the tubing will not turn by hand or move axially in the fitting.
4. Scribe the nut at the 6 o'clock position.
5. While holding fitting body steady, tighten the nut 1 1/4 turns to the 9 o'clock position.

Note: For 1/16, 1/8, and 3/16 in.; 2, 3, and 4 mm tube fittings, tighten the nut 3/4 turn to the 3 o'clock position.

Fig. 4



Gaugeability

On initial installation, the Swagelok gap inspection gauge assures the installer or inspector that a fitting has been sufficiently tightened.

Position the Swagelok gap inspection gauge next to the gap between the nut and body.

- If the gauge will not enter the gap, the fitting is sufficiently tightened (Fig. 4).
- If the gauge will enter the gap, additional tightening is required (Fig. 5).

Fig. 5

Fig. 6

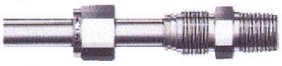


Fig. 7

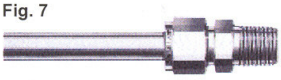


Fig. 8

Reassembly Instructions

You may disassemble and reassemble a Swagelok tube fitting, port connector, cap, and plug many times.

1. Insert tubing with preswaged ferrules into the fitting body until the front ferrule seats (Fig. 6).
2. Rotate the nut with a wrench to the previously pulled-up position; at this point a significant increase in resistance will be encountered.
3. Tighten slightly with a wrench (Fig. 7).

Note: Do not use the gap inspection gauge with reassembled fittings.

13.4 Spare Parts

13.4.1 Disclaimer

Only use original Wedeco spare parts and accessories or spare parts and accessories approved by Wedeco.

We expressly point out that spare parts or accessories not supplied by us have not been tested and approved by us.

Therefore, the installation and/or use of such products may have a negative effect on the specified design characteristics of the system, thus impairing active and/or passive safety characteristics.

Any damage caused by the use of parts other than the original Wedeco spare parts and accessories will void all liability and guarantee obligations on the part of Wedeco.

If in doubt, contact your regional Wedeco Service.

13.4.2 Spare Parts Orders

Place your spare parts order with your regional Wedeco Service.
Refer to Chapter Contact Addresses.

In order to ensure proper and rapid processing of your spare parts order, please have the following data available

- Customer name
- Identification data of the system
- Description of the required spare part
- Required quantity
- Desired type of delivery

Please specify all data completely to ensure rapid and correct handling of your order.

13.5 Allowable Torques for Stainless Steel Bolts

Allowable torques for stainless steel bolts (metric)

Scope:
Ozone systems and piping

Property class:

For bolts W18-8 (A2), by ambient temperature, up to length 8 x nominal thread diameter, but for -50 (the limitation of length is not applicable here):

- 50
- 70 is used by Wedeco
- 80

Coefficient of sliding friction:

μ = 0,10 means very good surface, lubricate
μ = 0,15 means good surface, lubricate or dry
μ = 0,20 means surface black or phosphate, dry

1. Hexagon bolts ISO 4014 A2-70
   With coefficient of sliding friction of μ = 0,15 the following torques arising:

   - M 7 allowable torque 2 Nm 17.7 lbf in
   - M 10 allowable torque 35 Nm 310 lbf in
   - M 12 allowable torque 60 Nm 531 lbf in
   - M 14 allowable torque 94 Nm 832 lbf in
   - M 16 allowable torque 144 Nm 1275 lbf in
   - M 18 allowable torque 199 Nm 1761 lbf in
   - M 20 allowable torque 281 Nm 2487 lbf in
   - M 24 allowable torque 269 Nm 2381 lbf in

2. Studs DIN 938 A2

Because there is no standardized definition for studs, however, we use the studs in the same quality like the hexagon bolts, one can go out from the same allowed torques.

- M 7 allowable torque 2 Nm 17.7 lbf in
- M 10 allowable torque 35 Nm 310 lbf in
- M 12 allowable torque 60 Nm 531 lbf in
- M 14 allowable torque 94 Nm 832 lbf in
- M 16 allowable torque 144 Nm 1275 lbf in
- M 18 allowable torque 199 Nm 1761 lbf in
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