Pierson Process Technology

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Arkwood Pilot System:

System description:
The System will be designed to ozonate 30 to 40 gallons per minute of water from two existing wells, so that the ozone laden water can be returned to the aquifer. The ozonated water ideally will assist in oxidizing PCP as well as freeing PCP existing in the formation for treatment downstream. Typically, direct ozonation reactions selectively target double carbon bonds.

The ozone equipment will be located in an existing building within a silo at the Arkwood site.

The system will include an ozone generator and oxygen concentrator for production of ozone from oxygen feed gas, a mass transfer system for dissolution of the ozone gas into groundwater, an off gas destruct unit for converting any non dissolved ozone back into oxygen, and a control and monitoring system – designed for a manual start of the system, automatic shutdown for key operating parameters, and measuring and recording ozone production, water flow, and ozone residuals.

The ozone system will be designed for an initial capacity of 12 PPD of ozone, which will allow for an ozone dosage of up to 33 mg/l of applied ozone to the groundwater. Should additional ozone capacity be desired in the future, the ozone generator has the capacity to be increased to 16 to 20 PPD ozone by increasing the oxygen flow to the ozone generator(additional mass transfer system modifications would be required to accommodate the additional flows).

Equipment specifications:

<u>Ozone Generator</u>
The ozone generator shall be a corona discharge, water cooled ozone generator, with high efficiency stainless steel/borosilicate glass dielectric assemblies and integrated medium, frequency power supply. The ozone generator shall be a PCI-Wedeco model GSO 50

Capacity: Nominal capacity of 16 PPD ozone @ 10% by wt in oxygen
12 PPD ozone @ 12% by wt. in oxygen
24 PPD ozone @ 6% by wt in oxygen

Dimensions: 36” wide x 19” deep x 64” high

Utilities: Oxygen - 1 scfm oxygen at 25 psig
Cooling water - 3 gpm, potable quality, 68^0F
Power - 460 volt, 3 phase, 5.4 amps

9125692

Connections: Oxygen inlet: ½" FNPT
Ozone Outlet ½" FNPT
Cooling Water Inlet ½" FNPT
Cooling Water Outlet ½" FNPT

Compressor/oxygen concentrator Skid

The compressor/oxygen concentrator skid includes a rotary screw compressor, air receiver, oxygen concentrator, oxygen surge tank, factory skid mounted and pre-plumbed.

The compressor shall be a rotary screw compressor , providing optimum performance, the compressor shall be an Atlas Copco GXC5FF Compressor with integrated of refrigerant dryer, compressed air filters and a 53 gallon air tank .

The oxygen concentrator shall be a twin bed molecular sieve based oxygen concentrator, plc controlled with a capacity of 75 scfh of oxygen at 93% purity or higher. The oxygen concentrator shall be an OGSI model OG-75

The oxygen storage tank shall be an 80 gallon storage tank complete with pressure gauge, relief valve oxygen pressure regulator, and oxygen hoses.

Dimensions: 60" x 84"

Utilities: 460 volts, 3 phase, 12 amps

Mass Transfer Skid

The mass transfer skid consists of a booster pump, venturi injector with flow bypass, contact tank, degassing separator, and off gas relief valve. Instrumentation located on the mass transfer skid shall be a residual ozone analyzer and a totalizing flow meter, both with 4-20 mA outputs to a circular chart recorder.

Dimensions: 48" x 60"

Utilities: 460 volts, 3 phase, 4 amps

Off Gas Destruct Unit

Destruct unit shall be a catalytic type off gas destruct unit with thermal assist. The catalyst shall be Carulite 200, a manganese dioxide/copper oxide catalyst for efficient ozone destruction. Destruct unit shall be rated for 600 scfh. Pre-heater shall be rated at 150 watts.

Utilities: 120 Volts, single phase, 150 watts

Residual ozone analyzer

The residual ozone analyzer shall be designed to continuously monitor ozone residual at the effluent of the mass transfer system. The ozone sensor shall be a direct measuring polarographic sensor utilizing a special polymeric membrane to isolate the sensing electrodes from the sample.

The Dissolve Ozone Monitor shall provide a display of the dissolved ozone concentration directly in PPM on a backlit LCD display. The monitor shall have a range of up to 20 mg/l residual ozone. The monitor shall have a 4-20 mA output and two programmable alarm contacts. The monitor shall be housed on a NEMA 4X fiberglass enclosure.

The dissolved ozone sensor shall be mounted in a gravity fed flow cell with a flow rate of 15 gallons per hour of sample, with discharge to drain.

High Concentration Ozone Analyzer

The high concentration ozone monitor shall be a UV absorption, dual beam photometer with a long life mercury vapor lamp ozone concentration monitor with a microprocessor controlled 254 nm UV light source & photoreceptor, with inlet filtration and flow control. Range of 0-200 g/Nm^3.

System Control Panel

The system control panel shall be designed to start, stop, and shut down the system in the event of alarm conditions. The panel shall be NEMA 4 fiberglass enclosure, and fabricated to UL 508 standards.

The equipment to be controlled by the control panel includes:

- Air Compressor/Oxygen Concentrator skid
- Ozone Generator
- Mass transfer skid
- Off gas destruct unit
- Ambient ozone detector

The control panel will include a main disconnect, emergency stop, and the following panel indicators/operators:

- Panel Indicators(annunciator: Panalarm or Ronan)

  System ON
  Generator On
  Oxygen Concentrator On
  Alarm Lights
  - Low well flow
  - Loss of vacuum
  - Backflow failure
  - Ozone Generator failure
  - Ambient ozone alarm

  (Note: Generator failures indicated on Generator panel will be:
  High water temp, low oxygen flow, power supply fault,
  Power supply high temp)

- Selector switches:

System Start/off	On/Off
Ozone Generator	Hand/off/auto
Oxygen concentrator	Hand/Off/Auto
Mass transfer Skid	Hand/Off/Auto
Off gas destruct	Hand/Off/Auto

Ambient Ozone Detector

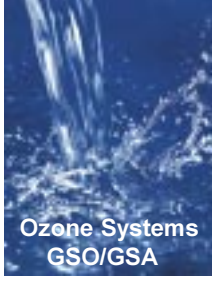
The ambient ozone detector shall be an electrochemical ozone gas sensor that will create a signal proportional to the ozone concentration present, mounted in a fiberglass enclosure. The receiver shall have an LED display to indicate ambient ozone levels in parts per million as well as flashing indicators if adjustable alarm contact set points are exceeded.

O_3 Systems

Effizon® Ozone Generators

Type GSO/GSA

PCI-WEDECO
Environmental Technologies



Ozone Generators for Small and Medium Demand Applications

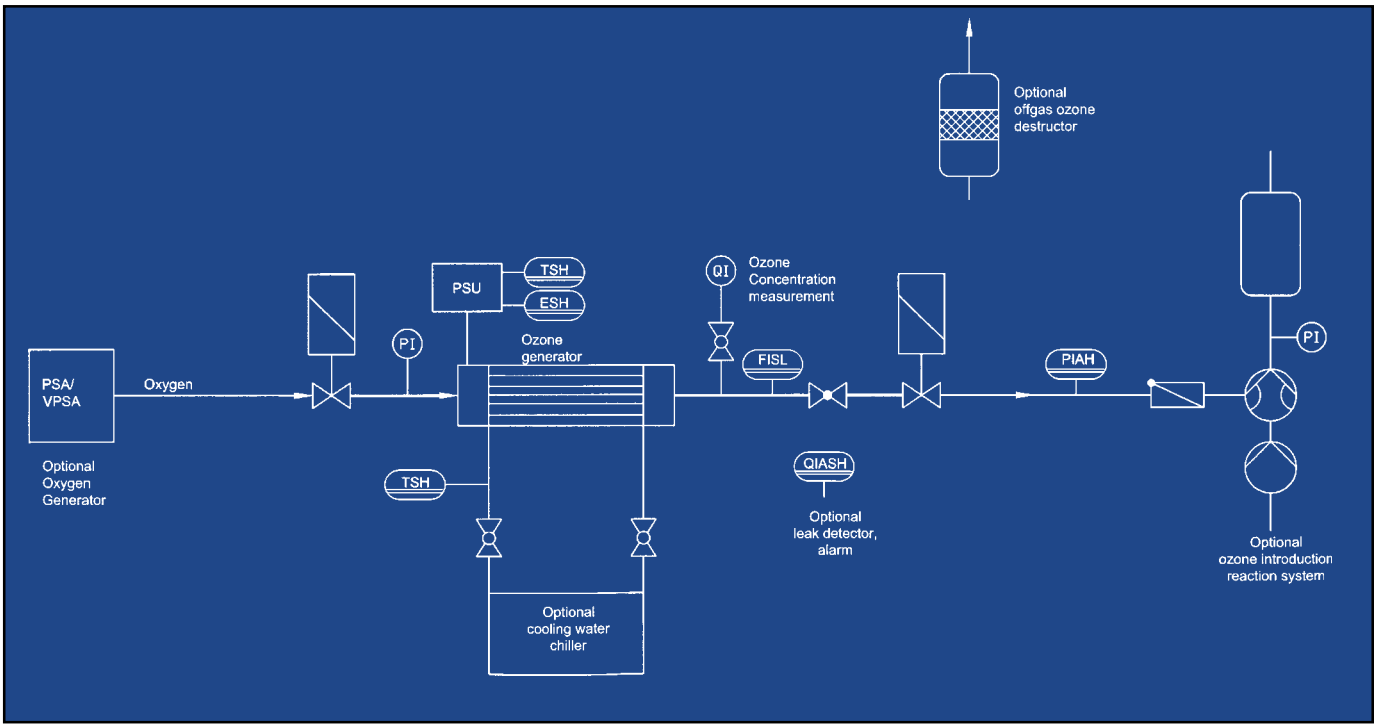
GSO/GSA ozone generators are compact, integrated units delivered fully assembled and ready to produce ozone economically from oxygen or air. Ozone production levels can be adjusted within a broad performance range to suit the application requirements. Critical operating parameters are monitored to ensure a safe reliable operation.

Applications

- Drinking Water
- Process Water
- Cooling Water
- Food & Beverage
- Chemical Oxidation

Advantages

- Features the unmatched reliability of Effizon® dielectric technology
- Reduced energy consumption per unit ozone production
- Drastically reduced oxygen demand due to high ozone production concentrations
- Low capital investment and operating costs
- Ideally suited for industrial, laboratory, and pilot plant applications
- Compact design reduces overall footprint



Technical Data

Model Number	Voltage	Input KW	Cooling Water Flow Rate (gpm)	10% wt. Ozone Output (g/h)	10% wt. Ozone Output (ppd)	Oxygen Flow Rate (scfm)	1.5% wt. Ozone Output (g/h)	1.5% wt. Ozone Output (ppd)	Air Flow Rate (scfm)	Dimensions (inches) W	Dimensions (inches) H	Dimensions (inches) D	Shipping Weight (Lbs.)
GSO/GSA 10	230VAC/1/60	0.58	0.35	20	1.06	0.09	12.4	0.66	0.41	34	32	12	195
GSO/GSA 20	230VAC/1/60	0.58	0.35	40	2.12	0.18	25.0	1.32	0.82	34	32	12	215
GSO/GSA 30	230VAC/1/60	1.10	0.75	77	4.07	0.34	46.0	2.43	1.51	34	32	12	215
GSO/GSA 40	230VAC/1/60	2.20	1.50	165	8.73	0.72	92.0	4.87	3.02	34	32	12	250
GSO/GSA 50	460VAC/3/60	4.30	3.00	320	16.93	1.41	203.0	10.74	6.66	36	63.5	19	640

Rated Ozone Output, 68 Deg. F Cooling Water, 15 psig *g/h = grams per hour +ppd = pounds per day

PCI-WEDECO
Environmental Technologies

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ITT Industries
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EFFIZON® Ozone Generator Series GSO/GSA

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Introduction

1.1 Information for the customer

The basic prerequisite for safe handling and trouble free operation of this system is good knowledge of the fundamental safety instructions. Insure that all personnel working on and with the system observe these operating instructions, particularly the part containing the safety instructions. In addition, observe the accident prevention rules (OSHA) and regulations valid for the place of application.

1.1.1 General

Prior to operating the system and/or performing any conversion or maintenance work, read the respective chapter first; i.e., read the chapter on cleaning, for example, before you start with the cleaning work.

1.1.2 Additional necessary equipment

To be provided by the operator:
The required protection devices, e.g., personal breathing mask, measuring device to monitor the room air, etc., must be provided by the owner/user.

The owner/user of the system must ensure that, in accordance with the local, valid regulations, appropriate escape routes have been provided for the personnel in case of EMERGENCY. The owner/user must ensure that the escape routes are neither obstructed nor their function impaired (e.g., doors opening in the escape route direction).

1.2 Target groups

These operating instructions form an integral part of the delivery scope of the ozone generation system. Insure that the operating instructions are studied in detail, and that the relevant part is fully understood. In all cases, insure that the chapters “Introduction“ to ”Description“ and the chapter “Function“ are read very attentively.

Restrict system operation to qualified persons.

Owner/user definition:

a) The **owner/user**, as a higher ranking, legal person, is responsible for the intended use of the system, and for the training as well as employment of the authorized persons. The owner/user defines the legal competencies and authority to issue directives for the authorized personnel of his company.

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b) **Qualified personnel** are persons who, due to their technical training, knowledge and experience, as well as their knowledge of the relevant regulations, can correctly judge the work appointed to them, and who can recognize possible danger.
Here, only trained specialized personnel, who have been selected and deemed to be capable by the owner/user, are taken into account.

c) **Trained persons** are those who have been informed and trained with regard to the tasks appointed to them and possible danger in the event of improper behavior, as well as those who have been instructed with regard to the required protection devices and protective measures.

d) **Unskilled labor** are those who are qualified neither according to paragraph b) neither (qualified personnel) nor according to paragraph c) (trained persons).

Only allow **qualified personnel** to perform installation, disassembly, maintenance and repair work.
Restrict all other work to be performed on or with the system to **trained personnel**.

Observe the legal, admissible minimum age!
Restrict work on the system to persons over 18 years of age.

1.3 Structure of the operating instructions

The operating instructions are divided into sections in accordance with the following scheme:

- The chapter ”Introduction“ contains general information for the owner/user concerning the design and use of the operating instructions.

- The chapter “General“ contains general information concerning liability and guarantee as well as the address required to order additional copies of this operating manual.

- This chapter also contains the company address.

- The chapter “Safety” contains all information concerning safety, safety measures/devices on the system and its proper use.

- The system function is described in chapter “Description and function of the system”. This chapter also contains data concerning the system identification.

- Chapters “Transport and storage“ contain work instructions for maintenance/qualified personnel, concerning the transport and shutdown storing of the system. The general procedure for these activities is described here.

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- Chapter “Commissioning/start-up“ contains the work instructions for maintenance /qualified personnel, concerning the transport and commissioning/start-up.

- The basic settings of the system are described in chapter “Setting“. Additionally the procedures required for the feed gas change are described.

- In chapter “Operation”, the standard operation of the system and the start up and shut down procedures are described.

- In chapter “Malfunctions“, the general procedure for trouble shooting is described, and the malfunction list with possible solutions is shown.

- The work procedure for cleaning the system is described in chapter “Cleaning“.

- Chapter “Maintenance and Repair“ contains the general maintenance procedure together with the maintenance table for the system. Also included is information on ordering spare parts.

- Chapter “Shut-down and Disposal“ contains operating instructions for the maintenance /qualified personnel in the event the system is to be shut down for storage or has to be dismantled for disposal at the end of its service life.

- Chapter “Technical Data” contains a list of system data.

- Chapter “Appendix” contains the performance curves, the spare parts list, the EMC test certificate as well as the EC conformity declaration.

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2. General Information

This chapter contains general information of the operating instructions. In order to Insure safe use do read this chapter carefully prior to operating the system.

2.1 Liability and Warranty

All data and information concerning operation and maintenance of the system are based on our previous experience and know-how to the best of our knowledge.

We are only liable within the framework of the warranty obligation agreed upon in the main contract for any legal entitlement resulting from this contractual agreement.

The original version of these operating instructions has been prepared in the German language, and objectively examined by us.

All responsibilities of the manufacturer become invalid in the event:

- of insufficient or non-observance of the information contained in this manual;
- the system is used contrary to its specifications or in a manner for which it was not intended;
- spare parts or parts are used which are not approved by the manufacturer;
- of incorrect operation;
- protection devices are removed, manipulated or not used/installed;
- functions or materials to be processed are changed/modified in a manner not expressly approved for this system;
- of unauthorized changes/modifications of the system;
- maintenance is performed not in line with the operating instructions;
- wearing parts are excluded from the manufacturer's warranty;
  When replacing parts or procuring spare parts, only use original spare parts approved by the manufacturer.

Legal recourse is excluded when operating and/or usage errors can be proven.
Changes and/or adaptations of the system are possible in certain cases. These, however, require prior written approval of the manufacturer.

These operating instructions were prepared and compiled with the greatest of care. However, should you detect incompleteness and/or errors, please inform us at the address listed below.

Our operating instructions are updated on a regular basis. Your improvement suggestions will assist us in preparing a user-friendly operating manual.

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Therefore, if you can submit suggestions, please let us know so that we may take them into account.
We kindly request that you immediately inform us of any possible errors or uncertainties in writing.

All documentation is the intellectual property of WEDECO Ozone Technologies and must neither be copied nor published without our consent.

2.2 Safekeeping

Insure that the operating instructions for the **GSO series** Ozone Generator are accessible to the user and the maintenance and repair personnel for the duration of the system service life. Keep a copy of these operating instructions in close vicinity of the system! Keep a copy of these operating instructions available for maintenance and repair work! Insure that these operating instructions are always accessible!

2.3 Customer Service

Please contact our Customer Service in the event of questions, suggestions or problems, they will be pleased to assist you.

WEDECO
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2.4 Reorders

Further copies of these operating instructions may be ordered at the same address. Please note that such order is subject to a fee.

2.5 Copyright

All rights exclusively withheld. Do not copy or make available to third parties, regardless in which form, without prior written consent of WEDECO Ozone Technologies

3. Safety

The safety measures and safety devices are described in this chapter. Do read this chapter carefully prior to operating the system to insure its safe use.

3.1 Pictographs

In these operating instructions the following designations and pictographs are used to indicate danger:

Non-observance of these instructions <u>may</u> have serious, harmful effects and may even imply life-threatening injuries!

Warning: Property and/or environmental damage

Warning: Injuries or danger to life and limb of personnel

Important information

Warning: Dangerous electrical voltage

Warning: Poisonous/toxic substances
This may lead to serious injuries or death

Warning: Electromagnetic field

Warning: Explosive substances

Warning: Explosive atmosphere

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Warning: Environmental damage

Information

Prohibited for persons wearing pacemakers

No fire, naked flame and/or smoking

Splashing with water is prohibited

Use breathing protection apparatus/mask

3.2 General Safety Requirements

The system meets the fundamental EC safety and health requirements. However, this does not exclude dangerous situations.

1. In order to guarantee safety, insure that all persons coming in contact with the system are familiar with the content of these operating instructions. Only in this manner can the pending risks be reduced to a minimum.
2. Never use the system for a purpose other than that intended by the manufacturer. Misuse of the system may result in unforeseeable risks.
3. Always observe the local operating and safety regulations and laws. The same applies to the environmental regulations.
4. If the personnel detect errors/faults or danger, the operator or his representative must be informed immediately.
5. If several persons work on the system at the same time, excellent cooperation and precise coordination of the activities are required.

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Technical knowledge and the sense of responsibility of the employer and employee are necessary to insure the safe and effective use of the system.

6. Never remove, defeat or by-pass safety devices such as cover hoods/protective circuits during normal operation of the system.
7. If it is necessary to remove the safety devices during set-up, maintenance and repair, insure that the safety devices are refitted and checked immediately upon completion of the maintenance and repair work.
8. In order to guarantee safety, it is important that only personnel required for the specific activity is within the immediate danger zone of the system.
9. Restrict work on technical equipment (e.g. pneumatics, electric) to the respective qualified personnel.
10. When handling oil, grease and other chemical substances, always observe the safety regulations relevant for the particular product! Never come in contact with the chemicals. Always read and adhere to the user instructions on the package prior to working with these substances. This applies to all chemicals as well as cleaning agents.
11. Insure that personnel in training only work on/with the system under strict supervision of an experienced person.
12. Always keep all safety and danger signs/information on the system in a well legible condition.
13. Do not allow hot parts to come in contact with explosive or highly flammable chemicals.

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3.3 Safety Devices and Regulations

All existing safety devices or those to be provided by the system owner/user are described in this section.

DANGER

Insure that all safety devices are maintained in perfect condition.

3.3.1 EMERGENCY STOP

The system owner/user must insure that ozone production can be switched off by means of an EMERGENCY command device (EMERGENCY STOP switch). Insure that the EMERGENCY command device is located and identified at an easily accessible, safe location in the vicinity of the door of the ozone generator room.
An EMERGENCY STOP switch is of a red/yellow color.

The electric circuit is designed such as to allow the system to be integrated in an EMERGENCY STOP circuit. For this purpose, connect the unit to a socket, which is isolated from the supply voltage in the event of an EMERGENCY STOP.

Only use EMERGENCY STOP switches in the event of danger to person or system.
In all other cases, insure that the system is switched off in its normal manner.
Reset the EMERGENCY STOP switch to allow restarting of the system.

ATTENTION

In case of EMERGENCY, actuate the EMERGENCY STOP switch in the vicinity of the door of the ozone generator room or the power switch of the system. Once activated, the power supply and the feed gas flow will be stopped immediately.

Resetting following an EMERGENCY STOP of the system:

- Start the system (Refer to chapter “Operation“)

3.3.2 Protection Devices

Insure that protection devices are only removed/deactivated by persons authorized for this purpose, and only if absolutely necessary to perform certain work. Insure that the protection devices are reattached/activated immediately upon completion of this work.
Only use original fastening hardware for the protection devices.

<u>Lockable covers</u>
All system parts such as the complete electrical equipment, ozone generators, etc., are permanently installed in a sheet metal cabinet, secured by a lockable door. This prevents contact with these parts and protects against serious injuries.

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3.3.3 Personal Protection Equipment (PPE)

The owner/user must Insure that an ozone resistant breathing protection apparatus in form of a full mask with effective filter is available for, and identified with the name of, all persons working on/with the ozone system.
Furthermore, he must insure that the employees are familiar with the use of the breathing protection apparatus by having at least one exercise/practice per year, and that they are properly used.

3.4 Guidelines for Handling of Ozone and Oxygen

3.4.1 Safety Instructions for Ozone

Ozone consists of three oxygen atoms with a modular mass of ≈ 48 kg/kmol. At normal conditions (0°C and 1.013 bar (abs)), the density of ozone is 2.15 kg/m^3. The chemical notation is O_3.

Ozone is heavier than air!

At normal pressure, ozone is a colorless to blue gas. The boiling point of ozone is approx. -112°C. Ozone condensate is a blue fluid.
Depending on the concentration ozone produces an odor similar to carnations, hay or chlorine.
The smelling threshold is approx. ≈ 0.02 mg/m^3 (≈ 0.01 ppm$_v$),
The maximum workplace concentration value is approx. 0.2 mg/m^3 (≈ 0.1 ppm$_v$), 0.1 ml/m^3.

Ozone is non-combustible; however, it does promote combustion processes, so that even spontaneous explosive reactions are possible.

Ozone oxidizes almost all metals, inorganic and organic substances (except for example gold, platinum, stainless steel, glass and ceramic).

The intensive oxidation characteristics of the ozone are used for disinfecting purposes (extremely damaging effect on low organisms, e.g., bacteria, fungi's), and for the application of organic and inorganic substances through oxidation (e.g., COD degradation, AOX degradation). Organic compounds are oxidized through ozone. They can be degraded to carbon dioxide and water.

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3.4.2 Health Risks of Ozone

Physiologically, ozone acts as an irritant. Particular targets are mucous membranes of the eyes, nose and lungs. Ozone can result in poisoning when inhaled.
Physical strain and a rise in the ambient temperature increases the toxicity of ozone, so that otherwise harmless concentrations could have a toxic effect. An increase of the room temperature by 8°C doubles the toxicity.

Irritation of the throat (urge to cough) occurs in the event of prolonged exposure to an atmosphere with ozone concentrations exceeding 0.2 mg/m^3 (≈ 0.1 ppm$_v$).
Concentrations from 1.0 mg/m^3 (≈ 0.5 ppm$_v$) cause extreme irritation of the eyes and the mucous membranes of the respiratory tract. Several minutes of exposure cause extreme irritation of the throat and **deadening** of the sense of smell. Difficulty of breathing occurs, indicating toxic pulmonary edema.
From 2.0 mg/m^3 (≈ 1.0 ppm$_v$) tightening of the chest, dizziness and headaches can be felt, higher concentrations result in circulatory disorders and salivation.
Persons who are exposed to low ozone concentrations frequently or for a prolonged period of time may fall ill with chronic bronchial ailments.

DANGER

Prolonged exposure to ozone concentrations exceeding 20 mg/m^3 (≈ 10 ppm$_v$) will result in unconsciousness, pulmonary hemorrhaging and death. Inhaling ozone in concentrations exceeding 10000 mg/m^3 (≈ 5000 ppm$_v$) will lead to death in several minutes.

3.4.3 Recommended Protective Measures

Insure that ozone systems are installed in closed, lockable rooms. Do not allow permanent workplaces in rooms with 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 room air.
The maximum workplace concentration value of 0.2 mg/m^3 (≈ 0,1 ppm$_v$) applies .

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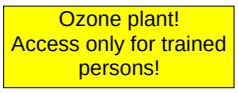
Insure that rooms in which ozone leaks may occur are effectively monitored by means of gas detectors with visual and acoustic indicator.
These rooms are, for example: rooms containing ozone systems, rooms crossed with ozone supplying pipelines.
Insure that the monitoring device (measuring sensor) is attached at a location where the highest ozone concentration can be expected in the event of a hazardous incident.
If this concept is taken into account, the alarm value may be set to 1.0 mg/m^3 (≈ 0,5 ppm$_v$).

Insure that rooms accommodating ozone systems are identified with the following warning symbols:

Warning: Poisonous substances



Ozone system! Access only for trained persons

No fire, naked flame and/or smoking

Prohibited for persons with pacemakers

The symbols must meet the accident prevention regulations "Safety identification at the workplace" (VBG 125).

- High performance ozone generators can generate ozone concentrations up to 13 wt% and above. These values by far exceed the deadly limit. 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 Insure that ozone gas detectors are installed in this area.

- Insure 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.

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– Only enter rooms in which an ozone accumulation exists or can be expected when wearing a breathing protection apparatus to rescue an injured person or to avert acute danger.

– Never keep breathing protection apparatus in rooms containing any equipment of the ozone system.
An ozone-resistant full mask with an effective filter may be used as a breathing protection apparatus. Due to the fact that masks are intended for individual persons, Insure that a mask identified by the person's name is provided for each operator.

– Insure that ozone systems are only serviced by specialized personnel. Specialized personnel are persons who, due to their technical training and experience have adequate knowledge with the handling of ozone systems, and are sufficiently familiar with the relevant, public work protection regulations, accident prevention regulations, pertinent standards, and regulations to correctly assess an operationally safe condition of ozone systems.

– **Insure that parts coming in contact with the ozone are free of oil and grease.**

– Insure that off-gas containing ozone is lead to the outside via an effective residual ozone destruction system.
– Prior to opening systems with gas containing ozone, rinse them until no more ozone can be detected. Remove the gas safely (refer to chapter "Rinsing the system for drying").

In general, we would like to point out that the owner/user is responsible for posting operating instructions "Handling ozone" in the operating room, easily legible for all employees. Please refer to the chapter "Appendix" for a draft text.

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3.4.4 Safety Instructions for Oxygen

- Oxygen consists of two oxygen atoms with a molar mass of ≈ 32 kg/kmol. At normal conditions (0°C and 1.013 bar (abs)), oxygen has a density of 1.43 kg/m³. The chemical notation is $\mathbf{O_2}$.
- Oxygen is heavier than air.
- At normal pressure, oxygen is a colorless and odorless gas. At -183°C and normal pressure, oxygen condensate is a blue liquid. Below -219°C it crystallizes to form a blue pigment.
- Oxygen is non-combustible, however it enables and promotes combustion processes. No combustion is possible in an oxygen-free environment. That means that any flame will extinguish in the event of an oxygen deficiency.
  The oxygen content in the air is ≈ 21 Vol%.

DANGER

- A risk to health for humans exists when the oxygen content of respiratory air drops below 17 Vol%.
- An increased oxygen concentration causes a considerable increase in the combustion speed. Furthermore, technical safety characteristics such as pressure increase speeds, ignition and glow temperatures, explosion pressures and flame temperatures also change.

DANGER

- Oxygen can cause spontaneous ignition of oil and grease. This also applies to clothing soiled by oil and grease.
- Oxygen bonds with almost all elements. Most substances react so violently with oxygen, that they either burn following ignition or even self-ignite.

3.4.5 Health Risks of Oxygen

- At normal pressure, oxygen concentrations below ≈ 50 Vol% can be regarded as harmless even at prolonged exposure.

- When pure oxygen is inhaled for a prolonged period of time, lung damage and functional disturbances of the autonomic nervous system may occur. Lung damage may lead to toxic pulmonary edema.
- Inhaling pure oxygen at higher pressures (>3 bar) 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.

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

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- Liquid oxygen may cause serious frostbite.
- An increased risk of fire exists when clothing is contaminated with oxygen.

DANGER

- The danger of oxygen enrichment is high, particularly as an increased oxygen concentration is imperceptible for people. Therefore, Insure that
  - no oxygen penetrates the clothing
  - no combustion is induced through an excess of oxygen
  - no ignition is triggered.

Therefore, never

DANGER

- use oxygen for ventilation
- blow dust or dirt out of clothing using oxygen
- wear clothing soiled with oil and/or grease
- never handle lines carrying oxygen with hands soiled by oil or grease
- smoke where oxygen is suspected

3.4.6 Recommended Protective Measures

- Due to the danger of ignition, Insure that all system parts coming in contact with oxygen have been cleaned; i.e., they must be free of particles that are loose or can be released during operation, such as slag, welding residue and machining swarf, as well as oil, grease and solvents. This requirement can be fulfilled by pickling stainless steel following the welding process.

- Only use fittings, seals and measuring devices that are approved for oxygen and kept free of oil and grease.

DANGER

- Never touch with oil-saturated cleaning cloths or greasy fingers. Never wear clothing soiled with oil and/or grease.
- Insure that only specialized personnel, having experience with the handling of oxygen, check the system for leaks.
- For heat insulation, only use materials which do not react dangerously with oxygen, e.g., glass wool or polyurethane sheeting.

DANGER

- Insure that lines carrying oxygen are identified by a coat of paint, inscription or signs.
- Insure that rooms where oxygen leaks can occur, are ventilated in such a way that the air cannot be enriched with oxygen. In the event that natural ventilation is not sufficient, technical ventilation is required.

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- Insure that floor covering only consists of non-combustible materials in areas where liquid oxygen can escape. Therefore, **asphalt** (bitumen) is not admissible.
- Never store combustible or self-igniting materials within a safety area of 5 m surrounding possible outlet points of liquid oxygen.

- **Fire, naked flames and smoking is prohibited in rooms where O_2 is used!**

  Insure that the employees have been made aware of the possible dangers when working with oxygen, and are instructed regarding the safety measures to be taken.

In general, we would like to point out that the owner/user is responsible for posting operating instructions "Handling oxygen" in the operating room, easily legible for all employees. Please refer to the chapter "Appendix" for a sample.

3.5 Intended Use of the System

Use the system exclusively for its intended purpose. This will be explained in more detail in chapter "Description and function of the system".

This system has been built in accordance with the current state-of-the-art technology, and is operationally safe, when the operating instructions as well as the system and operation related specifications and the accident prevention regulations are observed.
However, this system can pose a danger to life and limb of the user or third persons, as well as damage to the system and other property.

Only use the system when in perfect technical condition for its intended purpose. Always work in a safety conscious manner, being aware of possible dangers, while observing the operating instructions! Immediately rectify malfunctions (or have them rectified) which could influence the safety!

3.6 Inappropriate Use of the System

Danger may emanate from any machine, when it is used improperly by untrained personnel or not used in line with its intended purpose.

Insure that the operating instructions for the system are accessible to the user and the maintenance and repair personnel for the duration of the system service life. Keep a copy of these operating instructions in close vicinity of the system! Keep a copy of these operating instructions available for maintenance and repair work!!

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3.7 Inadmissible Operating Methods

The operational safety of the supplied system is only guaranteed when it is appropriately in accordance with our order documentation, particularly the order confirmation. Never exceed the limit values specified in the order documentation.

Always observe the content of this instruction of use! Any use deviating from this will invalidate the manufacturer's liability and guarantee!

Dispose of pollutants/contaminants in a manner to exclude any danger for people and the environment. Leakage of hazardous substances also endangers our environment. Strictly observe the legal regulations.

3.8 Instruction

The owner/user of the system is responsible to insure that every person working with or on the system is instructed with regard to the operating method, use and the protective measures to be observed.

Intended use also includes observing the operating instructions and fulfilling the inspection and maintenance conditions.

Insure that the persons instructed sign a confirmation indicating that they have completely read, and understood all points of, the operating instructions. Damage caused by untrained personnel is the sole responsibility of the owner/user.

3.8.1 Confirmation of the instruction

I herewith confirm that I have completely read and understood the operating instructions for this system.

Name, First name	Place, Date	Signature

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4. Description and Function of the System

4.1 System Identification

These operating instructions are part of the WEDECO Ozone Technologies ozone generator **series GSO**.

The machine plate is shown in illustration 4.1.

WEDECO

Type : GSO-40		**Const. year :**	1999
Manufacturer No.	:		
Process gas	:	Oxygen / Air	
Operating pressure	:	1,5 /2,5 7 / 22	bar g psig
Gas flow	:	2,0 / 5,0 1.17 / 14.7	m³/h cfm
Rated capacity	:	200 / 100 10.5 / 5.25	g/h lbs/day
Connected load :			

CE

230 V 10 A 50/60 Hz 2,2kVA

WEDECO GmbH D-32051 Herford Germany
Made in Germany

Fig. 4.1 Machine plate

A machine plate has been attached on the ozone generator of the **GSO series**, containing the following data. Shown below is example for the GSO - 40

Manufacturer	**WEDECO** GmbH	Ozone generation	200 g/h
Type	GSO 40	Gas flow for O_2/Air	2 m^3/h / 5 m³/h
Year of Manufacture	1999	Adm. oper. Over-Pressure	1.5 bar g for O_2, 2.5 bar g for Air
Manufacturer No.		Electr. conn.values	230V/50/60Hz/2,2kVA
Process gas	Oxygen or Air		

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Table 4-1 Machine plate explanation

4.2 Function of the System

This section contains a basic description of the operating sequence and provides an overview of the system production process.

4.2.1 Ozone Generation

Ozone generation principle

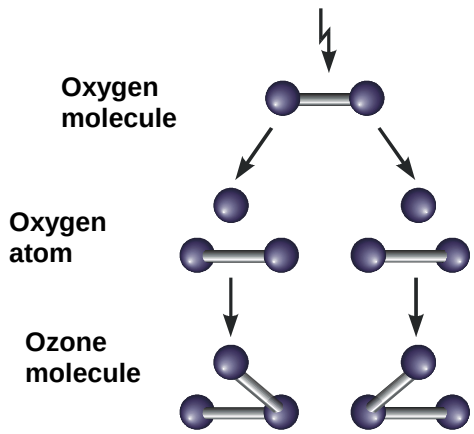

Fig. 4.2 Ozone generation principle

Next to fluorine, ozone is the strongest oxidizing agent, and when 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 reactive products, only oxygen develops, so that no toxic residual 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 produced technically through silent electrical discharge from oxygenous feed gases, typically air or oxygen, by special ozone generators.

Schematic presentation of the discharge in an ozone generator

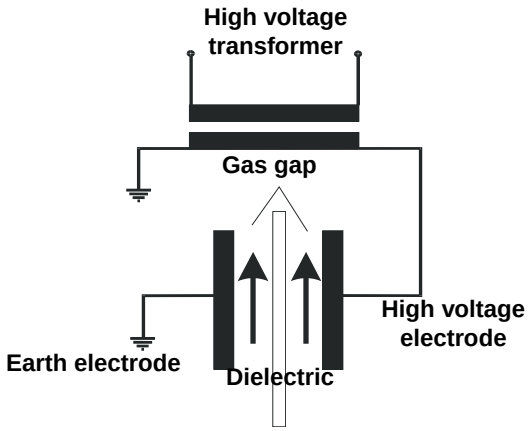

Fig. 4.3 Ozone generator diagram

During the ozone synthesis process at first oxygen molecules are split through the supply of energy. The resulting oxygen atoms react with oxygen molecules to form ozone. The reaction entahlpy released as heat must be dissipated by cooling (s. Fig. 4.2).

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 oxygenous gas flows through the gap, resulting in ozone generation in the electrical field (s. Fig. 4.3).

4.2.2 System Components

Ozone generator with ozone generating elements

The ozone generator is designed as a water-cooled tubular heat exchanger, to allow efficient dissipation of the heat resulting from the ozone generation.

The pipes in the ozone generator serve as gas discharge pipes, in which the ozone generation takes place in accordance with the “silent electrical discharge” principle. Electrodes are arranged in the gas discharge pipes which are separated from the pipes by a dielectric made of glass. A middle frequency high voltage, adjustable in order to adapt to the ozone production desired, is applied to these electrodes.

Energy supply

The converter is part of the energy supply of an ozone system. Its task is to adapt the ozone production to the respective requirements through variable adjustment of the electrical output voltage. The converter supplies a single phase, middle frequency output voltage, which is transformed by the high voltage transformer to the high voltage of approx. max 8 kV required for ozone production.

Fittings

The fittings and monitoring instruments, included in the delivery scope as standard, allow safe handling of the ozone system and protect it against destruction.

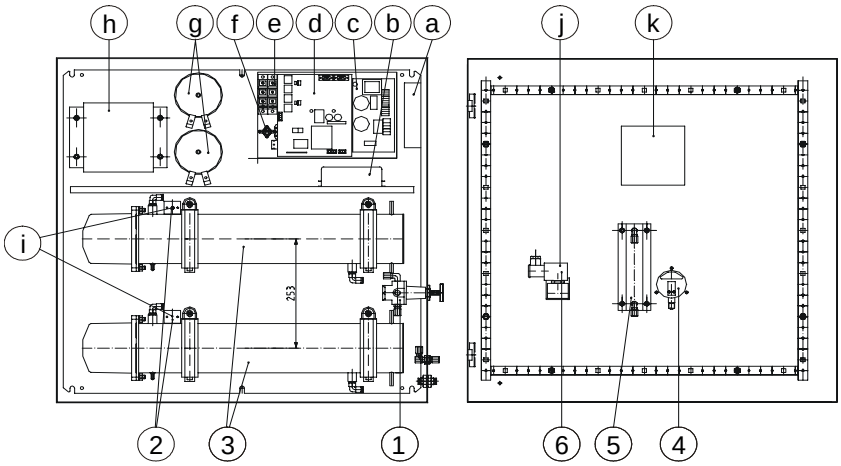

Fig. 4.4 Inside view of the system SWO 30/GSO 10 to SWO 200/GSO 40

Legend, mechanical

Pos. No.:	RI-No.:	Designation
1	02.00.01	Pressure reducer
2	02.00.02	Temperature monitor
3	02.00.03	Ozone generator
4	02.00.04	Pressure gauge
5	02.00.05	Flow meter with needle valve
6	02.00.06	Solenoid valve

Legend, electrical

Pos.:	Designation
a.	Axial ventilator
b.	RFI filter
c.	Module converter A
d.	Module converter B
e.	Module converter C
f.	Module converter D
g.	Intermediate circuit throttle
h.	High voltage transformer with temperature switch
i.	Temperature monitor
j.	Solenoid valve
k.	Module display

Table 4-2 System legend mechanical/electrical GSO10 to GSO 40

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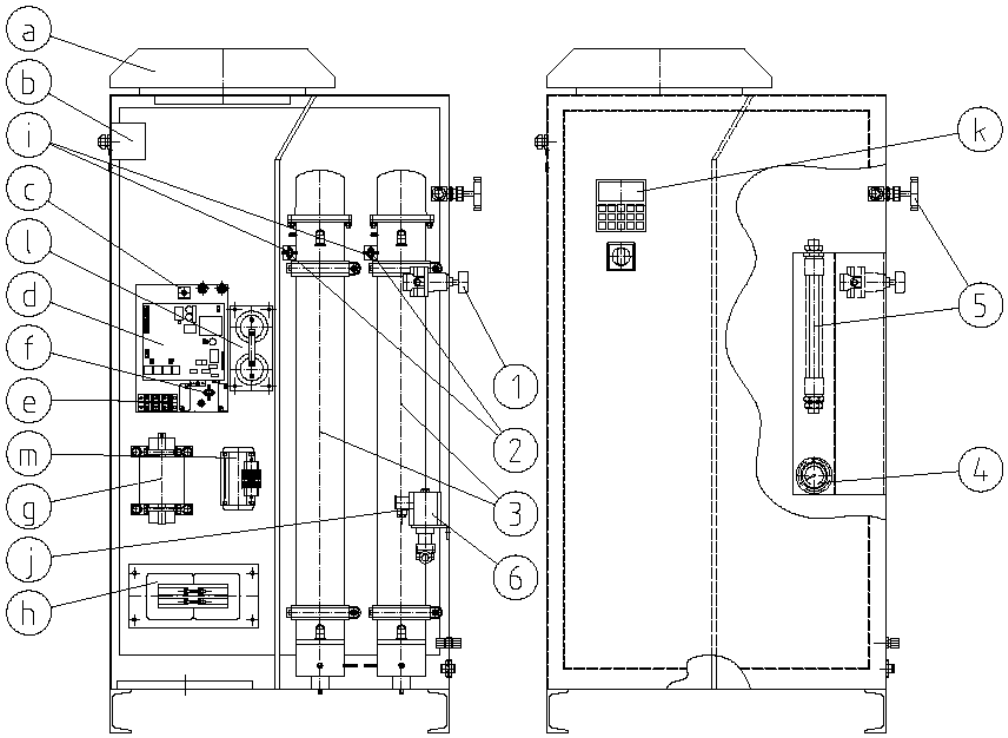

Fig. 4.5 Inside view of the system GSO 50

Legend, mechanical

Pos. No.:	RI-No.:	Designation
1	02.00.01	Pressure reducer
2	02.00.02	Temperature monitor
3	02.00.03	Ozone generator
4	02.00.04	Pressure gauge
5	02.00.05	Flow meter with needle valve
6	02.00.06	Solenoid valve

Legend, electrical

Pos.:	Designation
a.	ventilator
b.	RFI filter
c.	Module converter A
d.	Module converter B
e.	Module converter C
f.	Module converter D
g.	Intermediate circuit inductively
h.	High voltage transformer with temperature switch
i.	Temperature monitor
j.	Solenoid valve
k.	Module display
l.	DC capacitors
m.	net choke

Table 4-3 System legend mechanical/electrical GSO 50

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4.3 Specification of feed gas and cooling water

Specifications of the gases to be used in the EFFIZON®- GSO – ozone generators

	Oxygen from liquid tanks	Oxygen from air separation plants	Air	
Oxygen concentration	99.5...99.9	85...95 (93 standard)	21	Vol%
Water content	<4	<4	<4	ppm
Atmospheric dew point	<-70	<-70	<-60	°C
Content of hydrocarbons	<20	<20	<20	ppm
Nitrogen content	>1000	>1000		ppm
Solids content	particle free (filter 0.1µm)	particle free (filter 0.1µm)	particle free (filter 0.1µm)	

Table 4-4 Requirements placed on the consumables

In addition, other limit values are possible to meet special customer requirements. However, this also requires a special design of the respective system. Please contact our customer service regarding this matter.

Specifications of the coolants to be used in the EFFIZON® - GSO – ozone generators

The use of drinking water as coolant implies no problem. When other fluids are used, at least the following values must be observed:

ATTENTION

- No rust or iron particles
- No indissoluble or corrosive components
- Iron < 0.3 mg/l
- Manganese < 0.05 mg/l
- Chloride < 100 mg/l

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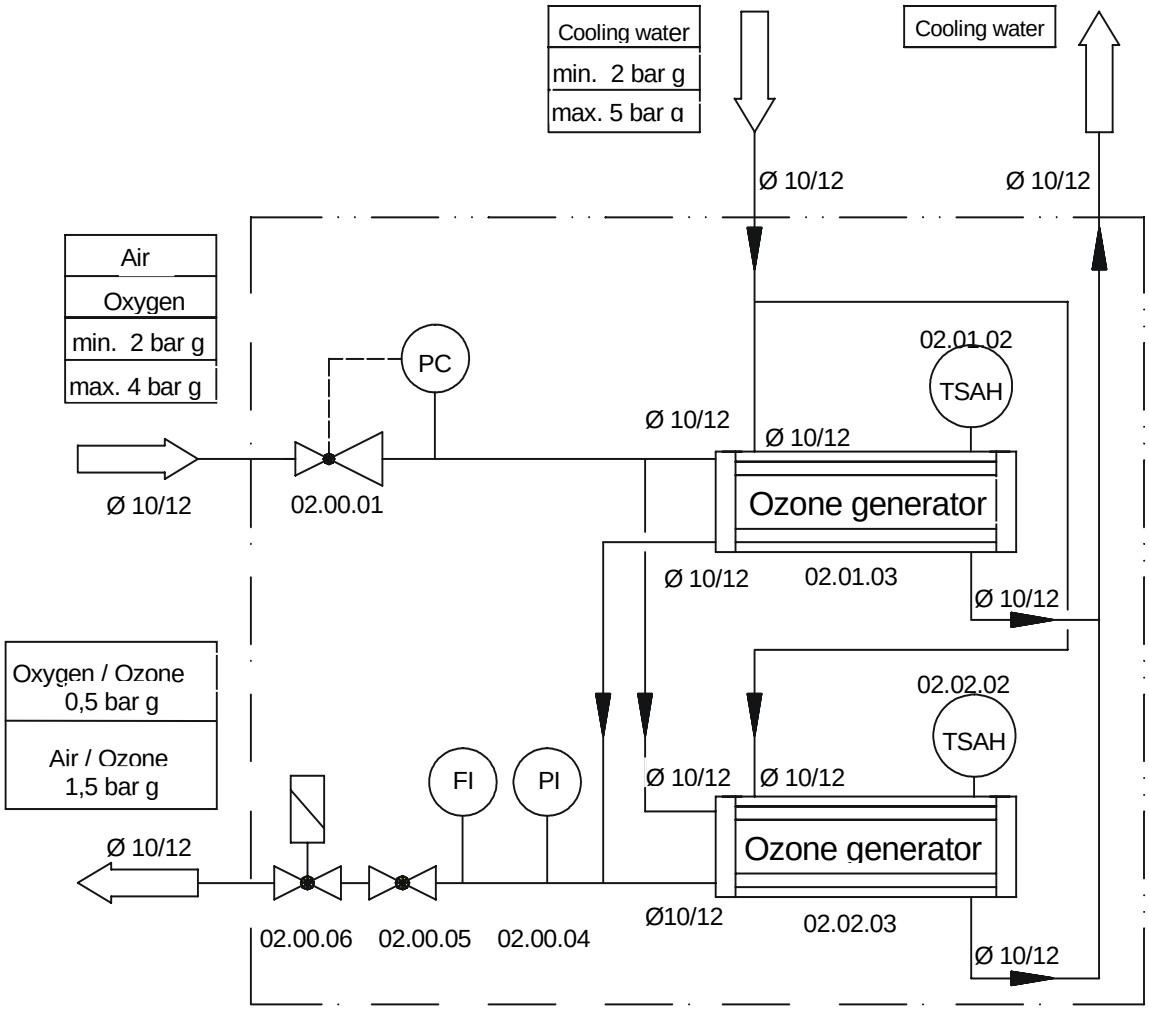
4.4 P&I Diagram



WEDECO Ozone Technologies scope of delivery ends here

Fig. 4.6 P&I Diagram

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5. Transport and Storage

5.1 General

It is advisable to check the total scope of delivery for completeness and possible damage immediately upon arrival. This is possible using the enclosed delivery note and accompanying documentation. Generally, claims are only taken into consideration if they are reported to the hauler and/or the manufacturer.

Transport and storage include the following activities:

- Packing
- Storage
- Transport
- Unpacking

5.2 Unpacking

If possible, the packing material should be used several times or disposed of in accordance with the local regulations.

The system requires an acclimatization time of 24 hours, to exclude malfunctions due to condensation. Remove any condensation, which may have formed during transit. Check the delivery condition of the system (refer to the beginning of this chapter).

ATTENTION

IMPORTANT: Do remove the desiccant bag from the unit prior to operation.

of insulation and packaging properly and compatible with the environment.
the national regulations.

5.3 Storage

Insure that the following steps are taken if the system is to be stored:

- Switch off the system (refer to chapter “Operation“)
- Disassemble/disconnect (refer to chapter “Shut-down and disposal”)
- Transport (see chapter “Transport“)
- Protect the corrosion susceptible parts (bare metal)
- Only store the system in dry rooms

ATTENTION

Store the system in such a way, that any possible damage is prevented. Store the system lying on its back.

ATTENTION

Store the system complete including all individual parts, otherwise important parts may be missing when the system is commissioned again.

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Type	GSO 10/ 20	GSO 30	GSO 40	GSO 50	
Ambient temperature for operation	5...40 (41…104)				°C (°F)
Ambient temperature for Transport and storage	-20...60 (-4…140)				°C (°F)
Protection type for installation	IP 42 (Nema 1)				
Power dissipation to the environment	100	200	400	700	W

Table 5-1 Ambient conditions

Completely remove the coolant from the ozone generators when the storage temperatures drop below 0°C.

5.4 Packing

In order to prevent damage, pack the different system parts according to their function, taking the following protective measures into account:

- Protect against rain during transport
- Protect against damage due to contact with other objects
- Protect against frost, if various parts of the system contain water
- Protect against excessive air humidity (risk of corrosion due to condensation!)
- Insure that the system is sealed in plastic and provided with a silica gel additive to protect against moisture.

Dispose of insulation and packaging properly and compatible with the environment. Observe the national regulations.

5.5 Transport

Transport the system using standard transporting devices.

ATTENTION

Only use transporting devices and tools suitable for the load. For example, when lifting a system part, only use appropriately dimensioned and undamaged cables. The weight of the system is indicated in the appendix in chapter “Technical data”.

Secure the load reliably.

ATTENTION

Fasten the system on a pallet or transport it in a suitable crate.

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Only have experienced persons attach the loads. Insure that the loads are carefully fastened and secured on the hoists.

Ozone system: Weight

Lift the system at the base frame and transport using a stacker truck. Please take into account, that relatively weak parts may be damaged by the stacker truck.
Furthermore, Insure that the system is subjected to as few vibrations as possible.
Prior to moving the system, Insure that the necessary ambient conditions are created at the new installation site (refer to “Technical data”).

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6. Commissioning/Start-up

6.1 General

The procedures during installation and commissioning/start-up of the system are described in this section. Information is provided describing how the required work is to be performed and where particular attention is required. Appropriate technical knowledge is required by the personnel performing this work.
Commissioning/start-up is an activity requiring qualified personnel.

6.2 Workplaces and Installation Arrangement

Insure that the ozone generating system is installed on a sturdy, low vibration foundation in a dry, frost-free and aerated room or fastened to a sturdy, low vibration frame or to a wall using 4 screws.

Insure that the installation area is dimensioned such, that operation, maintenance and repair can be done without hindrances. Observe the technical data.

Type	GSO 10/ 20	GSO 30	GSO 40	GSO 50	
Ambient temperature for operation	5...40 (41…104)				°C (^{o}F)
Ambient temperature for Transport and storage	-20...60 (-4…140)				°C (^{o}F)
Protection type for installation	IP 42 (Nema 1)				
Power dissipation to the environment	100	200	400	700	W

Table 6-1 Ambient conditions

In order to Insure good ventilation of the system, provide a free area around the unit.
Insure sufficient room ventilation during normal operation and in case of a malfunction/hazardous incident.

Insure that no inadmissible heating-up of the operating room can occur due to the dissipated heat of the generator. In addition, insure that the installation site meets all safety regulations, as described in chapter “Safety”, for rooms in which oxygen or ozone may escape.

Insure that the air humidity does not exceed 70% during continuous operation, higher values are possible for brief periods (<1h). Also Insure that no condensation resulting from moisture (dew) occurs in or at the unit.

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The pressure gauge used in the generator indicates the pressure of the system in relation to the barometric air pressure at the installation site. That means: if the gauge shows 0,5 bar (7.25 psi) the absolute pressure is 1,5 bara (21.95 psia). Furthermore if the unit is installed at altitudes of more than 1000 meters above sea level, the operating pressure must be corrected depending on the ambient pressure in order to prevent a loss in capacity.

Insure that ozone systems are installed in closed, lockable rooms. For example, these rooms also include technical rooms, and, if required, service passageways around swimming pools. When oxygen is used, also refer to the accident prevention regulations for “Oxygen”.

DANGER

Do not allow permanent workplaces in rooms accommodating ozone systems.
If this requirement cannot be met for technical processing reasons, insure that the ozone concentration in the room air at the workplace does not exceed the maximum workplace concentration value of 0.2 mg/m^3.

Insure that rooms in which ozone may escape in case of a hazardous incident are effectively monitored by means of gas detectors with visual and acoustic indicator. These rooms are, for example: rooms housing ozone system, rooms crossed by ozone supplying pipelines. Effective monitoring means that the measuring sensors of the gas detectors are installed at the point where the highest ozone concentration can be expected in the event of a hazardous incident, e.g., for pressurized systems, in close vicinity of the ozone production system and always close to the floor, as ozone is heavier than air. Such a measuring sensor arrangement allows the alarm threshold of the gas detector to be set to an ozone concentration of 1.0 mg/m^3 (1.0 ppm).

Insure that rooms housing ozone systems are identified with the following warning symbols:

Warning: Poisonous substances

Ozone plant!
Access only for trained persons!

Ozone system! Access only for trained persons

No fire, naked flame and/or smoking

Ozon

Insure that lines carrying gas containing ozone are identified

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6.3 Installation

Insure that the mechanical installation of the system is performed in accordance with chapters “Workplaces” and “Installation arrangement”. Please refer to the chapter's “Technical data” and “Appendix” for information and detailed data such as the connection plans. Insure that all connections coincide with the data.

Once the installation has been completed, check that:
- the system is in horizontal position
- all supporting points support equally to avoid stress on the system

6.3.1 Mounting and Fastening

Perform the following work prior to operating the system:
- Mount the system on the wall or safely install on a firm foundation
- Assemble/connect the system parts
- Connect the supply lines

DANGER

Prior to connecting the system, insure that the main electrical switch is switched off. Please refer to chapter “Operation” for information on the switch-off procedure.

- Connect the lines for the media (gas, cooling water)
- Connect the electrical lines
- Establish the electrical connection in accordance with the local regulations. The unit has been provided with a socket (DIN 49457). An appropriate power connection cable (earthing contact plug with coupling) is part of the delivery scope. The appropriate adapters for connection to the supply power of other standards must be provided by the customer.

Insure that no dirt particles ingress into the system during installation.

DANGER

Insure that all pipelines, carrying gas containing oxygen or ozone, are free of oil and grease.

DANGER

Insure that no leaks occur once the connections have been installed.

Finally, check for leaks. During this process, subject all lines to operating pressure and subsequently, check the lines carrying ozone for leaks using a leakage spray.

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ATTENTION

Repeat the leakage check until no more leaks can be detected.

For the ozone generator connections and the process piping only ozone resistant pipe, seals and fitting materials must be used. All lines have to be labeled. The ozone application system must be designed to prevent fluid back flow into the ozone generator. Water or moist gas must never be allowed to enter the gas side of the ozone generator.

Ozone production must only be started when a sufficient cooling water flow is present and the residual ozone destruct system has been turned on.

Protect all lines against damage or tearing off.

Start the ozone room air monitoring unit. Ozone containing gas must never be vented to the atmosphere but instead be fed to an ozone destruct system. This applies to ozone process off gas, too.

Gas and cooling water connections

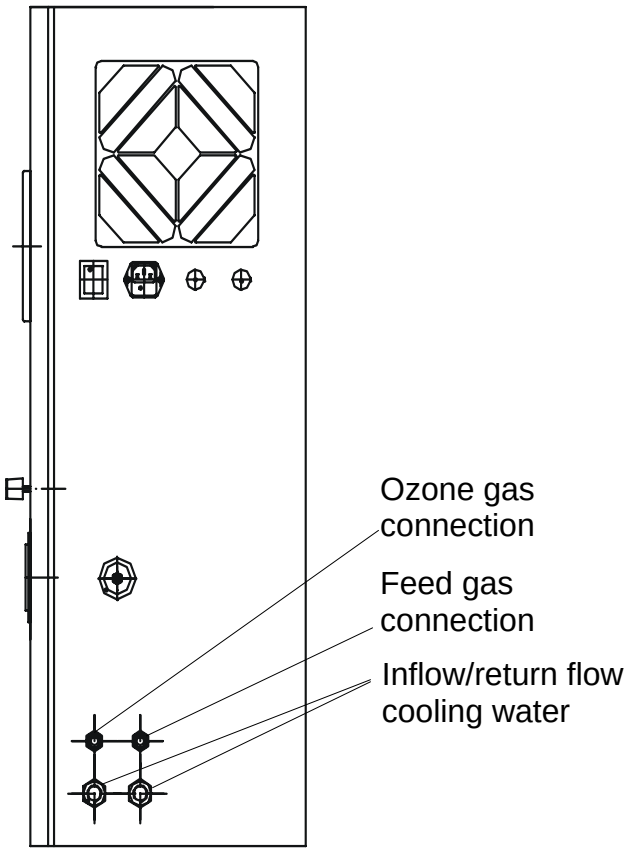

Fig. 6.1 Gas and cooling water connections GSO 10 to 40

<u>Ozone gas connection:</u> Bulkhead fitting SERTO stainless steel, SO 51521-10 for hose and pipe lines, ∅ 10x1 mm **(With adapter to ¼" NPT for US vers.)** <u>Feed gas connection:</u> Angled bulkhead fitting SERTO brass, SO 42721-10 for hose and pipe lines, ∅ 10x1 mm **(With adapter to ¼" NPT for US vers.)** <u>Coolant IN / OUT:</u> Bulkhead plug-in connection Landefeld IQSS-100, for hose line, ∅ 10x1 mm **(With adapter to ¼" NPT for US vers.)**

Table 6-2 Gas and cooling water connection GSO 10 to GSO 40

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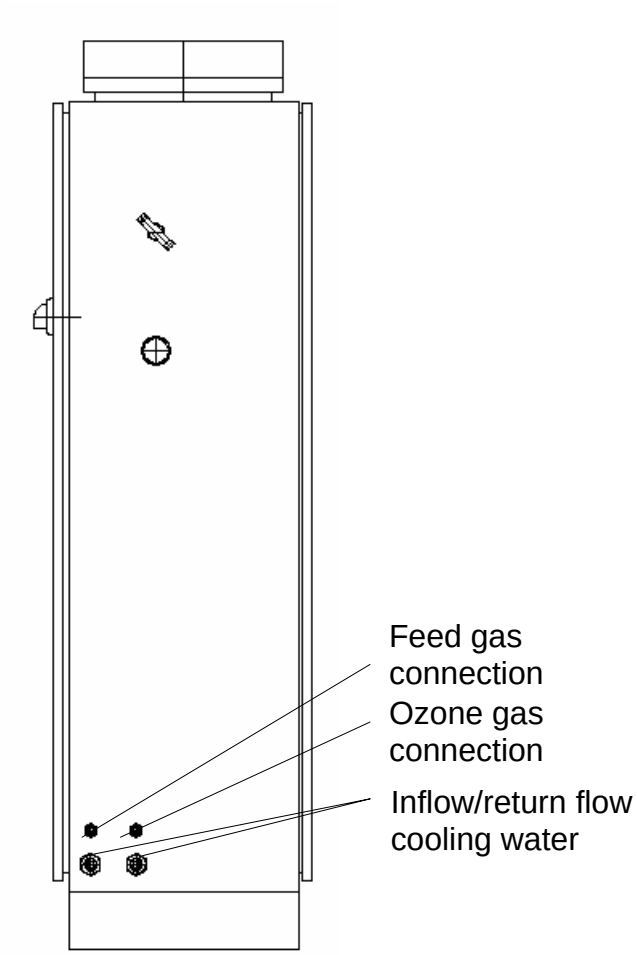

Fig. 6.2 Gas and cooling water connections GSO 50

<u>Ozone gas connection:</u> Bulkhead fitting SERTO stainless steel, SO 51521-12 for hose and pipe lines, ∅ 12x1 mm **(With adapter to ½" NPT for US vers.)** <u>Feed gas connection:</u> Angled bulkhead fitting SERTO brass, SO 42721-12 for hose and pipe lines, ∅ 12x1 mm **(With adapter to ½" NPT for US vers.)** <u>Coolant IN / OUT:</u> Bulkhead plug-in connection Landefeld IQSS-120, for hose line, ∅ 12x1 mm **(With adapter to ½" NPT for US vers.)**

Table 6-3 Gas and cooling water connection GSO 50

We recommend the following materials for the external connections:

Ozone	Fluorinated plastics (PTFE, PVDF) Stainless steel (316, 316L)
Oxygen	Fluorinated plastics (PTFE, PVDF) stainless steel (316, 316L), copper
Air	Fluorinated plastics (PTFE, PVDF) stainless steel (316, 316L) copper, brass, galvanized steel
Water	Plastics (PVC, PTFE, PVDF, PE, PA) copper, brass, galvanised steel

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Please refer to the chapter “Appendix” for SERTO installation instructions for external connections.

6.3.2 Purging the system for drying

Prior to commissioning the ozone generator for the first time, or after changes to the connection lines have been done, insure that all moisture is removed from the gas lines. To do this purge the gas flow circuit for a **minimum of 4 hours** for drying using the feed gas. Proceed as follows:

The power switch is located beneath the input/output cooling air flow at the front of the unit housing. This power switch is illuminated by a lamp when the ozone generator is turned on. For GSO 50 you will find the power switch below the display unit.

Switch on the unit.

```
EOZ-S-0022-2
SYSTEM TEST
SYSTEM TEST O.K.
```

Once the system test has been successfully completed, decide which feed gas is to be used.

```
GAS TYPE:
OXYGEN:        1
AIR:           2
```

Subsequently, the main menu is accessed.

```
SETUP MENU          9
AUTOMATIC MODE      1
MANUAL MODE       ENTER
SERVICE_MODE       XXXX
```

In the main menu, press the *“ENT key“* to select the manual mode.

```
DRY MODE
   YES        - - >        2
   NO       - - >       ENTER
```

```
PRESSURE OK ?
   YES        - - >        3
   NO       - - >          2
```

Press *“key 2“* followed by *“key 3”* to start the dry mode.

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```
DRY MODE
END        - - >          4
      hh.mm.
```

- Press *"key 4"* to end the dry mode and return to the main menu. The system is switched off again, and it is now prepared for initial commissioning/start-up.

6.3.3 Initial Commission / Start up

During the course of the initial commissioning/start-up ozone is already being produced. Should an ozone odor be noticed, switch off the power switch immediately, and leave the operating room while observing the safety measures.

Initial commissioning/start-up always takes place in manual mode.

The power switch is located beneath the input/output cooling air flow at the front of the unit housing. This power switch is illuminated by a lamp when the electric circuit is closed. Illumination of the lamp indicates that the system is switched on. For GSO 50 you will find the power switch below the display unit.

Switch on the unit.

```
EOZ-S-0022-2
SYSTEM TEST
SYSTEM TEST O.K.
```

Once the system test has been successfully completed, decide which feed gas is to be used.

```
GAS TYPE:
OXYGEN:        1
AIR:           2
```

Subsequently, the main menu is accessed.

```
SETUP MENU          9
AUTOMATIC MODE      1
MANUAL MODE       ENTER
SERVICE-MODE       XXXX
```

- Press *"key 9"* in the main menu to access the set-up menu, then press *„key 3"* to select the set point value.

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```
CONTROL MODE :
   LCL   :            1
   REM  :             2
SET= 0%
```

Once the set point value (LCL [local]) has been selected, set it to 0% using the *„arrow keys“* on the operating terminal.

- Press the *„ENT key“* to return to the main menu.
  Select manual mode by pressing the *”ENT key“* in the main menu.

- Press the *„ENT key“* repeatedly to access the different menus in which the respective feed gas and coolant can be set.

- When gas pressure and cooling water are OK, press the ”ENT key“ to access the following menu:

```
CONVERTER ON :        5
```

- Press *„key 5“* to start ozone production. Now you have 10 sec. to set the gas quantity.

```
CONVERTER IS
STARTING
ADJUST
GAS FLOW    !
```

Subsequently, the ozone production (power) is indicated on the display.

```
MANUAL                SET  : int
CONVERTER OFF   - - >   6
PROD. HOURS :
SET POINT=     %     P=        W
```

- Press the *”arrow keys“* to increase or reduce the set point value. Note: Minimum power setpoint is 10% for GSO 20 to 50 and 15% for GSO 10. The converter is off (no ozone production) when the setpoint is below these values.

It is advisable to increase the set point value slowly, and to recheck all lines for leaks. Also pay attention to any ozone odor in the room.

If everything is in order, you may increase the set point value to 100% and observe the function of the system.

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At the end of the initial commissioning/start-up set the set point value back to 0%. Switch off the converter by pressing *"key 6"*, and following an automatic rinsing mode of 60 seconds, the system returns to the main menu.

This concludes the initial commissioning/start-up.

If the system is not to be used further, switch off the power switch, pull out the power connection cable, shut off the gas and cooling water.

6.4 Lighting

Only operate the system in an environment with sufficient lighting in accordance with the work place (OSHA) regulations.

6.5 Noise

Due to the noise caused during system operation, we recommend using the following to reduce the sound effects:

- ear plugs or
- ear muffs.

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7. Setting the System

7.1 General

The procedure during setting and conversion work on the system is described in this chapter. Only entrust this work to the respective qualified personnel.

The interior of the system does not contain any elements to be set by the operator!

Should it become necessary to change the setting on the interior of the machine, do not undertake any changes until this is authorized in writing by the manufacturer. Insure that previously authorized changes are performed by the respective qualified personnel.

7.2 Setting the Operating Parameters

In order to allow the produced ozone quantity and concentration to be rated as precisely as possible, it is important to observe the operating parameters. The setting curves contained in appendix 16.3 apply to the respectively indicated feed gases, a cooling water inlet temperature of 15°C (59°F) and an operating pressure of 1.5 bar abs (7.25 psig) (oxygen operation) or 2.5 bar abs (22 psig) (air operation). Deviations from these values will entail changes to the ozone quantity and concentration.

This also applies when the unit is installed at altitudes above 1000 m from sea level. The built-in pressure gauge indicates the relative system pressure in relation to the respective ambient pressure. Adapt the setting accordingly in these cases.

7.3 Setting the Ozone Production and Quantity

DANGER

Insure hat the ozone production system is only operated by trained qualified personnel. Prerequisite being, that the personnel have read and understood the operating instructions, particularly the chapter “Safety”.

Observe the performance curves and flow meter calibration curves in chapter “Appendix”.

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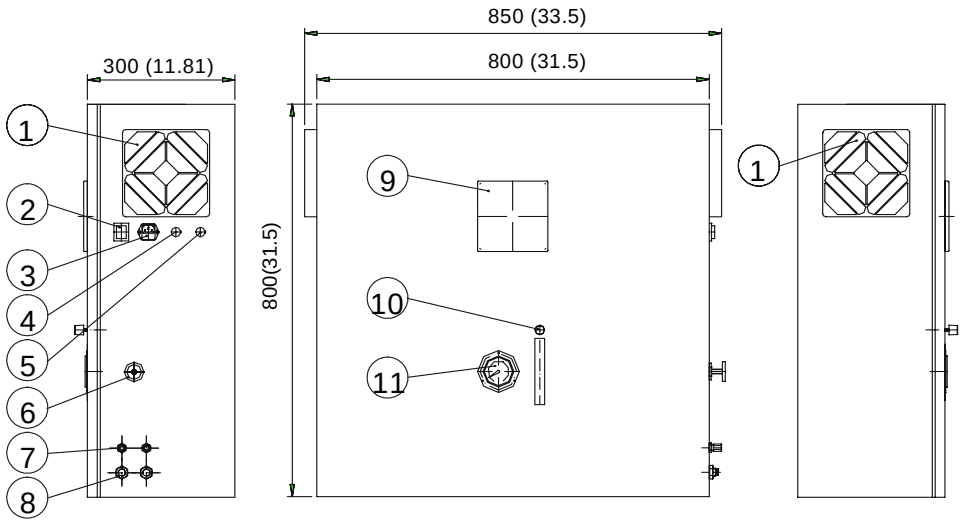

Fig. 7.1 Overall view of the system GSO 10 to 40

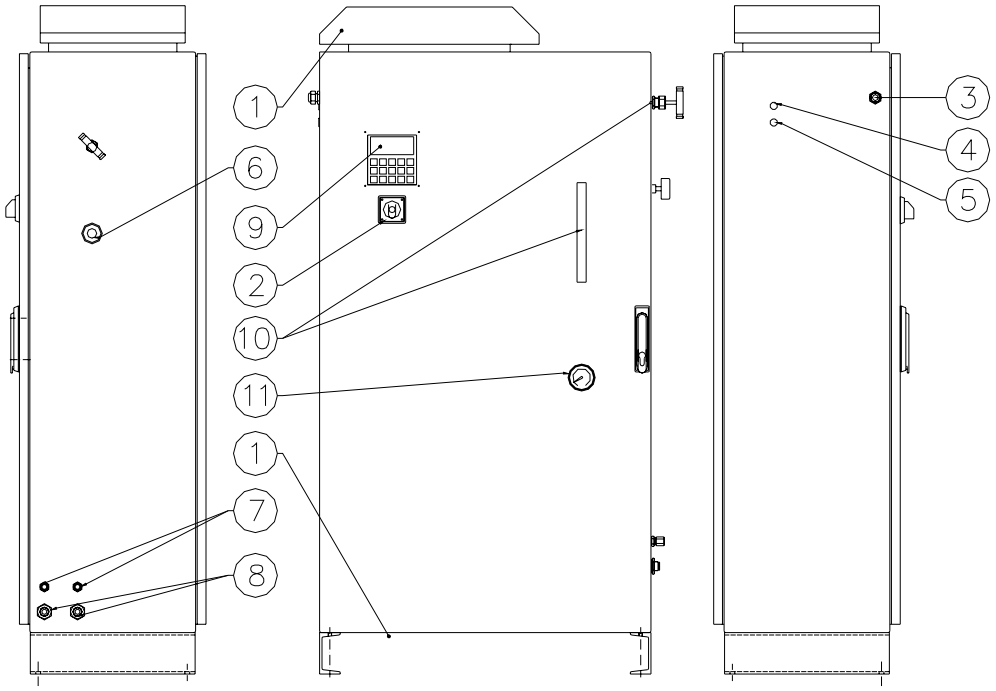

Fig. 7.2 Overall view of the system GSO 50

Legend:

1. Input / output of ventilator
2. Power switch
3. Line connector
4. Ext. set point value (X11)
5. Ext. interface (X12)
6. Pressure reducer
7. Inlet feedgas /outlet process gas
8. Inlet/outlet cooling water
9. Display (operation panel)
10. Flow meter
11. Pressure gauge

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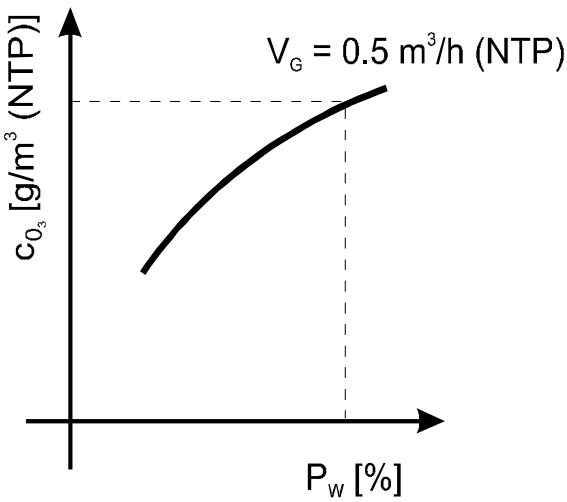
7.4 Setting the Ozone Production Quantity and Concentration

In order to set a specific ozone production quantity and concentration the characteristic curves in appendix 16.3 are needed. The characteristic curve fields 16.3.1, 16.3.2, 16.3.3 for oxygen and 16.3.4, 16.3.5, 16.3.6 for air, indicate the ozone concentration as a function of the set point value of the converter capacity in percent. A variable parameter is the gas volume flow in standard cubic meters. Multiplying this gas volume flow value by the ozone concentration yields the produced ozone quantity.



m_{o3} *(g/h)* $= C_{o3} * V_g$

m_{o3} *(lbs/day)* $= C_{o3} * V_g * D_g * 1440$ *(lbs/day)*

m_{O_3} : Ozone output [g/h] or [lbs/day]

c_{O_3} : Ozone concentration [g/m^3 (NTP)] or [%/wt]

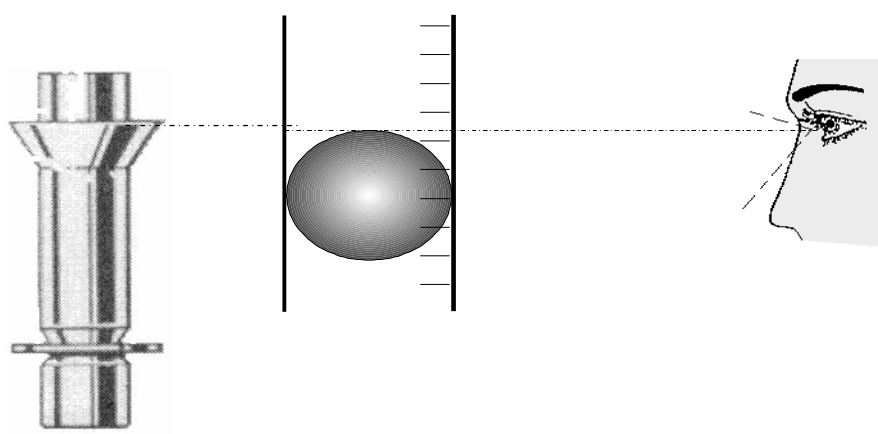
V_G : Gas volume flow [m^3/h (NTP)] or [scfm]

D_g : Gas Density lbs/ft^3) at STP

1440 = minutes/day

If the gas volume flow does not coincide with one of the curves for the selected ozone concentration and the desired ozone quantity, interpolate between the lines.

To set the previously determined gas volume flow on the unit, the setting curves for volume flow meter 16.3.7 and 16.3.8 are needed. These diagrams show the flow meter % - value as a function of the gas flow. Now set a percentage value coinciding with the gas flow determined previously. Read the volume flow meter at the top horizontal tangent of the ball.



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7.5 Measuring Processes Using an Ozone Concentration Measuring Device

If you use an ozone concentration measuring device (optionally available) for your measurements, and/or the operating conditions deviate from the values indicated above, a correction of the gas flow may indicated by the flowmeter may be required. Proceed by using the following equation:

$$V_{G,k} = V_{G,a} \cdot \sqrt{\frac{p}{p_E} \cdot \frac{T_E}{T} \cdot \frac{\rho_E}{\rho}}$$

$V_{G,k}$: Corrected gas volume flow [m^3/h (NTP)] or [scfm]
$V_{G,a}$: Read-off volume flow [m^3/h] or [cfm]
p : Operating pressure [bar abs] or [psig]
p_E : Calibration pressure [= 1.5 bar abs] or [7.35 psig]
T_E : Calibration temperature [= 293.15 K] or [68 ^oF]
T : Operating temperature [K] or [^oF]
ρ_E : Calibration density [= 1.48 kg/m^3] or [.09246 lbs/ft^3]
ρ : Density of the operating gas mixture under standardized conditions [0 °C; 1013 mbar abs] or [32°F, 14.69 psi]

The indicated volume flow in [m^3/h] or [cfm] is a result of the flow meter maximum value and the display in percent:

$$V_{G,a} = \frac{A \cdot V_{\max}}{100}$$

A : Display in [%]
V_{max} : 100% value of the flow meter (values based on feed gas Oxygen)

GSO 10/20 =[0.65 m^3/h] or [1.1 cfm]
GSO 30 = [1.5 m^3/h] or [2.55 cfm]
GSO 40 = [3.5 m^3/h] or [2.0 cfm]
GSO 50 = [5.7 m^3/h] or [3.35 cfm]

The ***corrected*** gas volume flow multiplied by the value of the ozone concentration [g/m^3(NTP)] or [%/wt x gas density x 1440 min/day] yields the produced ozone quantity.

7.6 Conversion

Conversion means adapting the system when the feed gas is changed between oxygen and air.

Change between air and O_2 as desired is possible without a reduction in performance.

ATTENTION

Observe the following points when changing from oxygen to air or from air to oxygen as the feed gas:

Use the setting curves for the respective feed gas indicated in chapter “Appendix”.

- Select the feed gas at the operating terminal.
- The system operates at an optimum outlet pressure of 2.5 bar (abs) 22 psig), with air and at 1.5 bar (abs)(7.35psig) with oxygen.
- Set the flow rate based on the setting curves.

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8. Operation

8.1 Operating and Control Elements

An operating terminal has been provided for system control and operation.

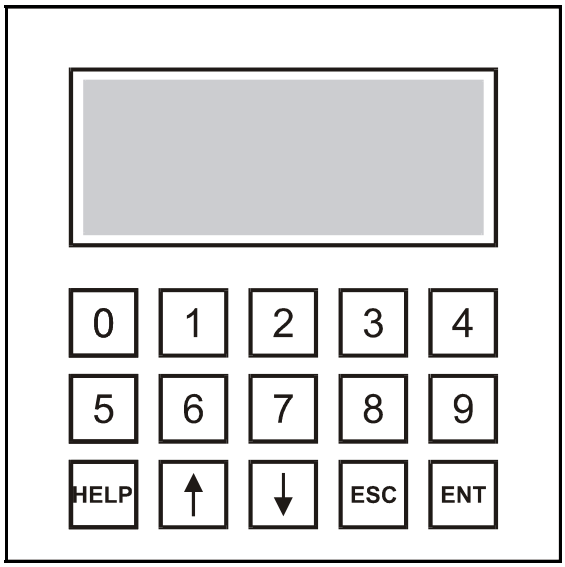

Fig. 8.1 Operating panel

- The keypad containing the numbers from 0-9 is intended for selecting the various operating modes as well as setting the date and time.
- If a fault message is displayed, press the *„HELP key“* to obtain more information regarding the cause and instructions for fault rectification.
- The *„arrow keys“* serve to set the set point value. In the set-up menu, select a specific point in the display with the aid of the arrows.
- Return to the main menu from the various sub-menus at any time by pressing the *”ESC key“*.
- Press the *”ENT key“* to save and activate the entered values.

The entered values remain saved even in the event of a power failure.

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8.2 Starting

Starting of the system is divided into the following steps:

- Switching on the system;
- Starting the system.

ATTENTION

Inform yourself about the stopping process prior to starting the system; i.e., please finish reading this chapter prior to switching on the system. Only then will you be qualified to operate the system for a normal operating sequence.

“Switching on” indicates preparing the system for production at the beginning of work.
“Starting” refers to the actual ozone production of the system for the production, e.g., following switch-on or after a brief stop (break).

ATTENTION

Visually inspect the system for defects prior to starting.

8.2.1 Switching on the System

The power switch is located beneath the input/output cooling air flow at the front of the Unit housing. This power switch is illuminated by a lamp when the electric circuit is closed. Illumination of the lamp indicates whether or not the system is switched on.

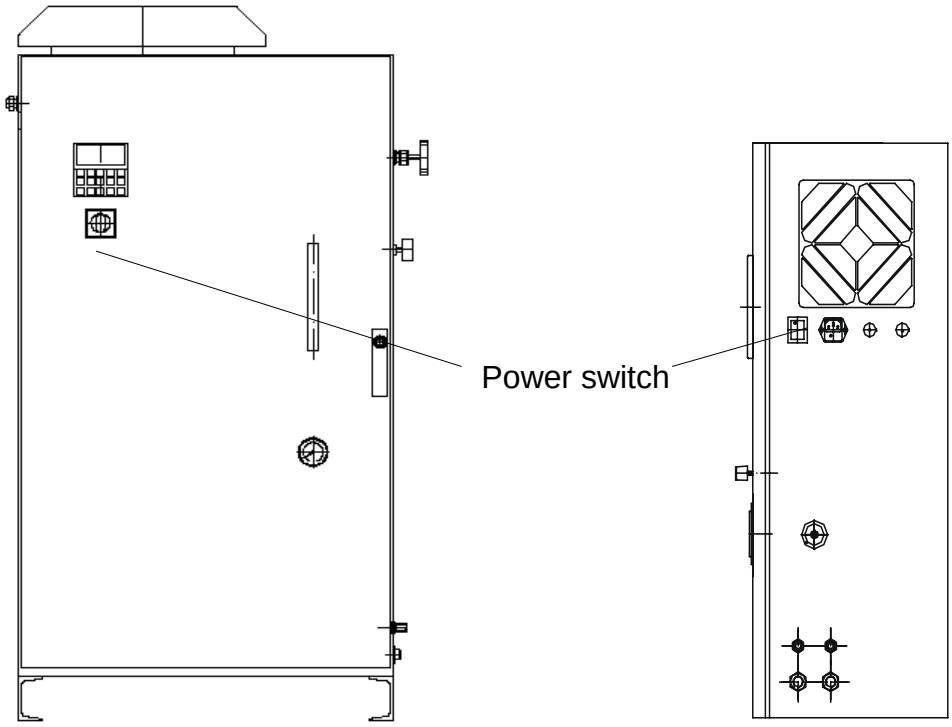

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Fig. 8.2 Position of power switch

Switch on the Unit.

```
EOZ-S-0022-2
SYSTEM TEST
SYSTEM TEST O.K.
```

- Once the system test has been successfully completed, decide which feed gas is to be used.

```
GAS TYPE:
OXYGEN:          1
AIR:             2
```

- Subsequently, the main menu is accessed.

Select between 3 different operating modes by means of the terminal.

```
SETUP MENU        9
AUTOMATIC         1
MANUAL          ENTER
SERVICE-MODE     XXXX
```


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The operating modes read as follows:

Set-up Menu
Automatic mode
Manual mode
Service Mode

8.2.2 Starting the System

Set-up Menu

- Press *"key 9"* in the main menu to access the set-up menu.

```
COUNTRY          - - >    1
SYSTEM TIME      - - >    2
SET  VALUE       - - >    3
QUIT           - - >  ENTER
```

- Once *"key 1"* has been pressed in the set-up menu, the operator can choose among 4 languages.

```
GERMAN        - - >    1
ENGLISH       - - >    2
FRENCH        - - >    3
SPAIN       - - >    4
```

The subsequent text containing information regarding operation of the system will now appear in the language selected.

- Now press *"Key 2"* in the set-up menu to set the date and time.

```
00  –  00     00:00:00
DD – MM  hh:mm:ss
```

ATTENTION

Enter the desired values for day, month, hour, minute and second each followed by pressing the "ENTER" key. If no entry is made for more than one minute the display returns to the previous screen.

- Press *"key 3"* in the set-up menu to select the control mode and adjust the set point (power level).

```
CONTROL MODE :
   LCL   :              1
   REM  :               2
SET=  0%
```

In this menu, choose between LCL (local) (from the operating terminal) or REM (remote) (0-20 mA from an external unit).
In addition, the unit allows setting the set point value to the desired value with the aid of the *"arrow keys"*. Press the *"ENT key"* to take over or save the settings.

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8.3 System Operation

Automatic mode

Press *"key 1"* in the main menu to select automatic mode.

In automatic mode, the function sequence of the system can be controlled automatically. Please note that the gas quantity and the pressure at the unit (ozone generator) must be manually set beforehand.

Two versions are available in automatic mode:
a) **External release**
b) **Time control**

```
EXT. RELEASE :        ENTER
TIME CONTROL  - - >     2
```

```
EXT. ENABLE :
PRODUCTION END:
                        ESC
```

To a) **External release** (Remote start/stop)

- Press the *"ENT key"* in automatic mode to access the "External release" mode.

External release means that the converter (ozone production) is switched on and off through an **external** signal (supplied by customer, direct voltage: +15...+24V). This signal may be supplied by a higher ranking system or a process computer. Once the signal is received, ozone production starts.

```
AUTOMATIC             SET : int

PROD: HOURS :
SET POINT=    %    P=       W
```

Terminate the ozone production with the external signal 0V. The ozone in the system is removed by purging and the unit waits for a new external release.

- If no further ozone production is desired, press the *"ESC key"* to exit the menu "External release" and return to the main menu.

If an error occurs during ozone production, the converter is switched off and an error message appears on the display.

```
ERROR ....................
MORE INFO     →     HELP
START MENU →        ESC
```


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- Press the *"HELP key"* to obtain additional information concerning the error. Press the *"ENT key"* and subsequently the *"ESC key"* to return to the main menu.

To b) **Time control**

- Press *"key 2"* in automatic mode to access the "time control" mode. In this operating mode, the system is automatically controlled over a specified time span. The unit first inquires about the gas and cooling water .

```
PRESSURE;  WATER
O.K.  ?
YES        - - >          ENTER
NO         - - >            2
```

Once the gas and coolant have been set, the unit first inquires about the starting time,

```
START TIME:
              hh:mm
ACCEPT WITH  ENTER
```

and subsequently about the stopping time.

```
STOP TIME
              hh:mm
ACCEPT WITH  ENTER
```

ATTENTION

Confirm each part of the time **individually** by pressing the *"ENT key"*.

Now press the *"ENT key"* to start the time controlled ozone production.

A 60 sec. rinsing mode takes place first. During this time the gas flow and the operating pressure can be checked and adjusted.

```
PURGE MODE
ADJUST GAS VOLUME
```

Once the internal system time reaches the saved starting time (hh.mm.), ozone production is automatically switched on.

```
AUTOMATIC            SET : int
STOPPING TIME              hh.mm.
PROD. HOURS :
SET POINT=     %      P=       W
```


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Once the saved stopping time is reached, the converter is switched off and the system returns to the start menu following the rinsing cycle.

The system will produce ozone between the two entered time points every day unless the entries for the starting and stopping time are changed. In this manner a repeated daily operation is achieved. Press the *"ESC key"* to interrupt the time controlled ozone production at any time and to return to the main menu.

If an error occurs during ozone production, the converter is switched off and an error message appears on the display.

```
ERROR ...................
MORE INFO →        HELP
START-MENU  →      ESC
```

Press the *"HELP key"* to obtain additional information concerning the error. Press the *"ENT key"* and subsequently the *"ESC key"* to return to the main menu.

ATTENTION

In order to return to the time control mode, select the time control in automatic mode, then enter and check the starting and stopping time **once again**.

The system will automatically return to the time control mode following an error.

Manual mode

- Press the *"ENT key"* in the main menu to access manual mode.

In manual mode, the system is set and controlled directly at the operating terminal. Submenus in which different operating sequences can be activated and can be accessed by pressing various keys.

Two options are available in **manual mode**:

a) **Dry mode (purge)**
b) **Manual mode**

To a) **Dry mode (purge)**

The dry mode is required for initial commissioning/start-up, trouble shooting as well as following extended down times or disassembly, in order to remove ozone and moisture from the lines.

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Once the manual mode has been selected in the main menu, the unit checks for the drying mode.

```
DRY MODE
   YES          - - >          2
   NO       - - >        ENTER
```

This is followed by an inquiry regarding the gas pressure and the cooling water.

```
PRESSURE, WATER
 OK?
   YES      - - >        ENTER
    NO      - - >          2
```

- If no gas pressure and cooling water exists, press *"key 2"* to return to the main menu.

- Press the *"ENT key"* to start the rinsing mode.

```
DRY MODE
END    - - >          4
```

- Press *"key 4"* to terminate the rinsing mode and to return to the main menu.

To b) **Manual mode**

- Once the manual mode has been selected, the system asks you for the gas pressure and the cooling water.

```
PRESSURE,  WATER
 OK?
   YES      - - >        ENTER
    NO      - - >          2
```

- If both exist, press the *"ENT key"* to confirm, and the control valve will be opened. Now set the gas quantity and gas pressure. After 60 seconds, the following will appear in the display:

```
CONVERTER ON :        5
```


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- Press *"key 5"* to start the ozone production.

```
MANUAL                    SET : int
CONVERTER OFF   - - >  6
PROD. HOUR :
SET =      %              P=       W
```

- During ozone production, the set point value and the electrical capacity are displayed. At the same time, the operating hours are displayed. Here, too, the possibility exists to terminate the ozone production by pressing *"key 6"*. Subsequently, a 60 second rinsing mode takes place automatically and the system returns to the main menu.

- During the ozone production the two *"arrow keys"* of the operating terminal are active, and can be used to raise or lower the set point value in order to set the desired ozone production.

If an error occurs during ozone production, the converter is switched off and an error message appears on the display.

```
ERROR ................
MORE INFO →        HELP
START-MENU →        ESC
```

Press the *"HELP key"* to obtain additional information concerning the error. Press the *"ENT key"* and subsequently the *"ESC key"* to return to the main menu.

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8.4 Stopping

The system can be stopped in two different ways:
- Switching off
- EMERGENCY STOP in connection with an EMERGENCY STOP circuit

8.4.1 Emergency stop

In the event of danger for man or system, the system can be immediately stopped using an EMERGENCY STOP switch. In this manner, the system is placed in a “safe status”.

Please refer to chapter “Safety” for a description of the EMERGENCY STOP switch, its position and function.

ATTENTION

Should a dangerous situation occur, such as ozone escaping or electrical accident, switch off the power switch of the system or actuate the EMERGENCY STOP button installed by the operator/owner. The electric power supply and the feed gas flow will be interrupted **instantaneously**.

8.4.2 Switching off the System

Proceed as follows:
- Terminate the ozone production by actuating the respective key on the operating terminal.
- Wait until the purge cycle has been completed.
- Actuate the power switch to switch off the system.
- Close the stop valves for feed gas and cooling water.

The main switch is located beneath the input/output cooling air flow at the front of the unit housing. This power switch is illuminated by a lamp when the electric circuit is closed. Illumination of the lamp indicates that the system is switched on. Attention the power switch for GSO-50 has no illumination. Visualization is realized by the display.

ATTENTION

If the system is not required temporarily, shut off the gas flow and close the valve on the processing side. This will save gas and also prevents water ingress into the system or the ozone generator.
Then close the stop valves of the cooling water supply line.

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9. Malfunctions

9.1 General

The ozone generator is equipped with a control system which displays abridged malfunction messages. These messages facilitate localizing simple malfunctions and enables their rectification. A certain number of malfunctions will not be reported by the control system or they are not immediately apparent from the message. These are complex malfunctions. Remedy is described below.
Insure that only the respective qualified personnel rectifies the malfunctions.

9.2 How to proceed

Prior to opening the system parts carrying gas containing ozone, continue rinsing them until no more ozone can be detected. Remove the gas in a safe manner.

Prior to starting work on ozone production elements, electrically discharge them in a safe manner.

DANGER

When trouble shooting or rectifying malfunctions in the unit, Insure that the work is only performed after the power cables have been pulled out and a waiting time of 30 minutes has elapsed.

Malfunction remedy:
Ozone production is stopped when an error message appears.

- Read the malfunction message from the control system
- Immediately rectify simple malfunctions
- Prior to rectifying a complex malfunction first read the relevant technical documentation in chapter ”Safety“
- Press the *”ESC key“*
- Start the system (refer to chapter ”Operation“)

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9.3 Error Rectification

Error, excess current

The display indicates

```
CURRENT OVERLOAD
MORE INFO →          HELP
START-MENU  →        ESC
```

- Once the *"HELP key"* has been pressed, the following will appear

```
FOR HELP
MANUAL
CHAPT. ERROR RECTIFICATION
```

Possible causes for these error messages are:

1. Short circuit in the ozone generator (glass break)
2. Short circuit in the high voltage transformer
3. Leakage in the ozone generator
4. Defective converter electronics

In order to rectify the error, switch the unit off and then on again.

If the error message appears again once the system has been switched on, notify the customer service at WEDECO Ozone Technologies.

Temperature of the electronics

The display indicates

```
TEMP. ELECTRONIC
MORE INFO →          HELP
START-MENU →         ESC
```

- Once the *"HELP key"* has been pressed, the following will appear
-

```
CHECK FAN
AND
 AIR FILTER
```

This error message indicates excessive temperature of the cooling body or high voltage transformer.

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Possible causes for this error message are:

1. Defective ventilator/fan
2. Dirty filter mat
3. Excessive ambient temperature (above 40°C)

Once the error has been localized and rectified, the unit may be switched on again.

If the error message appears again, notify the customer service at WEDECO Ozone Technologies

Temperature of ozone generator

The display indicates

```
TEMP. OZONE PRODUCER
MORE INFO →        HELP
START-MENU  →      ESC
```

Once the *"HELP key"* has been pressed, the following will appear

```
CHECK
COOLING CYCLE AND
WATER TEMPERATURE
```

This error message will appear when the temperature monitor at the cooling body of the ozone generator responds.

Possible causes for this error message are:

1. Coolant flow switched off or interrupted
2. Insufficient flow rate (refer to chapter "Technical data")
3. Excessive temperature (above 30°C)

Once the error has been localized and rectified, and after the ozone generator has cooled down (approx. 10 min.) the unit may be switched on again.

If the error message appears again, notify the customer service at WEDECO Ozone Technologies

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Error of converter

The display indicates

```
ERROR CONVERTER
MORE INFO →          HELP
START-MENU  →        ESC
```

Once the *"HELP key"* has been pressed, the following will appear

```
NO COMMUNICATION
TO THE CONVERTER
```

This error message indicates a malfunction in the communication between the converter PCB and operating terminal.

Possible cause for this error message is:

- Insufficient contact of the 9 pole plug-in connection. Check the plug-in connection, and if necessary, retighten the fastening screws. Then switch on the unit again.

If the error message appears again, notify the customer service at WEDECO Ozone Technologies.

No display on the operating terminal

If no display appears on the operating terminal when the system is switched on, this means that the safety fuse in the unit socket has tripped.

A possible cause could be a short circuit in the unit.

- Once the fuse has been replaced, the unit may be switched on again.

If the error message appears again, notify the customer service at WEDECO Ozone Technologies.

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10.Cleaning

10.1 General

Cleaning of the system is divided into two categories:

- Cleaning during operation
- Cleaning during a stop

ATTENTION

Restrict cleaning work to trained personnel

Under normal circumstances the system may be cleaned according to your own assessment. However, read the cleaning regulations prior to cleaning anything. Note the specifications on the packaging prior to using cleaning agents.

DANGER

Prevent voltage carrying parts from coming into contact with liquids, as this could lead to “short circuits”.

Avoid contact with chemicals. For example, should your hands come in direct contact with chemicals, wash them immediately.

DANGER

Do not use compressed air to clean the system. Although the dirt particles will be blown away by the compressed air, this method implies the risk that dirt particles will settle on PCBs, for example, which in turn might result in malfunctions and short circuits.

ATTENTION

When using compressed air pay attention to “parts flying off”. Be aware that this may cause injury to your eyes.
Use a vacuum cleaner for the cleaning work.

Cleaning during operation

Always keep the system clean during operation.
That means:

- Keep the exterior of the system clean
- Keep the floor clean
- Tidy up packaging material, chemicals, etc.
- Avoid leaving tools lying around

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Cleaning during a stop

Prior to opening system parts carrying gas containing ozone, continue rinsing them until no more ozone can be detected. Remove the gas in a safe manner.

Prior to starting work on ozone production elements, electrically discharge them in a safe manner, unless automatic discharge takes place through constructive measures once the system is switched off.

Never spray water in rooms accommodating ozone production systems.

DANGER

In order to prevent injuries, never reach into the running system. Clean parts within the protection device only while the system is standing still.

In order to Insure safety while the protection device is open, always switch off the power switch when the system is standing still. Pull out the power cable and wait 30 minutes prior to opening the system. In order to prevent the system from starting accidentally, always secure it against unintentional switch on. Once the cleaning has been completed, check all lines for loose connections, chafe marks and damage! Rectify any detected defects immediately!

Use a soft brush in combination with a vacuum cleaner to remove dust. A cloth misted with alcohol may also be used.

Unless explicitly specified:

- avoid corrosive cleaning agents
- never use a steel brush or other hard auxiliary means/tools

Always use lint-free cleaning cloths for cleaning the system!
Prior to maintenance and repair work, remove oil, grease or care products from the connections and screw connections, in particular!

General procedure:

1. Prior to cleaning the system using cleaning agents, cover and/or lock all openings into which no cleaning agent is allowed to ingress due to safety and/or functional reasons. Electrical components are particularly crucial. Never use water and/or steam cleaners for cleaning purposes.
2. Following cleaning, remove the protective covers or closures from the openings previously covered for cleaning purposes.

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11. Maintenance and Repair

11.1 General

The individual maintenance steps and repair work on the system are described in this chapter.

ATTENTION

Insure that maintenance and repair work is only performed by trained qualified personnel, prerequisite being that the personnel have read and understood the operating instructions, and, in particular, the chapter “Safety”.

Maintenance and inspection of the system at regular intervals is of utmost importance. This will prevent malfunctions from occurring and increase the operational safety/reliability.

11.2 How to proceed

Prior to performing maintenance and repair work, observe the information provided in chapter “Cleaning”.

When performing installation work overhead, use the provided or other safe climbing aids and operating platforms. Never climb up on system parts!
Wear safety harnesses when performing maintenance work high up!

In order to insure safety while the protection device is open, always switch off the power switch when the system is standing still. Pull out the power cable and wait 30 minutes prior to opening the system. Switch off the external voltage for an external signal and pull out the plug connection. In order to prevent the system from starting accidentally, always secure it against unintentionally switching on.

Never spray water in rooms accommodating ozone production systems.

Always retighten any screw connections loosened during the maintenance and repair work!

If it is necessary to remove the safety devices during set-up, maintenance and repair, insure that these devices are refitted and checked immediately upon completion of the maintenance and repair work.
Insure an environmentally compatible disposal of consumables and auxiliary materials as well as replacement parts!

Dispose of pollutants/contaminants in such a manner, that they imply no danger for people and the environment. Strictly observe the valid local regulations.

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Observe the accident prevention regulations!

Secure all systems upstream and downstream of the ozone system, and operating media, e.g. the feed gas, against unintentional start-up.
Prior to all maintenance, inspection and repair work, insure that the system is isolated from the power and the power cable is pulled out.

Observe any existing national regulations when working in confined spaces!

When handling oil, grease and other chemical substances, always observe the safety regulations relevant for the particular product!

Immediately exchange the specified wear and safety parts in the event of damage.

Make sure that the power is switched off prior to connecting or disconnecting cables.
Non-observance may result in an electric shock or malfunctions in the system.

If the system must be started during maintenance work (trial run), the responsible operating personnel must insure that no persons or objects are within the hazardous area.

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11.3 Maintenance Intervals

Various maintenance and control work is required during the service life of the machine. The respective intervals which must absolutely be observed are listed in this section.

Insure that maintenance and repair work is only performed when the power switch is switched off and the power connection cable is pulled out.

When working on the ozone generator or high voltage transformer, insure that the high voltage connections are grounded in accordance with the local regulations. When working on the ozone generator or gas lines, make sure that the parts are depressurized and free of ozone.

Procedure		**Interval**	
C = Check S = Set CL= Clean	R = Retighten L = Lubricate E = Exchange	d = daily w = twice a week m = monthly	sa = semi-annually y = annually

Component	Check	Procedure	Interval	Remark
Complete system				
Medium supply	Check all lines and connections for leaks	C	m	It is advisable to check the system for leaks at regular intervals. For this purpose, pressurize the machine, close the external input and output valves and reduce the admission pressure to the ambient pressure. After approx. 10 minutes, record the initial pressure (pressure gauge) and after several hours the final pressure (pressure gauge). Take pressure changes resulting from a change in the ambient temperature into account.
Safety elements				
EMERGENCY STOP switches	Function check	C	d	Refer to chapter “Safety”
Warning signs and Warning pictographs	Check to Insure perfect condition	C	d	Replace if necessary, refer to chapter “Safety“. The pictographs are listed there.
Breathing protection apparatus	Check to Insure perfect function and completeness	C	-	Check the breathing protection apparatus at regular intervals. In addition, observe all local and national regulations and directives

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Procedure				Interval		
C =	Check	R =	Retighten	d =	daily	sa = semi-annually
S =	Set	L =	Lubricate	w =	twice a week	y = annual
CL=	Clean	E =	Exchange	m =	monthly	

Component	Check	Procedure	Interval	Remark
Ozone room air monitoring	Check to Insure perfect function and completeness	C	-	Check the ozone room air monitoring devices at regular intervals. Refer to the respective manufacturer's data for information on the time intervals.
Filter mat				
	The exchange intervals depend on the installation site and ambient conditions.	E	-	Also exchange the filter mats at regular intervals.
Complete system				
Electrical component	Check	C	y	Once a year, check all screws and plug-in connections of the electrical connections to Insure tight seating. Switch off the mains voltage and pull out the power plug. Do not open the door until a time of **30 minutes** has elapsed, as the condensers on the electronics need time to discharge. Prior to starting work on ozone generators, electrically discharge them safely and **individually** at the high voltage connections. Check the converter with a suitable measuring device to insure that it does not carry voltage. Once the work has been completed, re-close the door. **Danger to life exists if the 30 minute time limit is not observed!**
General condition of the system	Visual check	C	a	Look for corrosion

Table 11-1 Maintenance table

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11.4 Spare parts

Only use original parts as listed in the spare parts list.

We expressly point out that spare parts or accessories not supplied by us, have obviously not been tested and approved by us. Therefore, the installation and/or use of such products may possibly have a negative constructive effect on the specified characteristics of the system, thus impairing active and/or passive safety characteristics. Any damage caused by the use of parts other than the original spare parts and accessories will invalidate all liability and guarantee obligations on parts of the manufacturer.

If in doubt, contact WEDECO Ozone Technologies.

Please place all spare parts orders with our Customer Service Department.

In order to insure problem-free and rapid processing of your spare parts order, we require the following data:

1. Customer
2. Identification data of the system.
3. Designation of the desired spare part
4. Desired quantity
5. Desired type of delivery

Address:

WEDECO
Ozone Technologies

14125 South Bridge Circle
Charlotte, NC 28273 USA

TEL:(704) 409-9700
FAX:(704) 295-9080

WEDECO

UmwelttechnologieGmbH

Boschstraße 6
D-32051 Herford

Tel. +49 (0)5221/930-0
Fax +49 (0)5221/930-222

Please specify all data completely to insure smooth and correct handling of your order.

12. System Shut-down and Disposal

12.1 General

The procedure for the storage and/or disposal of the system is described in this chapter.

Storage or disposal requires work, which can only be performed by the respective qualified personnel.

12.2 Disposal

Disposal of the system requires the following to be performed:

- Switching off the system (refer to chapter “Operation“)
- Disassembly/disconnection (refer to chapter ”Commissioning/starting-up the system“)
- Complete disassembly and disposal or recycling
- Disassembly may be executed according to own experience. However, please note the following remarks.

ATTENTION

The system is equipped with various parts, which must be handled with the greatest of care. Therefore, please take the following remarks into account.

Disposal may also be executed by WEDECO Ozone Technologies against a small charge.

Please contact our Customer Service Department to this effect.

12.3 Environmental Compatibility

The materials primarily used and their characteristics are listed in order to enable proper disposal.

Materials used
Steel
Stainless steel
Brass
Glass
PVC
PVDF (Attention: Hazardous waste)
PTFE
Electronic components
Surface finish
Spray-paint of steel

Table 12-1 Materials used

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12.4 Disassembly and Disconnection

Complete the following work prior to transporting the system:

DANGER

Prior to disconnecting the system from all utilities, turn off the power switch. Refer to chapter “Operation” for a description regarding switch-off.

DANGER

Prior to final shut down of the system, thoroughly rinse all lines in order to lead any residual ozone into the process or to the residual ozone destruction system.

stem is to be used at a different site, only rinse using dry gas (atmospheric dew point –60°C or lower).

Following rinsing, bring the system pressure to ambient pressure, **seal off** the gas connection lines, and drain the coolant.

Disconnect the following parts from the utilities and mountings:

- Electrical connections
- Supply connection for the media
- System parts
- Fastening devices on the wall or floor

Disconnect the system from the power Supply prior to dismantling the electrical connection. Switch off the external voltage for an external signal, and pull the plug.

Oxygen or ozone may escape when the system is disassembled. This may result in an increased risk of fire and danger of gas enrichment, particularly in clothing. Therefore, it is urgently recommended to strictly observe all safety instructions when handling oxygen and ozone (chapter “Safety”).

ATTENTION

Place the system on a pallet using a suitable lifting device. Prior to loosening the fixing devices, protecting the system against tipping over, secure the Unit with the aid of the lifting device.

ATTENTION

Insure that no leaks occur when the connections are disconnected.

Store detached cabling such that the lines and plug-in connections cannot be damaged during transport. Exclude the danger of entanglement or tripping.
The same applies to the cabling which is only to be detached from one system part and remains connected to another system part.
The disconnected system parts may now be separately transported.

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13. Technical Data

Location of the system:
With regard to interference emission, 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. Please contact the manufacturer to this effect.

Unit dimensions

Type	GSO 10/20	GSO 30	GSO 40	GSO 50	
Width	800 (31.5)			910 (35.82)	Mm (in)
Depth	300 (11.81)			490 (19.3)	Mm (in)
Height	800 (31.5)			1610 (63.4)	Mm (in)
Weight	85 (187.4)	85 (187.4)	110 (242.5)	290 (640)	Kg (lbs)

Table 13-1 Unit dimensions

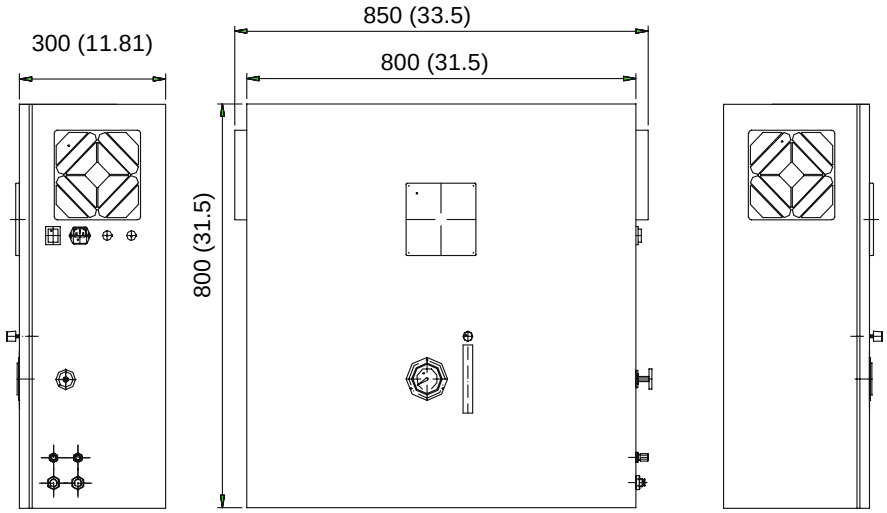

Fig.13.1 View of Unit GSO 10 to 40

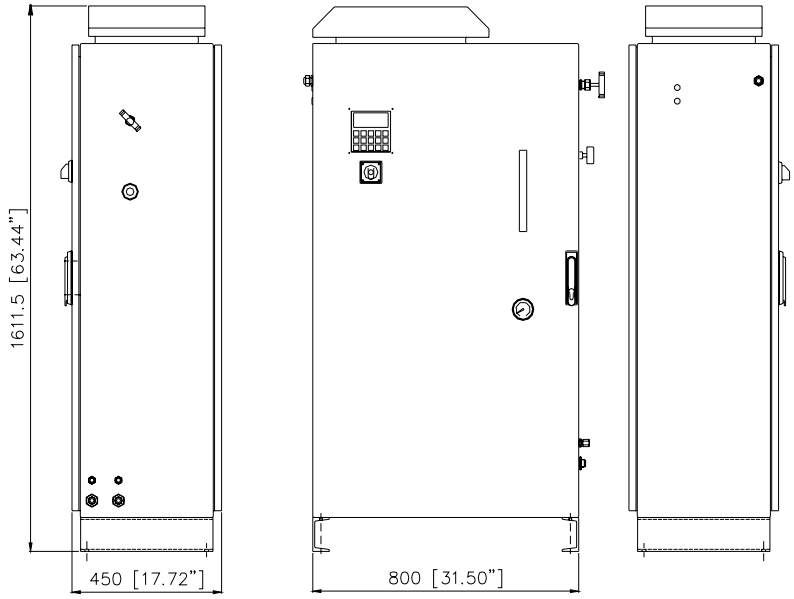

Fig.13.2 View of Unit SWO 400 / GSO 50

Nominal capacity (at a cooling water temperature at the input of 15°C - 59 °F)

Type	**GSO 10**		**GSO 20**		**GSO 30**		**GSO 40**		**GSO 50**		
Feed gas	Air	O_2	Air	O_2	Air	O_2	Air	O_2	Air	O_2	
Nominal production	9	30	25	50	46	100	92	200	203	400	g/h
Nominal production	.47	1.58	1.25	2.64	2.43	5.29	4.86	10.5	10.7	21	Lbs/day
Nominal ozone concentration	20	100	20	100	20	100	20	100	26	100	g/m^3
Nominal ozone concentration	≈1,5	≈7	≈1,5	≈7	≈1,5	≈7	≈1,5	≈7	≈1,8	≈7	%/wt
Feed gas flowrate	0,45	0,3	1,25	0,51	2,02	1,02	4,03	2,05	7,8	4,0	m^3/h
Feed gas flowrate	.29	.187	.77	.313	1.5	.63	3.0	1.25	6.63	2.5	Scfm
Output range	15...100				10...100						%
Water Flowrate	0,08 .36				0,17 .75		0,35 1.55		0,7 3.1		m^3/h gpm
Electric power consumption	0,6				1,1		2,3		4,5		KVA

Table 13-2 Nominal capacity data

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Operating data of the ozone generator

Feed gas: Air and oxygen

Type		GSO 10		GSO 20		GSO 30		GSO 40		GSO 50	
Feed gas		Air	O_2	Air	O_2	Air	O_2	Air	O_2	Air	O_2
Inlet pressure	Barg (psig)	2,5...6 (22…73.5)									
Outlet pressure	Barg (psig)	≈1,5 (22)	≈0,5 (7.25)	≈1,5 (22)	≈0,5 (7.25)	≈1,5 (22)	≈0,5 (7.25)	≈1,5 (22)	≈0,5 (7.25)	≈1,5 (22)	≈0,5 (7.25)
Temperature	°C/°F	5...25/41…77									
Gas flow range	Nm^3/h	0,08... 0,9	0,06... 0,65	0,08... 0,9	0,06... 0,65	0,3.... 2,1	0,2... 1,5	0,4.... 4,9	0,35.. 3,5	1,0... 7,8	0,45.. 5,7
Gas flow range	Scfm	0,05... 0,6	0,04... 0,4	0,05... 0,6	0,04... 0,4	0,17... 1,2	0,12... 0,88	0,25... 2,9	0,2.. 2,0	,58... 4,5	0,26.. 3,4
Ozone concentration	wt %	Air: 0...4 O_2: 0...13									

Table 13-3 Operating parameters, feed gas

Electrical data:

Type	**GSO 10**	**GSO 20**	**GSO 30**	**GSO 40**	**GSO 50**	
Main voltage	230 ±10%, 1-phase				440 ±10%, 3-phase	V_{AC}
Mains frequency	48...62					Hz
Mains current consumption	2,5	2,5	5	10	6,5	$Amps_{AC}$
Mains power consumption	0,6	0,6	1,15	2,3	4,5	KVA
Mains power factor	0,99				0,95	cosφ

Table 13-4 Electrical data

- Power set point value from external source (remote setpoint)
  0 ... 20 mA = 0…100%

- External interface

  External Interlock (relay contact)
  Local/Remote setpoint (relay contact) Open = Local - Closed = Remote
  External start/stop (+24 Vdc direct voltage) +24 = "start" - 0 = "stop"

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14. Nomenclature

BGZ	Employer's Liability Insurance Association for safety and health
EMC	Electromagnetic compatibility
O_2	Oxygen
O_3	Ozone
RI diagram	Pipeline and instrument diagram
UVV	Accident prevention regulations
VBG	Administrative Employer's Liability Insurance

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15. Quoted or supplemental rules and regulations

- BGZ documentation ZH 1/77
  "Directives for working in containers and confined rooms"
- BGZ documentation ZH 1/81
  "Leaflet for hazardous substances"
- BGZ documentation ZH 1/143
  "Instructions for first aid in the event of accidents"
- BGZ documentation ZH 1/307
  "Leaflet: Handling oxygen"
- BGZ documentation ZH 1/383
  "Leaflet: Danger due to oxygen"
- BGZ documentation ZH 1/474
  "Directives for the use of ozone in water treatment"
- BGZ documentation (ZH 1/701)
  "Regulations for the use of protective breathing apparatus"
- BGZ documentation (ZH 1/600.26)
  "Selection criteria for special industrial medical precautions in accordance with the Employer's Liability Insurance principles G 26. Protective breathing apparatus"
- Accident prevention regulation "Oxygen" VBG 62
- Accident prevention regulation "Gases" VBG 61
- Administrative Employer's Liability Insurance VBG 125
  "Safety and health protection identification at the workplace"
- Informational sheet from Linde "Safety instructions for handling oxygen"
- **WEDECO** Operating instructions No. 4 "Handling oxygen"
- **WEDECO** Operating instructions No. 5 "Handling ozone"
- DIN 2403 "Identification of pipelines in accordance with the flow substance"
- DIN 3181 "Breathing apparatus"
- DIN 19627 "Ozone production systems for water treatment application"

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16. Appendix

16.1 Spare Parts List for Model GSO 10 to 40

16.1.1 Electrical

Article	Art. No.	GSO-10/20	GSO-30	GSO-40
Mains filter, single phase	31693	1 pc.	1 pc.	1 pc.
Converter module	900001	1 pc.	1 pc.	1 pc.
Axial ventilator	31690	1 pc.	1 pc.	1 pc.
3 poles receptacle	31687	1 pc.	1 pc.	1 pc.
6 poles receptacle	31688	1 pc.	1 pc.	1 pc.
3 pole plug	31685	1 pc.	1 pc.	1 pc.
6 pole plug	31686	1 pc.	1 pc.	1 pc.
HV transformer	31680	1 pc.	1 pc.	-
HV transformer	31681	-	-	1 pc.
2 pole rocker switch, illuminated	31683	1 pc.	1 pc.	1 pc.
IEC socket	31684	1 pc.	1 pc.	1 pc.
Safety fuse, medium delay action	31708	1 pc.	1 pc.	1 pc.
Display module	31689	1 pc.	1 pc.	1 pc.
Intermediate circuit Throttle	34710	1 pc.	-	-
Intermediate circuit Throttle	31682	-	1 pc.	2 pc.

16.1.2 Mechanical

Article	Art. No.	GSO 10/20	GSO-30	GSO-40
Ozone generator module	201552	-	1 pc.	2 pc.
Ozone generator module	201740	1 pc.		
Temperature monitor	17043	1 pc.	1 pc.	2 pc.
Pressure reducer	34579	1 pc.	1 pc.	1 pc.
Flow meter 0.06-0.6 m^3/h	34604	1 pc.	-	-
Flow meter 0.15-1.5 m^3/h	31640	-	1 pc.	-
Flow meter 0.35-3.5 m^3/h	31637	-	-	1 pc.
Solenoid valve	34616	1 pc.	1 pc.	1 pc.
Pressure gauge	34383	1 pc.	1 pc.	1 pc.

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16.1.3 Miscellaneous

Article	Art. No.	GSO10/20	GSO-30	GSO-40
Hose PTFE ø10x1	12943	1 pc.	1 pc.	1 pc.
Hose PA ø10x1	31736	1 pc.	1 pc.	1 pc.
Teflon strip	15873	1 pc.	1 pc.	1 pc.
Set of supporting sleeves	900002	1 pc.	1 pc.	1 pc.
Set of clamping rings	900003	1 pc.	1 pc.	1 pc.
Set of screw connections	900004	1 pc.	1 pc.	1 pc.
Filter mat	31691	2 pc.	2 pc.	2 pc.
Power connection cable	31853	1 pc.	1 pc.	1 pc.

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16.2 Spare Parts List for Model GSO 50

16.2.1 Electrical

Article	Art. No.	GSO-50
Mains filter, 3 phase	34139	1 pc.
Converter module	90005	1 pc.
3 poles receptacle	31687	1 pc.
6 poles receptacle	31688	1 pc.
3 pole plug	31685	1 pc.
6 pole plug	31686	1 pc.
HV transformer	34120	1 pc.
Display module	31689	1 pc.
Intermediate Inductor	34121	1 pc.
Net Choke	34122	1 pc.

16.2.2 Mechanical

Article	Art. No.	GSO-50
Ozone generator module	201603	2 pc.
Temperature monitor	17043	2 pc.
Pressure reducer	32321	1 pc.
Flow meter 0.6 to 5,7 m^3/h	34393	1 pc.
Solenoid valve	34158	1 pc.
Pressure gauge	34383	1 pc.

16.2.3 Miscellaneous

Article	Art. No.	GSO-50
Hose PTFE ø12x1	12905	1 pc.
Hose PA ø12/10	34048	1 pc.
Teflon strip	15873	1 pc.
Set of supporting sleeves	900006	1 pc.
Set of clamping rings	900007	1 pc.
Set of screw connections	900008	1 pc.

16.3 Operating Instruction

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16.3.1 Operating Instruction "Handling Oxygen"

No.: 4	**Operating instructions**	Prepared by: Issued: Date:
Validity range:	Handling oxygen Ozone system	
Hazardous substance designation		
Oxygen		
Danger to man and environment		
Danger symbols with danger designation Fire promoting	**Oxygen is highly fire promoting.** **Note that an increased risk of fire exists when wearing clothing contaminated with oxygen.** Prolonged inhalation of pure oxygen may lead to lung damage and functional disorders of the autonomic nervous system. Liquid oxygen may cause serious frostbite.	
Protective measures and behavioral rules		
Mandatory and prohibiting sign 	Insure that all parts coming in contact with oxygen are kept free of oil and grease. Fire, naked flame and smoking is prohibited. Keep clear of ignition sources. We refer to the in-company training offered by **WEDECO** for instructions concerning the handling of ozone and oxygen.	
Behavior in the event of a dangerous incident		
Additional measure in case of Danger 	Interrupt the oxygen Supply. Observe the identified escape routes.	
First aid	**EMERGENCY call:** **Initial assistance:**	
Leave the danger area. Rescue injured persons from the danger area while exercising self-protection measures. Keep injured person calm, protect against heat dissipation. Immediately remove all clothing (including underwear and shoes) contaminated with oxygen. Be aware of fire danger. Cover frost-bitten areas using sterile materials, never move or rub frost-bitten limbs. Use padding and carefully apply bandages. Immediately notify a physician or ophthalmologist. Inform the physician of the oxygen exposure and the first aid measures taken.		
Proper disposal		
Insure adequate ventilation		

Danger

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16.3.2 Operating Instruction "Handling Ozone"

No.: 5	**Operating instructions**	Prepared by: Issued: Date:
Validity range:	Handling ozone Ozone system	

Hazardous substance designation

Ozone

Danger to man and environment

Danger symbols with danger designation Fire promoting Extremely toxic	**Ozone is highly fire promoting.** **Note that an increased risk of fire exists when wearing clothing contaminated with ozone.** Ozone may result in poisoning when inhaled. Irritation of the eyes and mucous membranes, deadening of the sense of smell. Difficulty in breathing to pulmonary edema. Higher ozone contents (exceeding 10 ml/m^3 for a prolonged exposure) result in death.

Protective measures and behavioral rules

Mandatory and prohibiting signs 	Ozone has an intensive, unmistakable odor, clearly lying below the maximum workplace concentration value of 0.1 ml/m^3. At the first sign of ozone odor: Switch off the ozone generator. Insure that all parts coming in contact with the ozone are kept free of oil and grease. Fire, naked flame and smoking are prohibited. Keep clear of ignition sources. We refer to the in-company training offered by **WEDECO** for instructions concerning the handling of ozone and oxygen.

Behavior in the event of a dangerous incident

 Breathing protection apparatus Ozone resistant full mask, gas filter DIN 3181-NO or DIN 3181-CO	Interrupt ozone production when the gas detectors respond. Observe the identified escape routes. Check the operatives of the aeration system. Only enter rooms in which an ozone accumulation is suspected using breathing protection apparatus to rescue an injured person or to avert acute danger. Warn anyone within the vicinity.

First Aid	**EMERGENCY call:** **Initial assistance:**

Move the person out into the fresh air.
Immediately remove clothing (including underwear and shoes) contaminated with ozone.
Be aware of fire danger.
In the event of breathing difficulties, administer oxygen.
Keep injured person absolutely calm, protect against heat dissipation.
Check pulse, breathing, and consciousness.
If conscious ⇒ move into secure side position.
If breathing stops ⇒ perform CPR.
Immediately notify a physician. Inform the physician of the ozone exposure and the first aid measures taken.

Proper disposal

Residual ozone removal system (catalytic converter)

Danger

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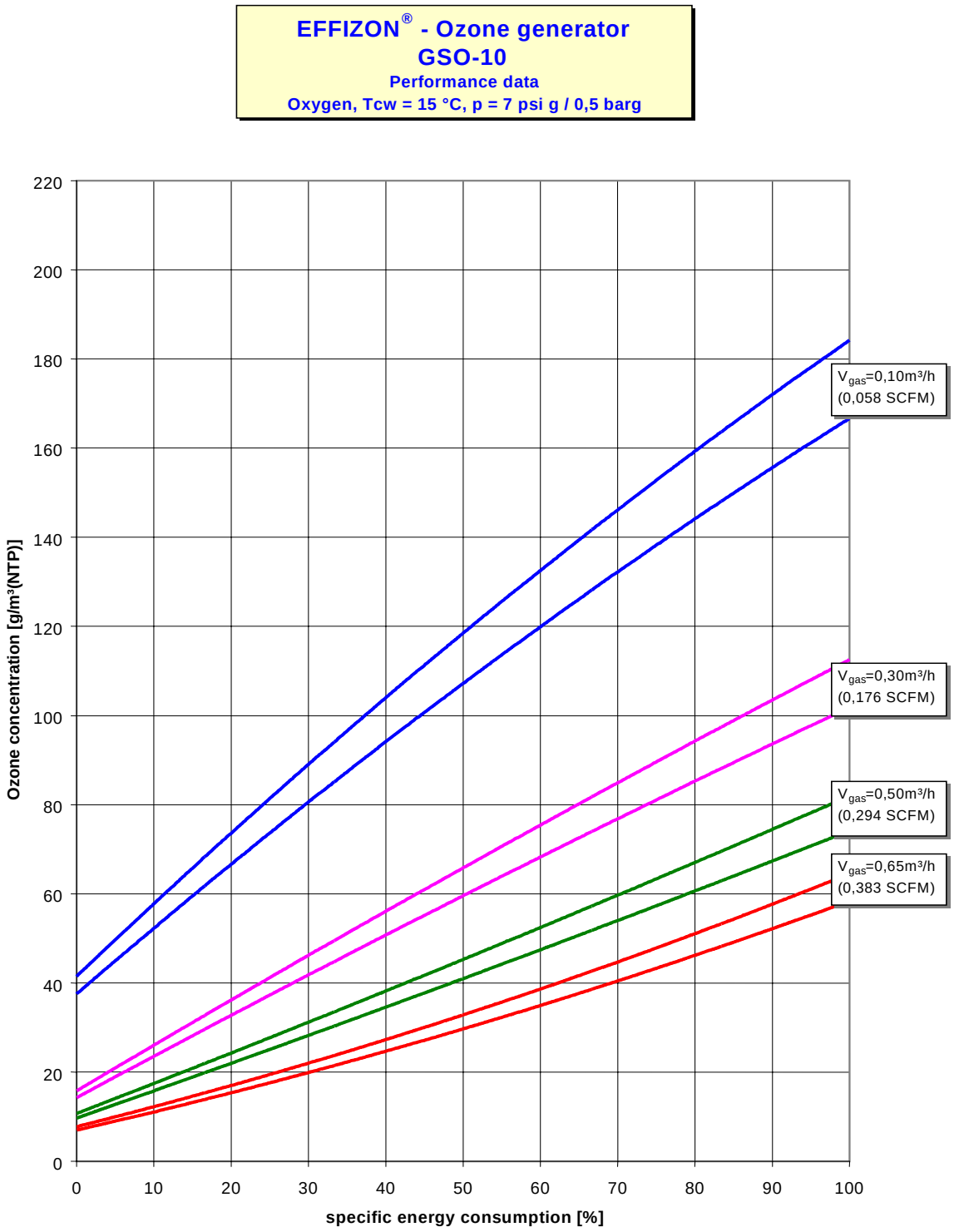
16.4 Performance Curves

16.4.1 Performance GSO 10 – Oxygen



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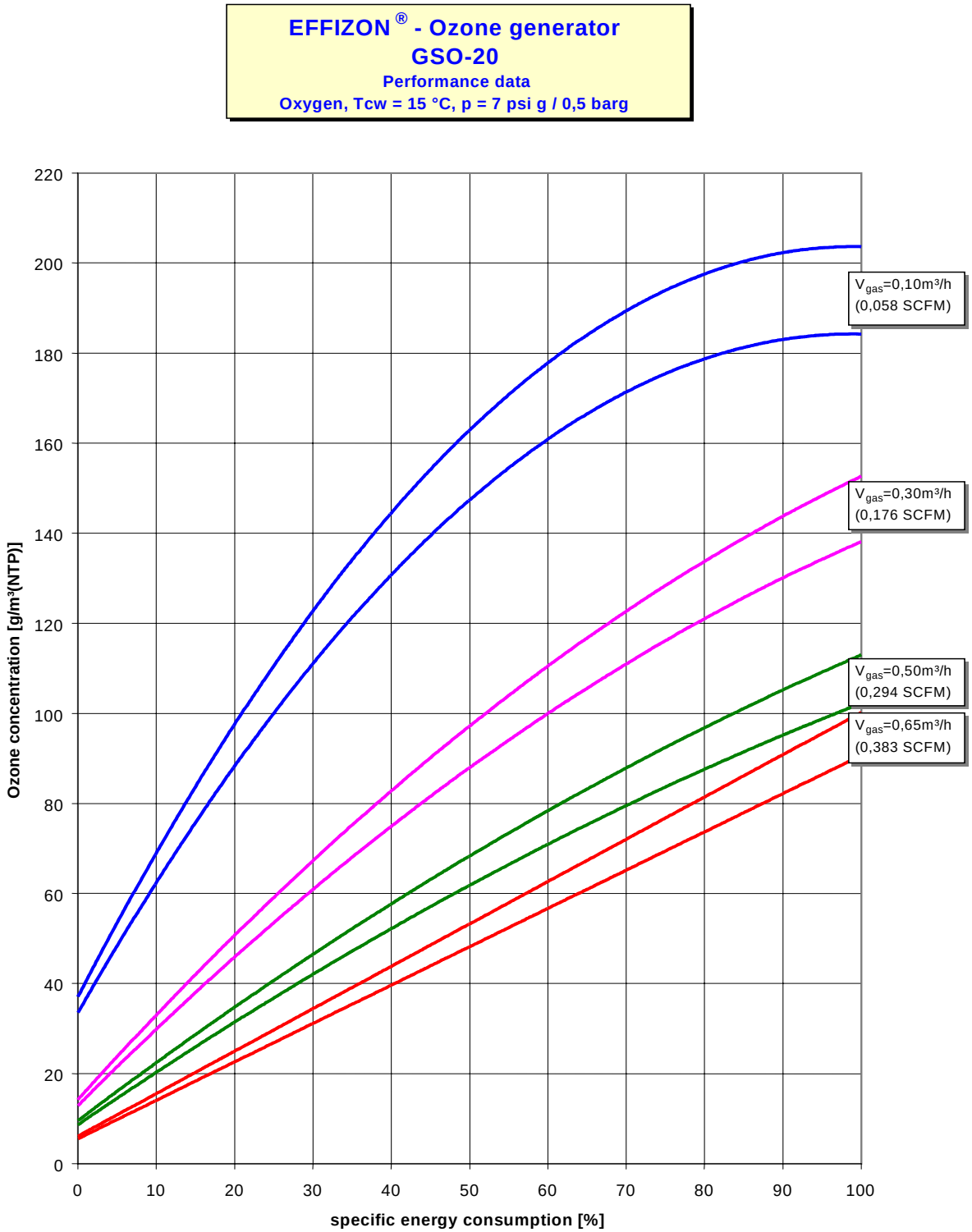
16.4.2 Performance GSO 20 - Oxygen



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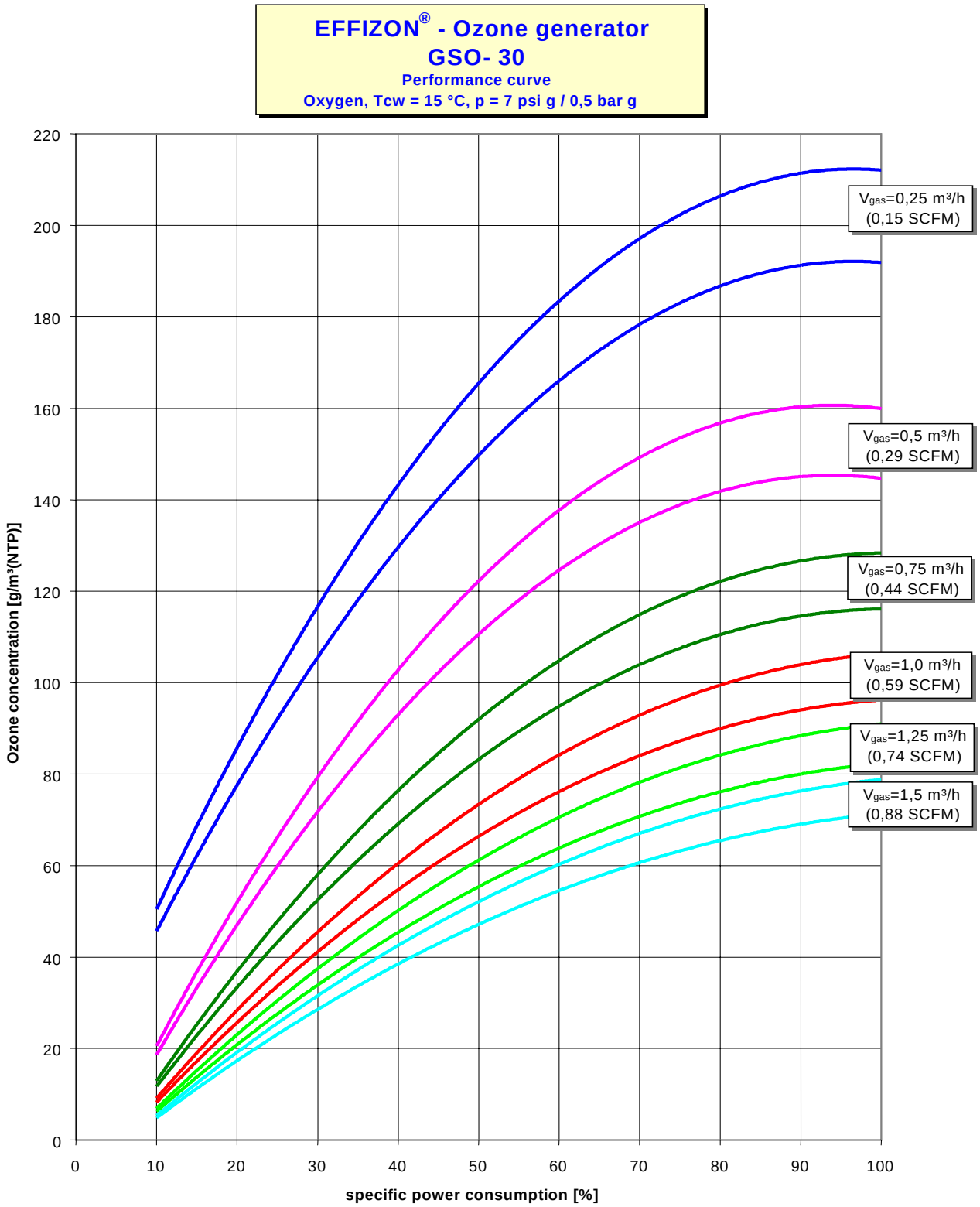
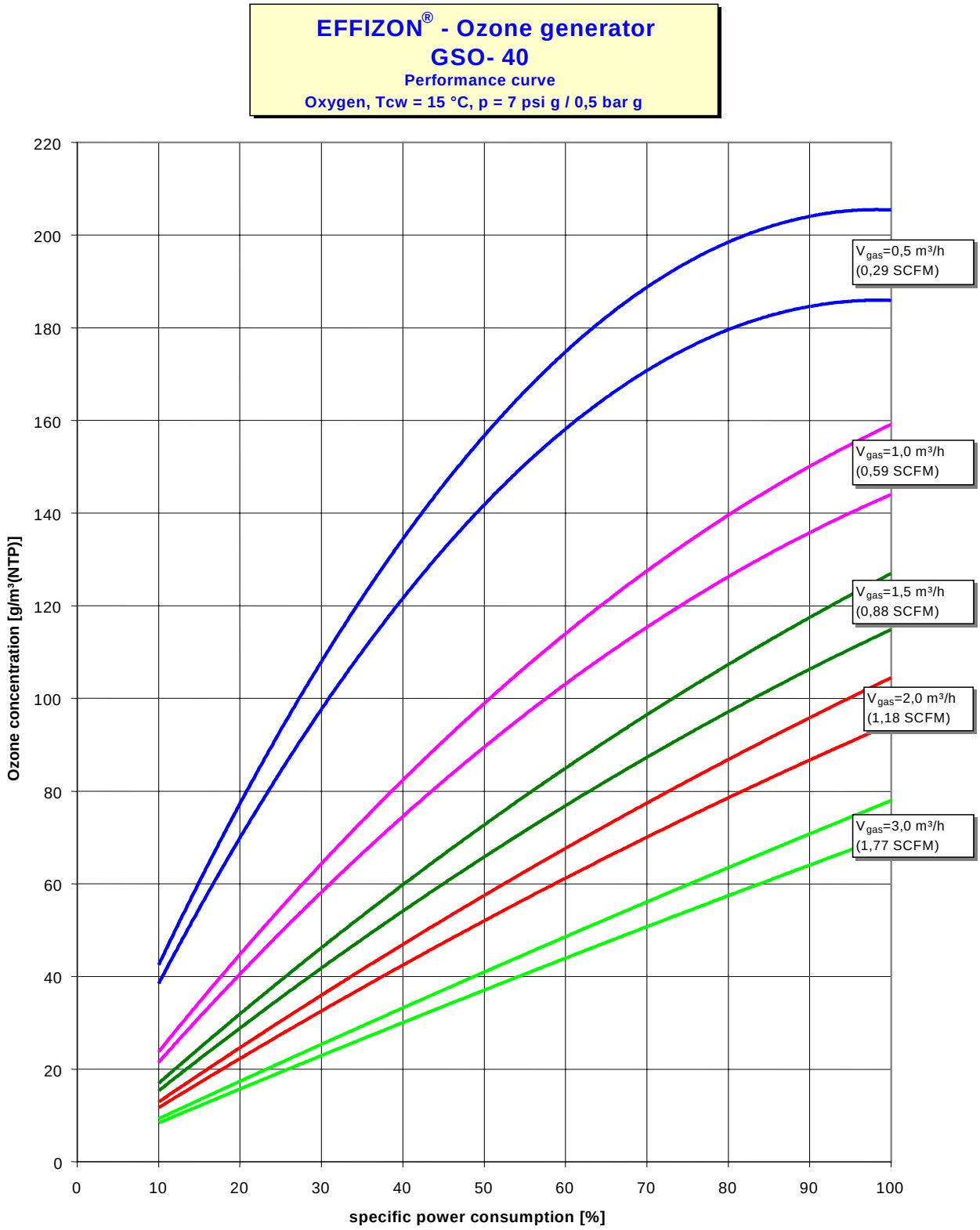
16.4.3 Performance GSO 30 - Oxygen



16.4.4 Performance GSO 40 - Oxygen



16.4.5 Performance GSO 50 - Oxygen

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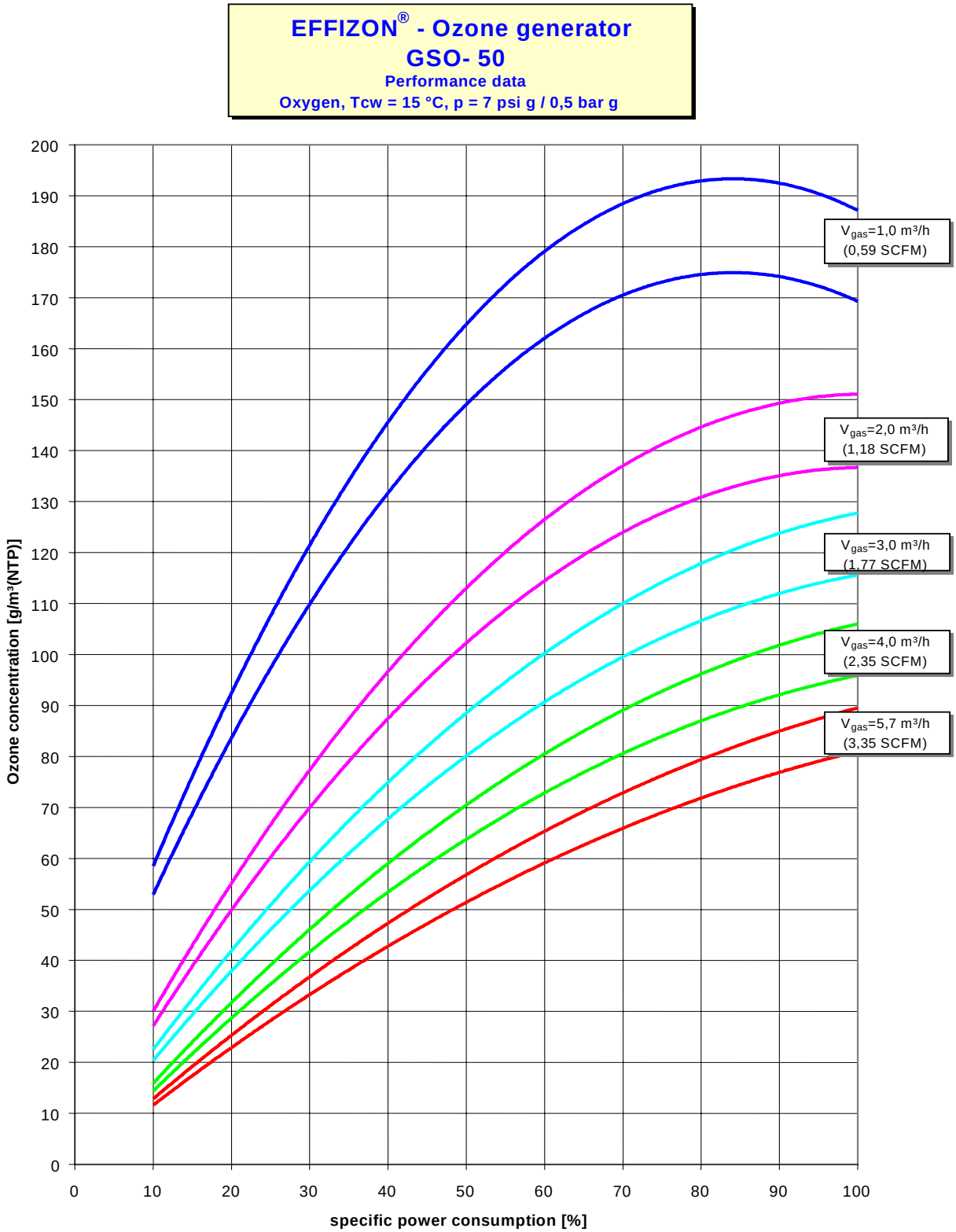
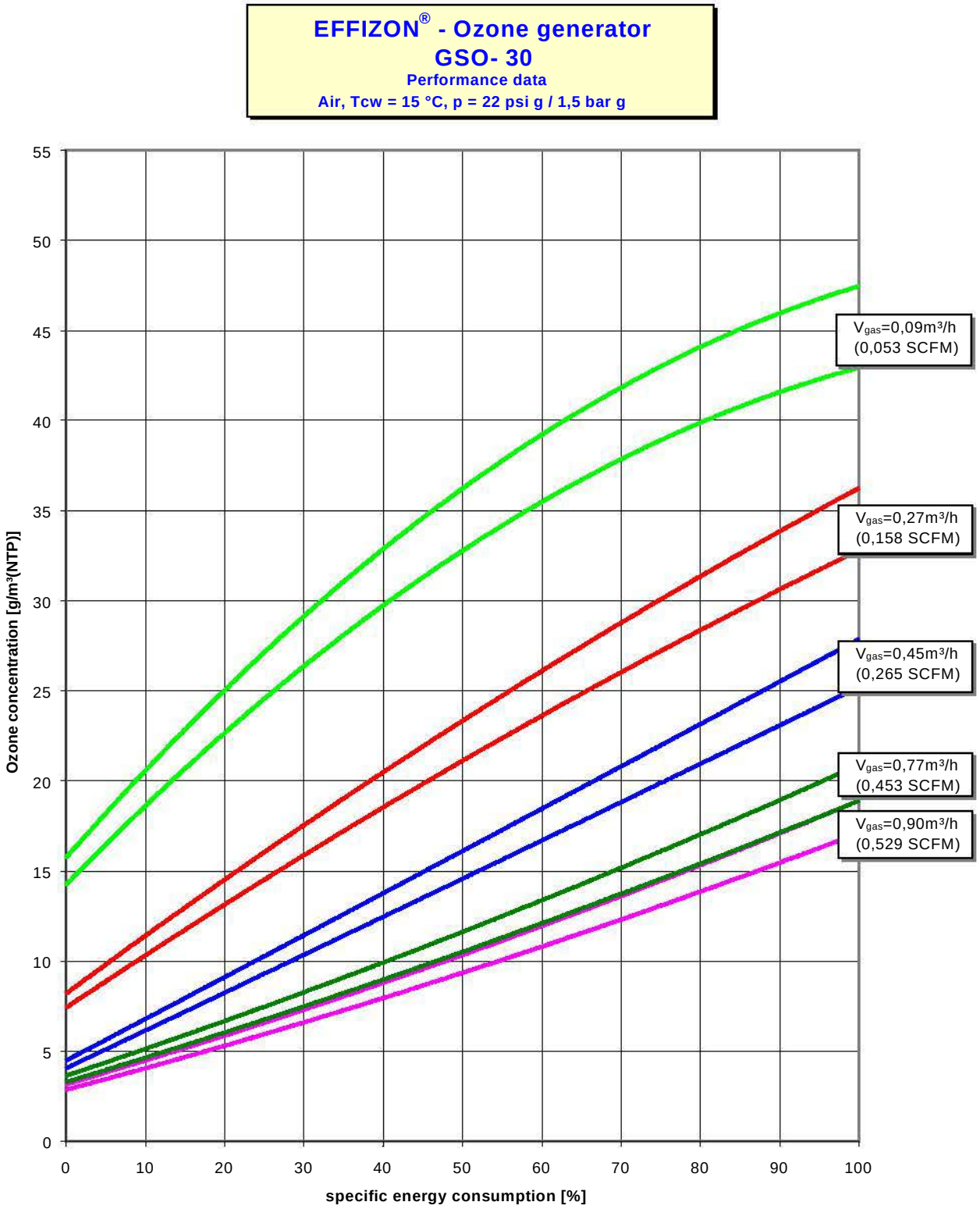


16.4.6 Performance GSO 10 – Air



16.4.7 Performance GSO 20 – Air

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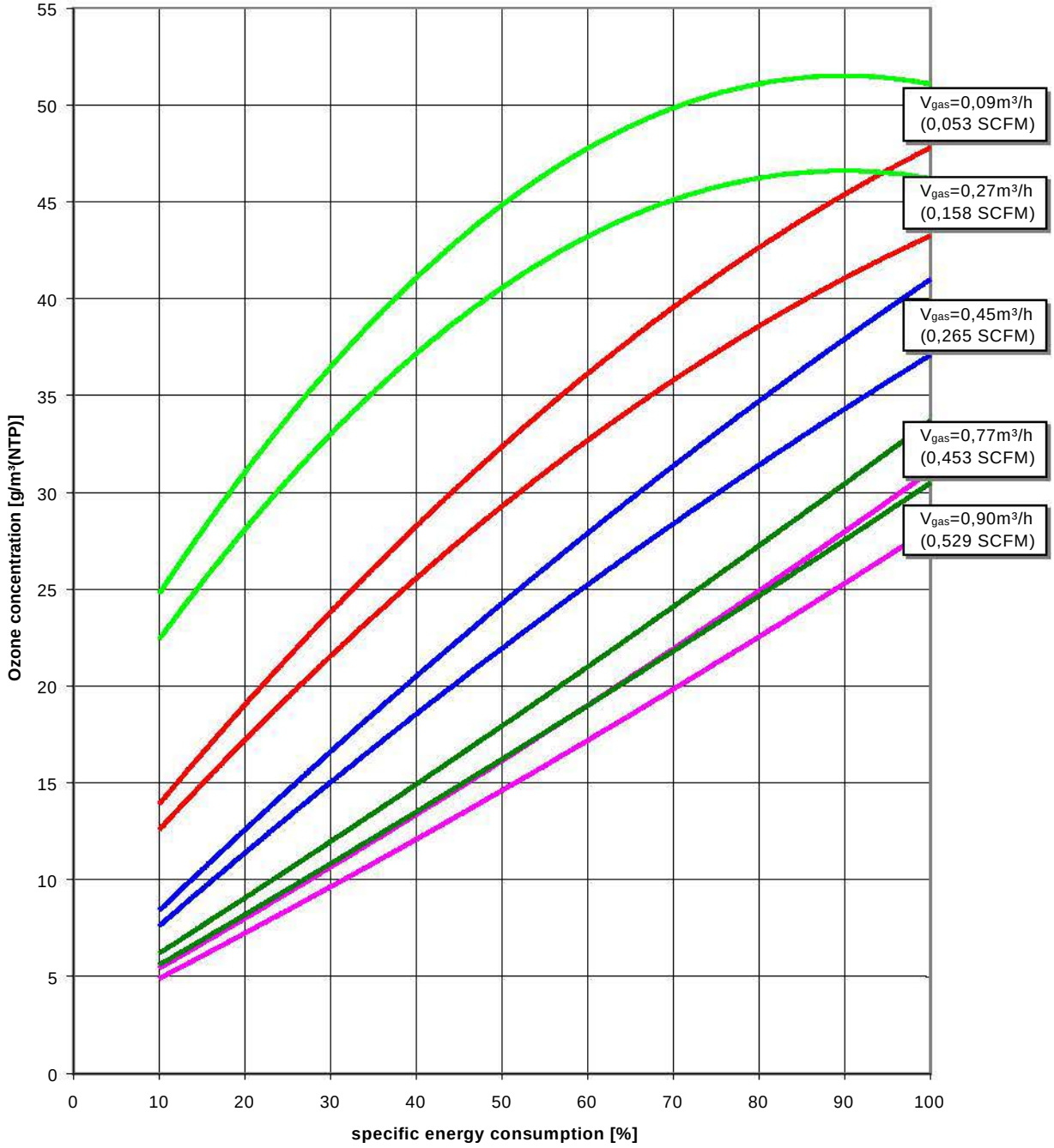
EFFIZON® - Ozone generator
GSO 20
Performance data
Air, Tcw = 15 °C, p = 22 psi g / 1,5 bar g



16.4.8 Performance GSO 30 - Air

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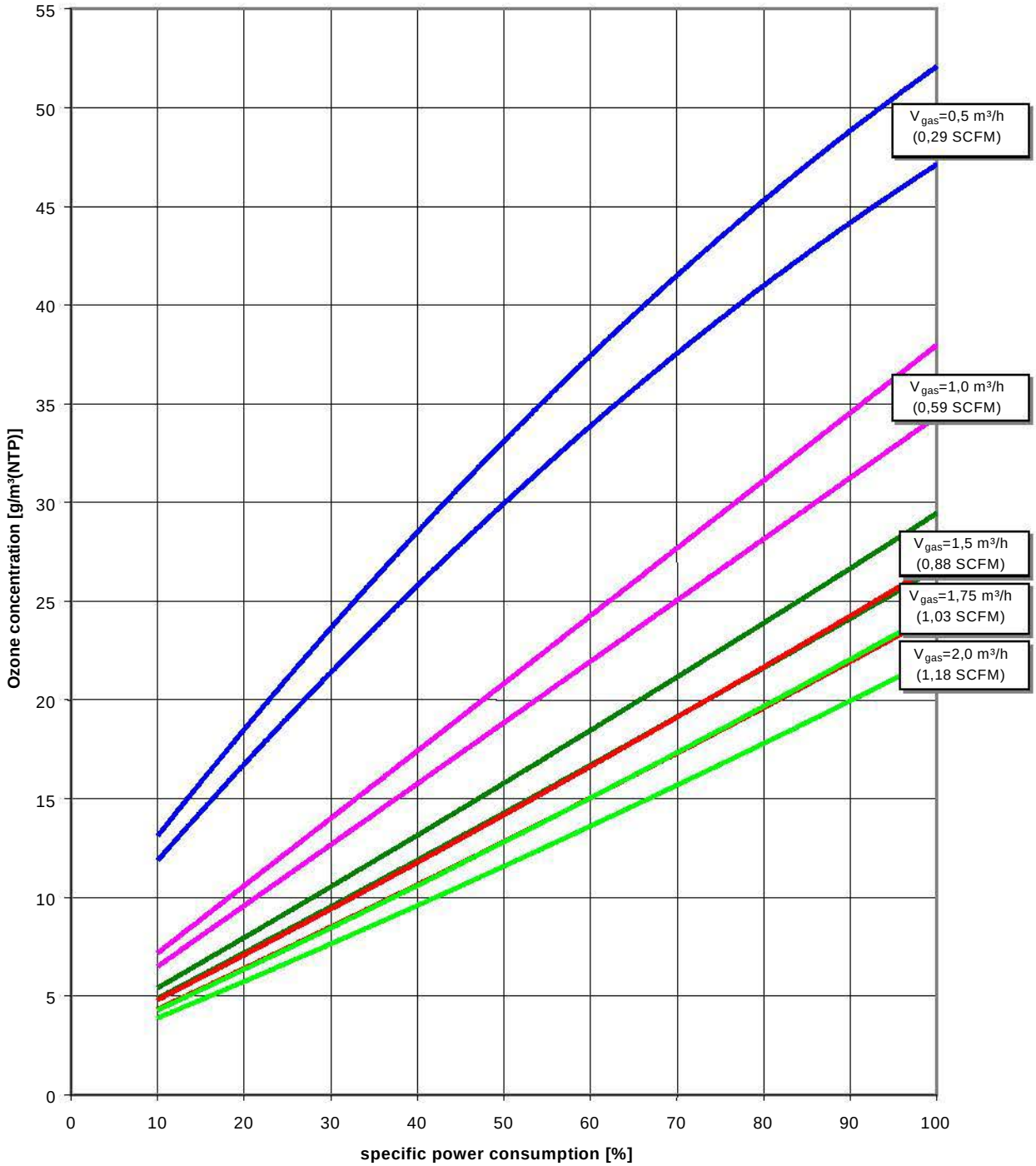
EFFIZON® - Ozone generator
GSO-30
Performance curve
Air, Tcw = 15 °C, p = 22 psi g / 1,5 bar g



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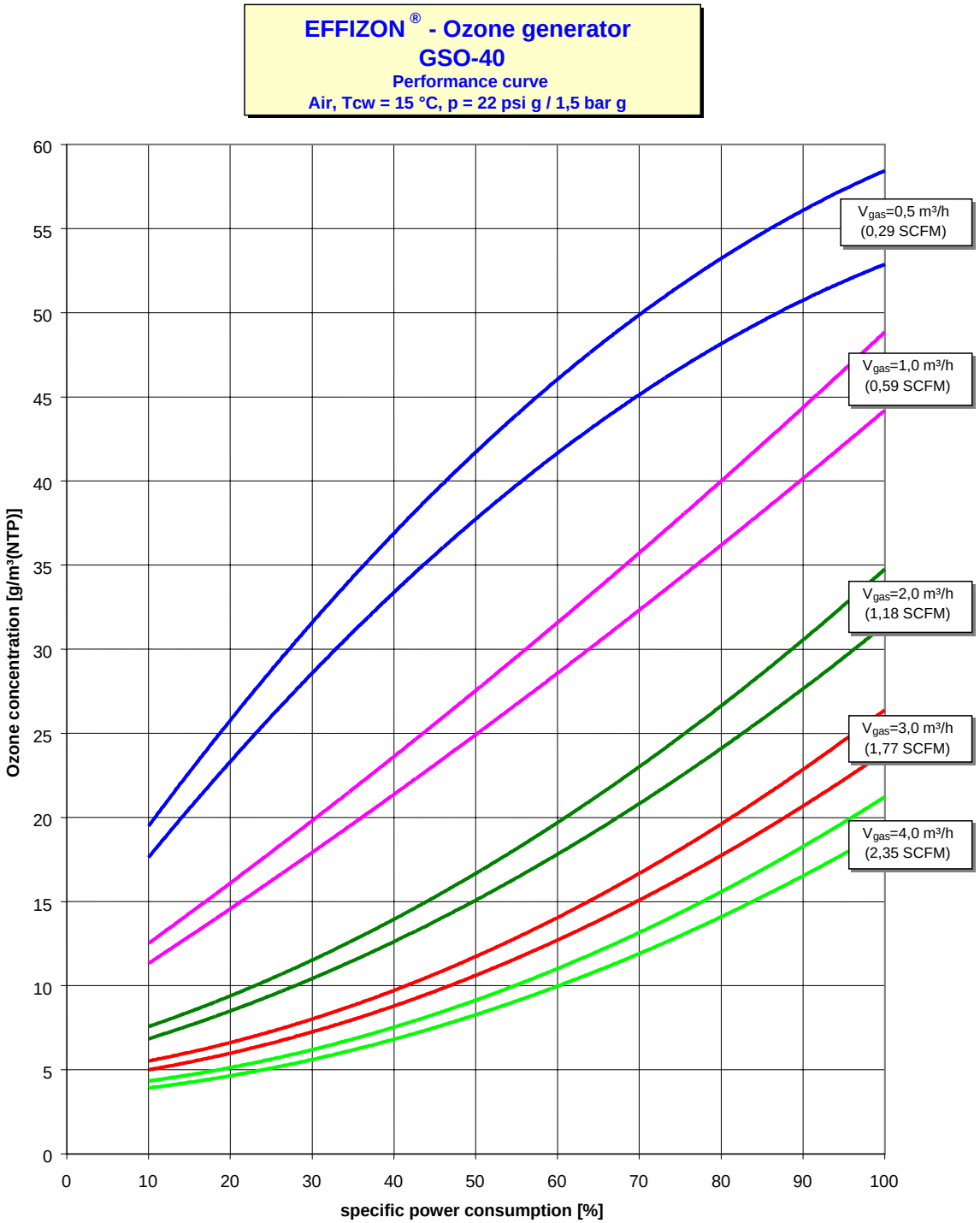
16.4.9 Performance GSO 40 - Air



16.4.10 Performance GSO 50 - Air

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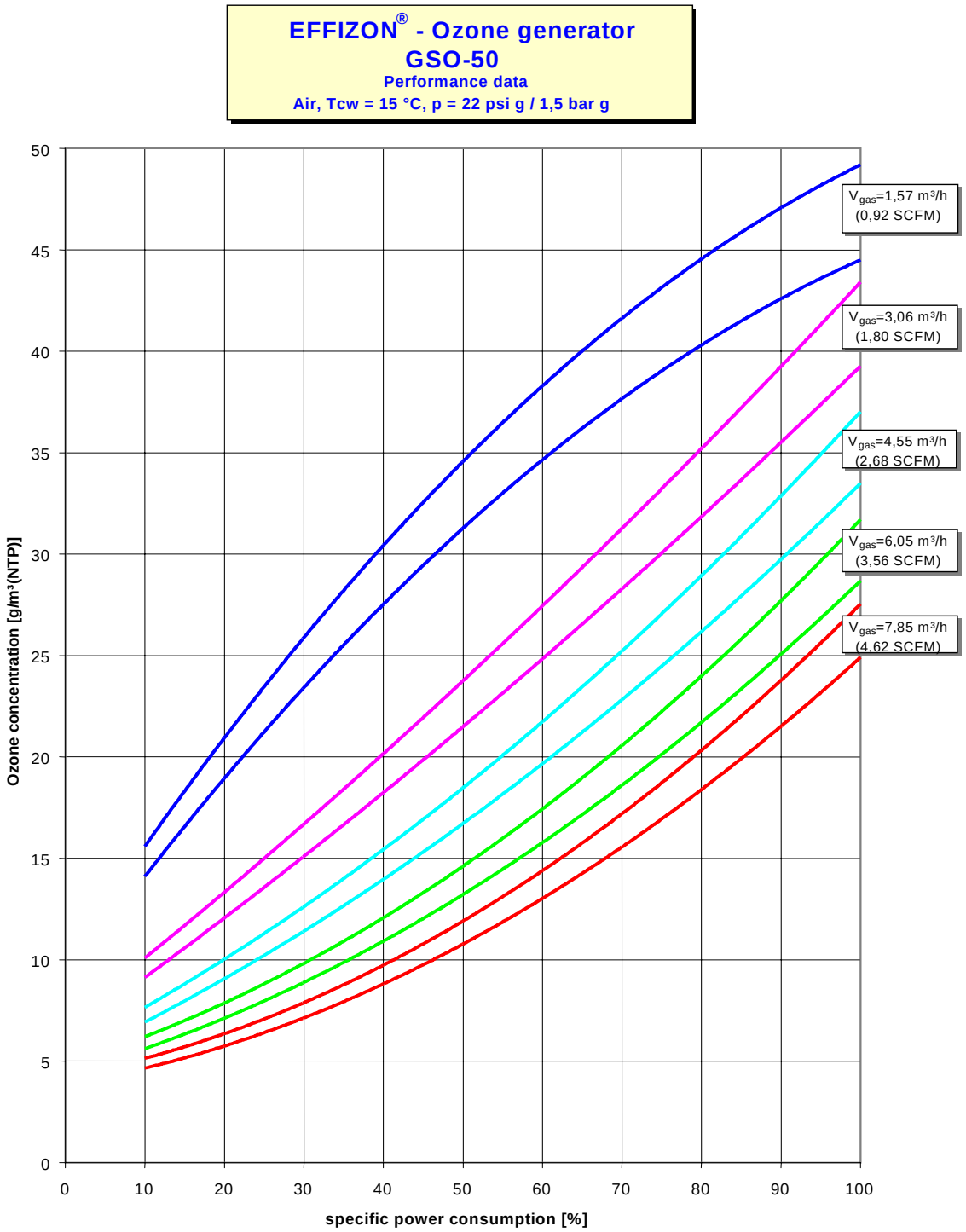

16.4.11 Gas Flow Meter Calibration Curve GSO 10 -20

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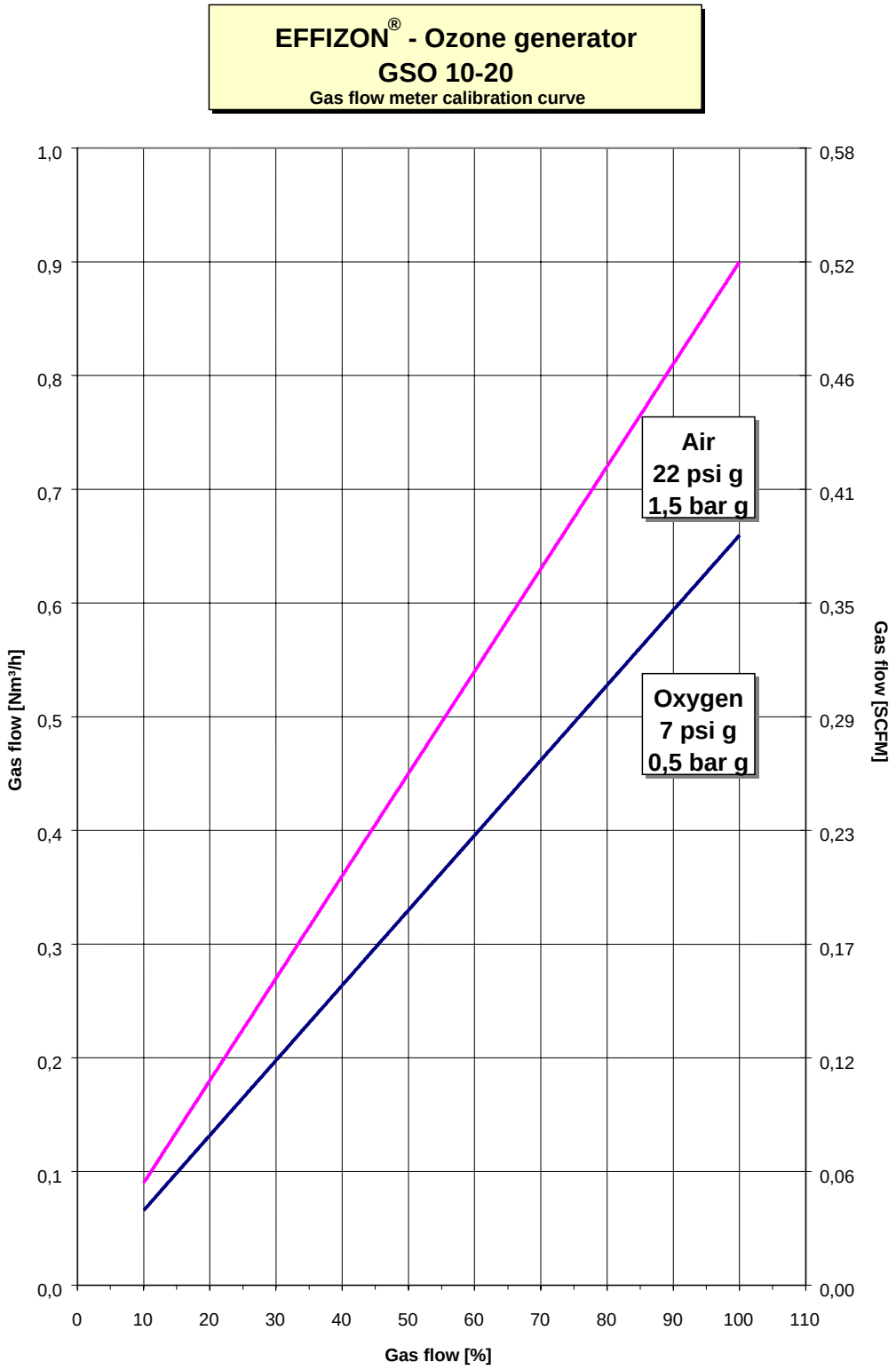
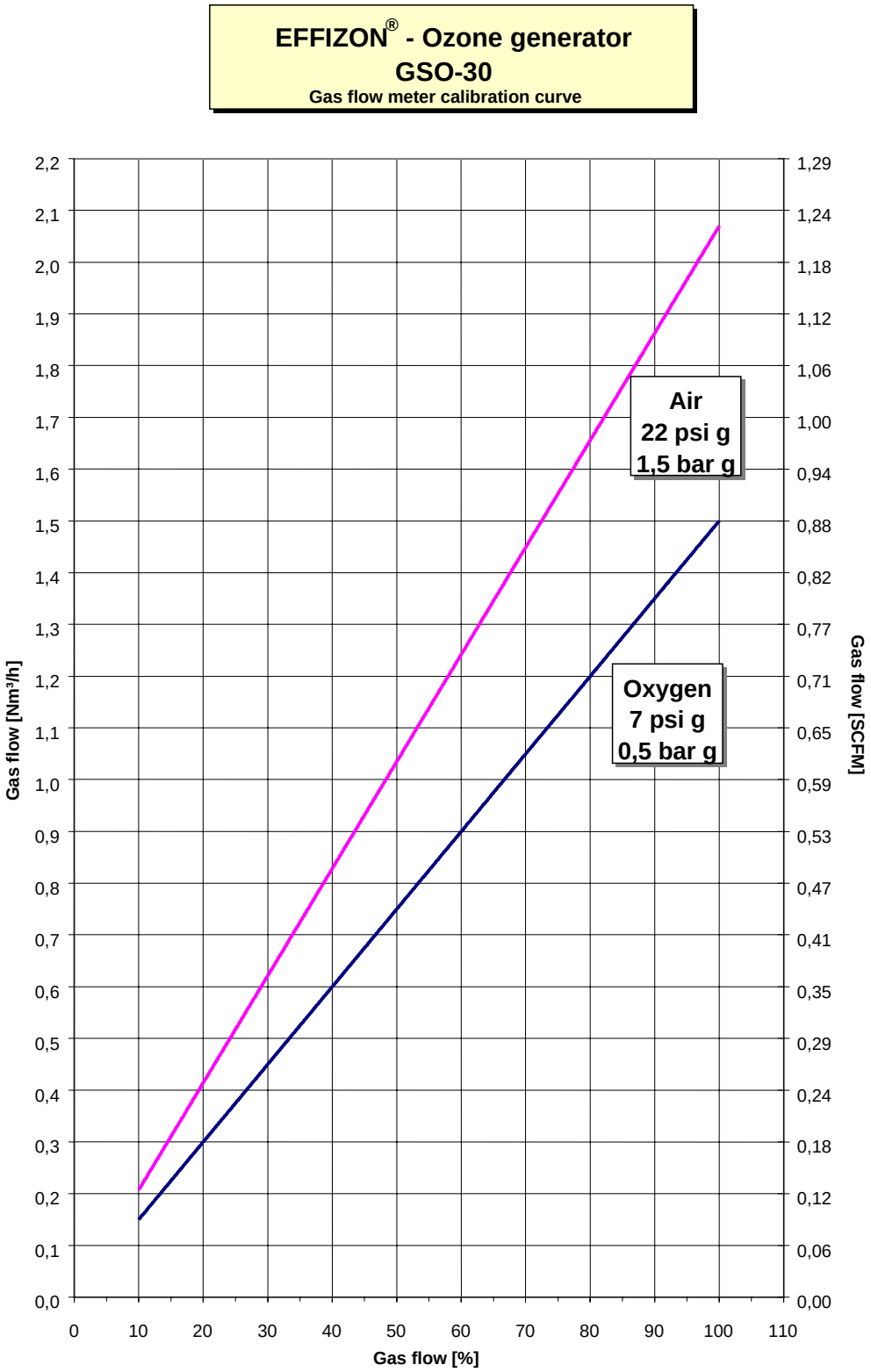


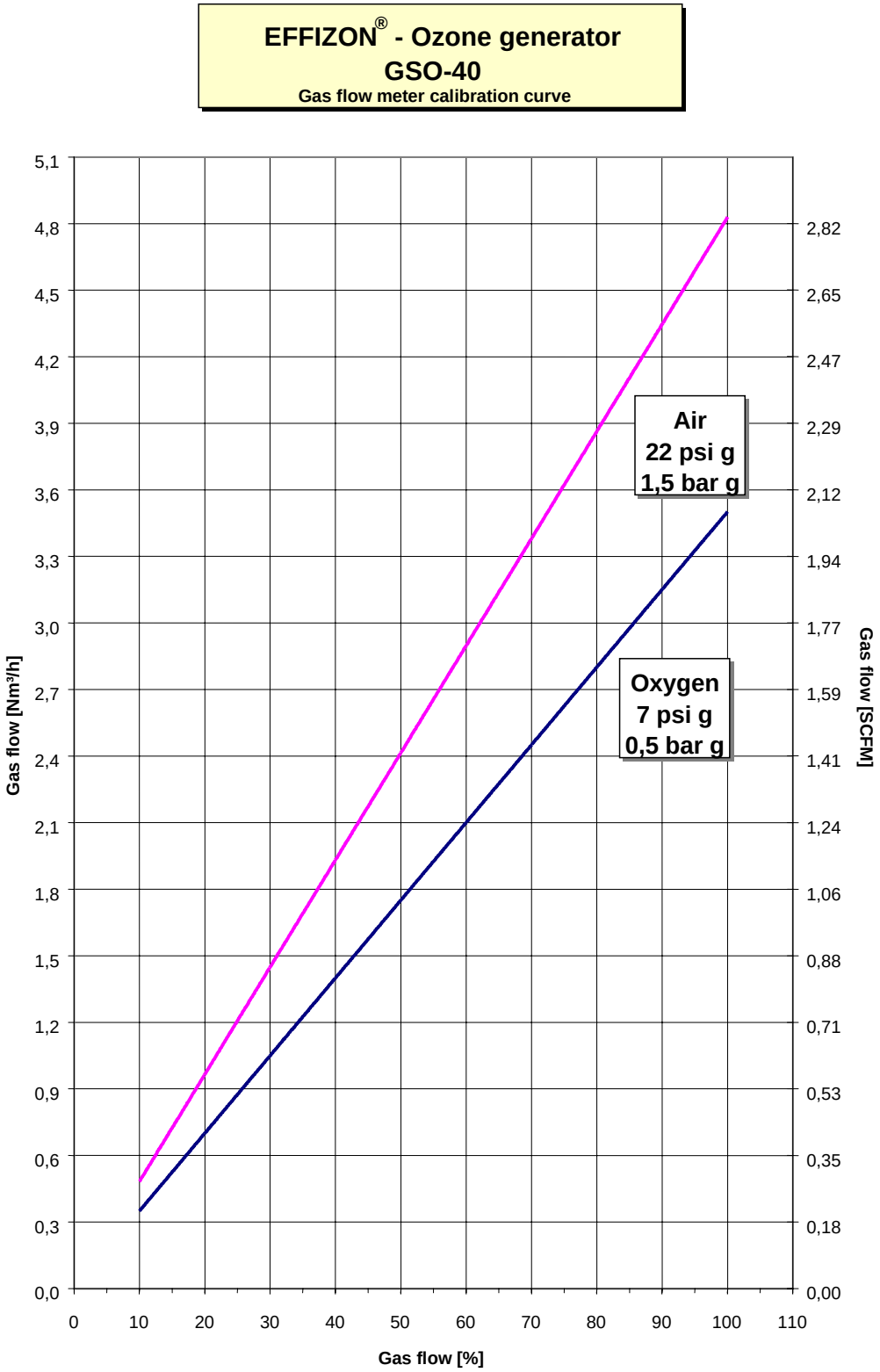
16.4.12 Gas Flow Meter Calibration Curve GSO-30

14125 South Point Circle, Charlotte, NC 28273 USA • Tel: (704) 716-7600 Fax: (704) 409-9838 Web site www.wedeco.us



16.4.13 Gas Flow Meter Calibration Curve GSO-40

14125 South Point Circle, Charlotte, NC 28273 USA • Tel: (704) 716-7600 Fax: (704) 409-9838 Web site www.wedeco.us



16.4.14 Gas Flow Meter Calibration Curve GSO-50

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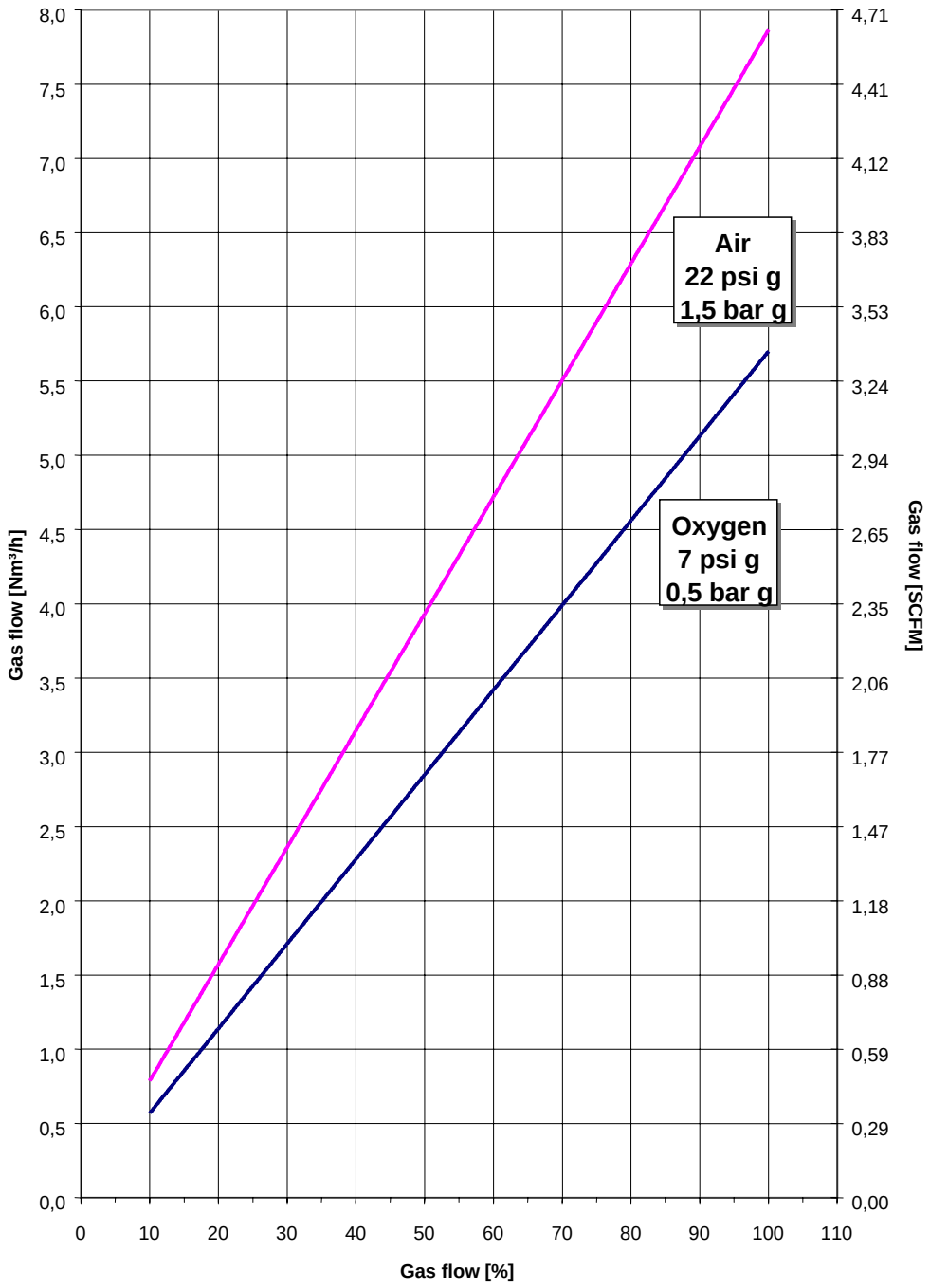
EFFIZON® - Ozone generator
GSO-50
Gas flow meter calibration curve



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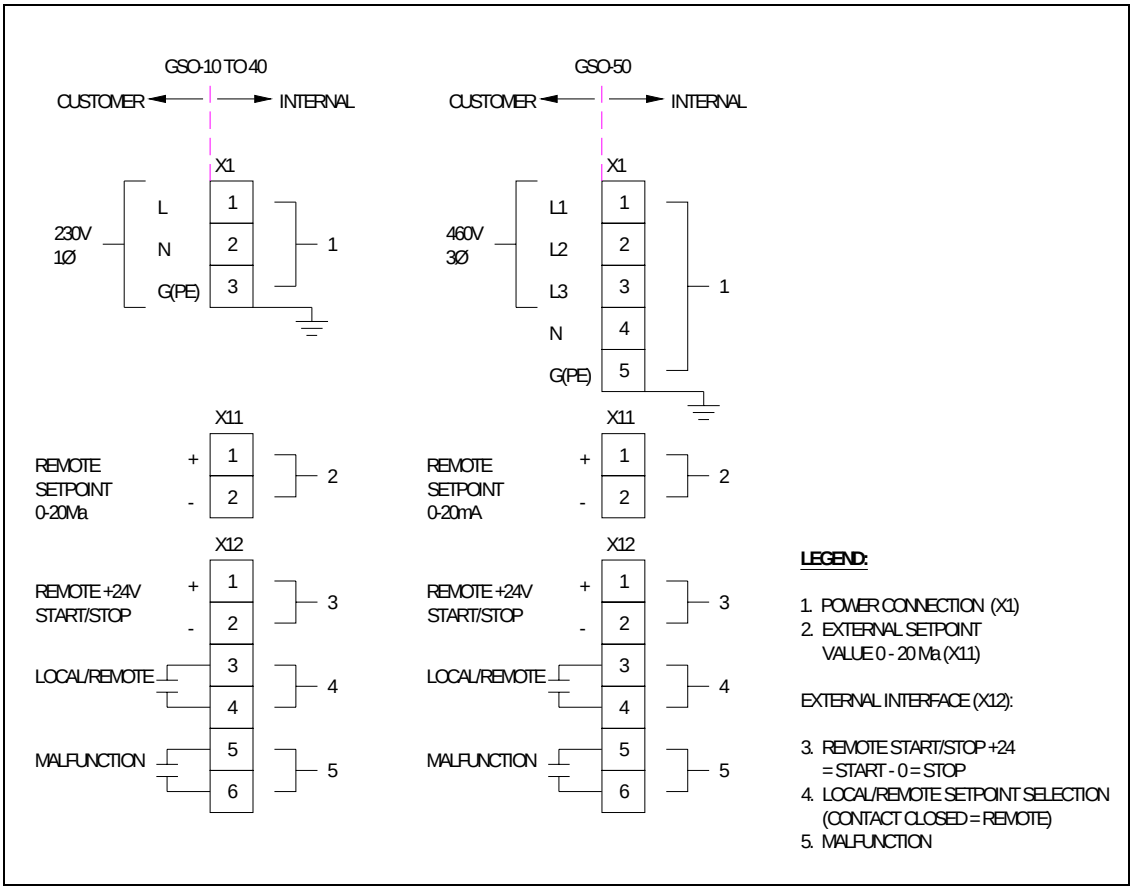
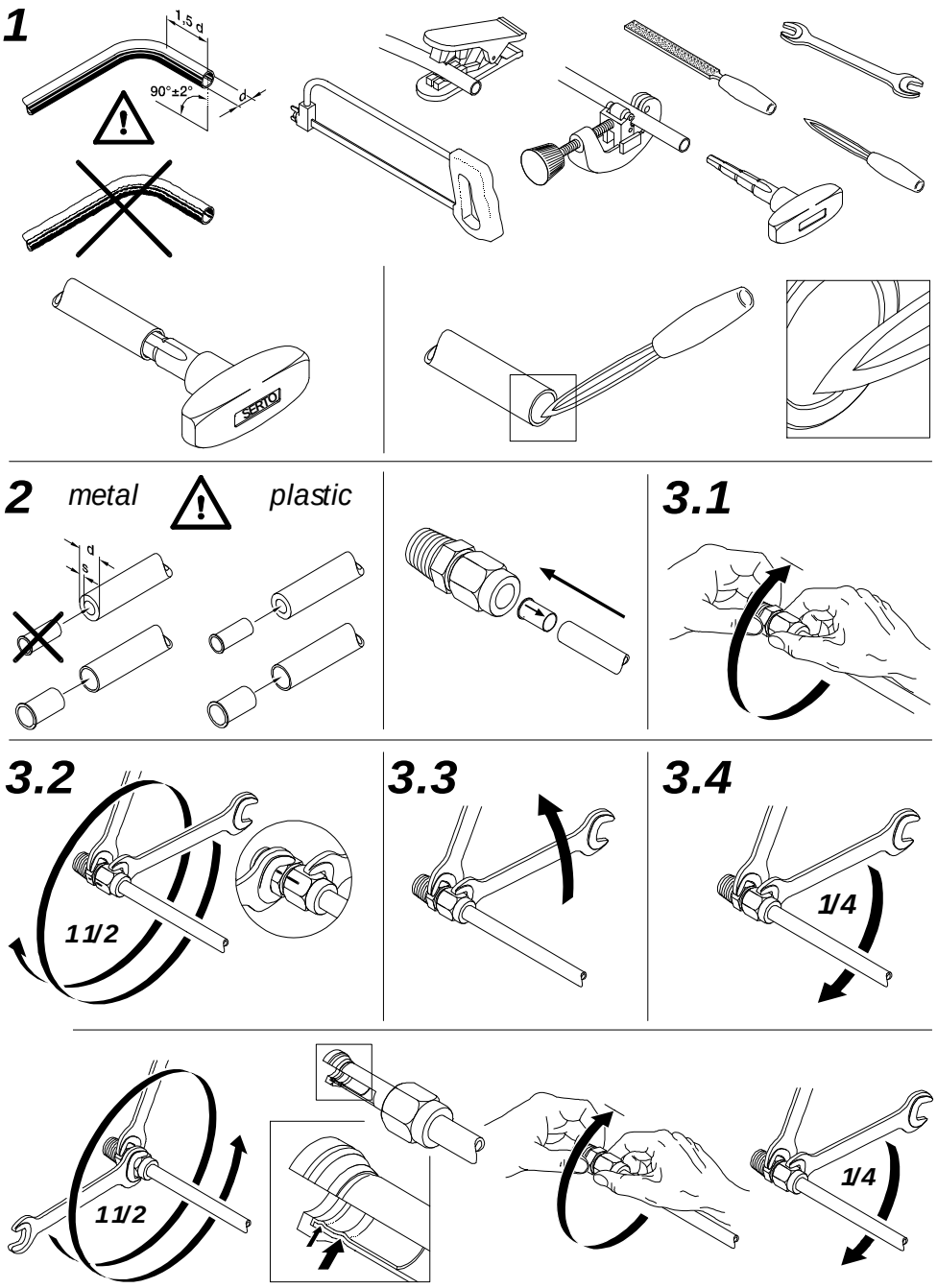
17. Electrical Interconnect



17.1 Electrical Connection Diagram GSO 10 / 20 / 30 / 40 / 50

17.2 SERTO – Assembly Instructions for External Connections



Assembly instructions for brass/stainless steel/steel

Brass chem. nickel plated, refer to separate instructions.

1. Preparation
Cut the pipe at right angles and remove burrs. Insure that the pipe end is straight for a length of approx. 1.5 and that its surface is undamaged. The screw connection is pre-lubricated. Assembly and re-assembly of larger screw connections can be further optimized by using lubricants such as oil, MoS_2, Teflon etc. (thread, clamping ring).

2. Reinforcing and inserting the pipe
Provide a support sleeve for thin walled and/or soft pipes such as plastic pipes.

Copper	from ø =10 mm with s < 1.0 mm
	from ø =12 mm with s < 1.5 mm
Stainless steel	from ø = 6 mm with s < 0.5mm
	from ø =10 mm with s < 1.5mm
Plastic all	

Insure that the pipe and screw connection are perfectly aligned. Insert up to the stop.

3. Deforming, relieving

3.1 Manually screw on the connection nut up to a tangible stop, while pressing the pipe against the base section.

3.2 Tighten the connection nut by 1 ½ revolutions using a work wrench. (Marking will simplify checking the specified number of revolutions.)

3.3 Now slightly loosen the connection nut to relieve the pipe.

3.4 Then fit the connection nut again up to the tangible stop, and tighten for the final assembly by another ¼ revolution using the wrench. (Steady the nipple using a second wrench.)

4. Checking the assembly
Loosen the connection completely. Check the deformation. A distinct bead must be visible on the inside of the pipe.

5. Re-assembly
For re-assembly of the same screw connection, fit the connection nut again up to the distinctively tangible stop, and tighten by a ¼ turn using the wrench.
Lubricate the parts prior to re-assembly.

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Pipes
Only use pipes having a clean, smooth surface, the outer diameter of which are within ± 0.1 mm.

Turnable clamping ring
The quality of the connection is not influenced if the clamping ring can be turned on the pipe or if the pipe can be turned in the connection nut following assembly.

Assembly sockets for pre-assembly
SO 56000, stainless steel, tendered for stainless steel and the brass M range.
SO 6000, CrNi steel, hardened for steel.

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17.3 Certificate in Accordance with the EMC Directive

PHŒNIX TEST-LAB

Bescheinigung
einer zuständigen Stelle

**im Sinne des § 4 Abs. 2 EMVG bzw.
des Artikels 10 Abs. 2 der EMV-Richtlinie 89/336/EWG**

Zertifikat-Nr.: Z990404

Hiermit wird bescheinigt, daß das nachfolgend genannte Produkt den grundlegenden Schutzanforderungen der Richtlinie des Rates vom 03. Mai 1989 zur Angleichung der Rechtsvorschriften über die elektromagnetische Verträglichkeit (89/336/EWG) entspricht.

Inhaber der Bescheinigung:	WEDECO Umwelttechnologie, Postfach 5114, 32051 Herford
Hersteller:	siehe Inhaber
Technischer Bericht, Datum:	990404 vom 29.04.1999
Produktbezeichnung:	Gerät für Ozonerzeugung aus Sauerstoff/Luft
Bestimmungsgemäße Verwendung des Produktes:	Industriebereich
Anlage(n):	1 Seite, Liste der Gerätebezeichnungen

Diese Bescheinigung bezieht sich nur auf das zur Konformitätsbewertung vorgestellte Produkt oder den technischen Bericht. Ihre Gültigkeit erstreckt sich auf den gesamten Europäischen Wirtschaftsraum.

Blomberg, 29.04.1999
Ausstellungsort, Datum

Leiter der zuständigen Stelle
Dr.-Ing. Holger Altmaier

PHOENIX TEST-LAB GmbH
Königswinkel 10

D-32825 Blomberg

akkreditiert von der Regulierungsbehörde für Telekommunikation und Post
unter der DAR-Registriernummer BPT-ZE-018/95-00

17.4 Declaration of Conformity

1.1.1EG – Konformitätserklärung

(nach EMV – Richtlinie 89/336/EWG)

Wir,

Hersteller: **WEDECO Gesellschaft für Umwelttechnologie mbH,**
Boschstr. 6,
D-32052 Herford

erklären in alleiniger Verantwortung, daß das Produkt:

Fabrikat: **EFFIZON – Ozonerzeuger**
Typ: **SWO – Baureihe**

Baujahr: **1999**

auf das sich diese Erklärung bezieht, mit der/den folgenden Norm(en) oder andere normativen Dokument(en) übereinstimmt:

73/23/EWG, Niederspannung

EN	50081-2	1993	EN 61000-3-3	1994
EN	50082-2	1995	EN 61004-2	1996
ENV	50140	1993	EN 61004-4	1996
ENV	50081	1993	EN 61004-5	1996
EN	55011	1991	EN 61004-11	1995
EN	61000-3-2	1995		

Gemäß den Bestimmungen der Richtlinie 89/336/EWG, elektromagnetische Verträglichkeit

Herford, den 30.07.01
(Ort und Datum)

Firmenstempel und rechtsverbindliche Unterschrift
Geschäftsführer/ Technischer Leiter

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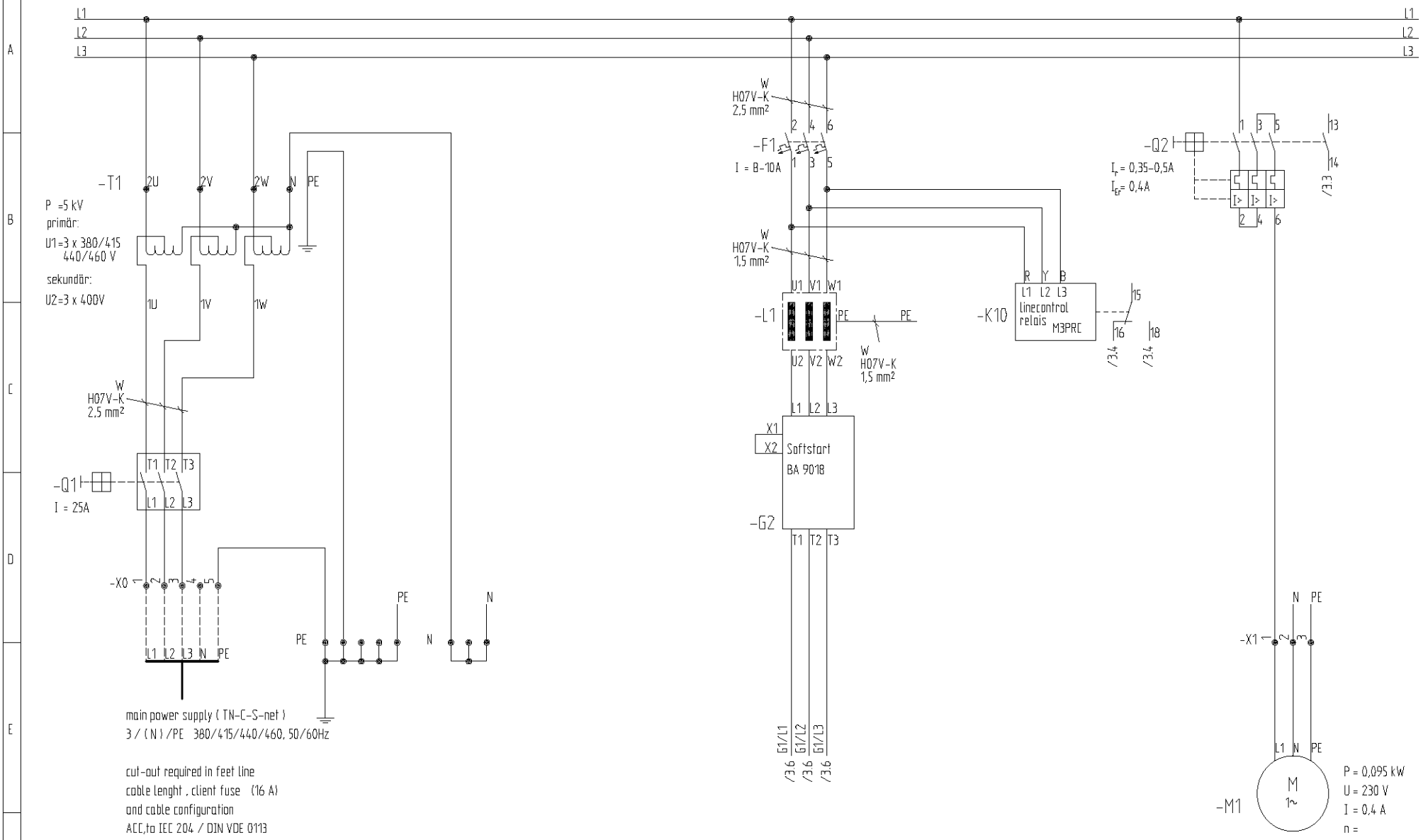
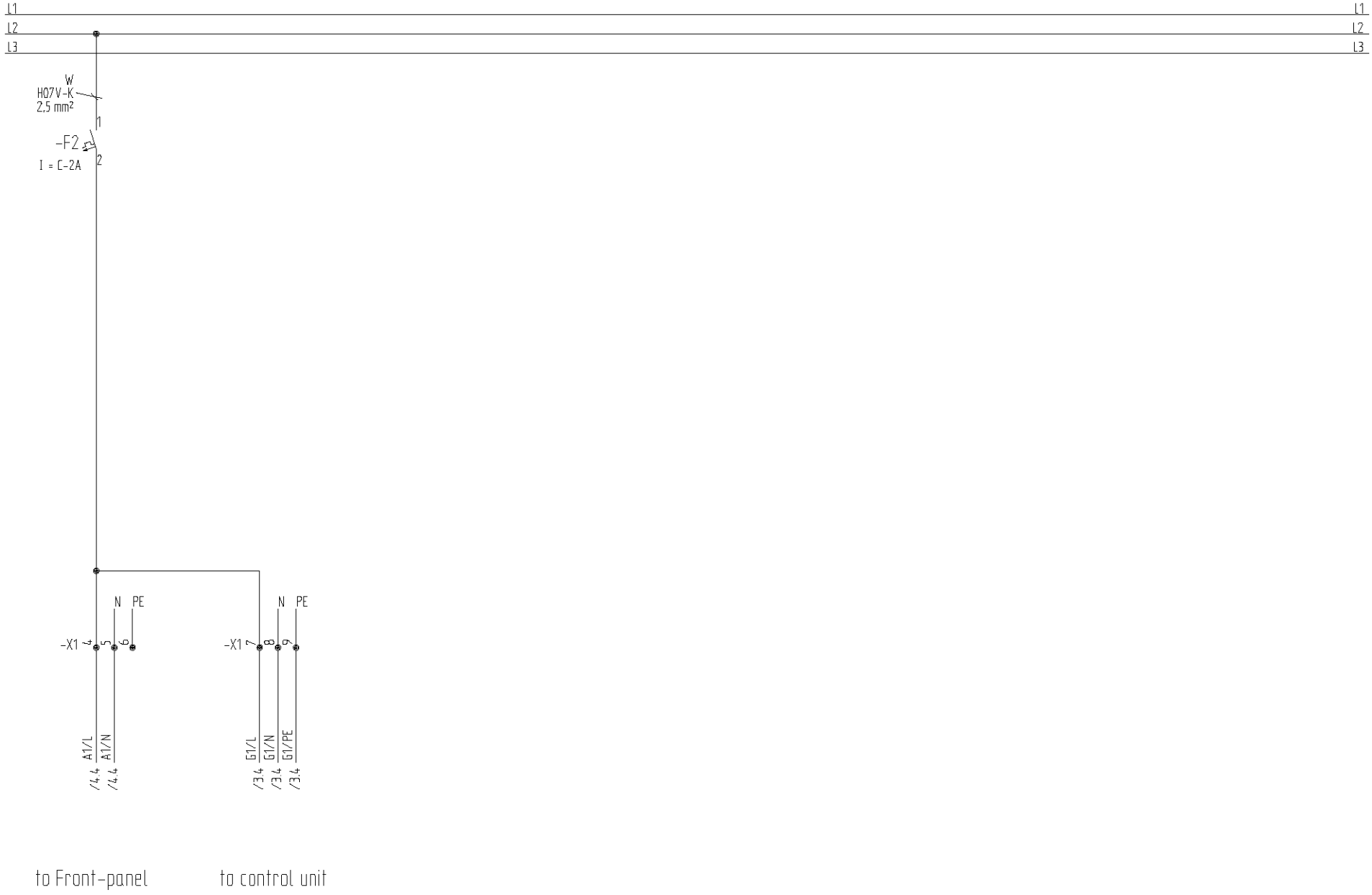
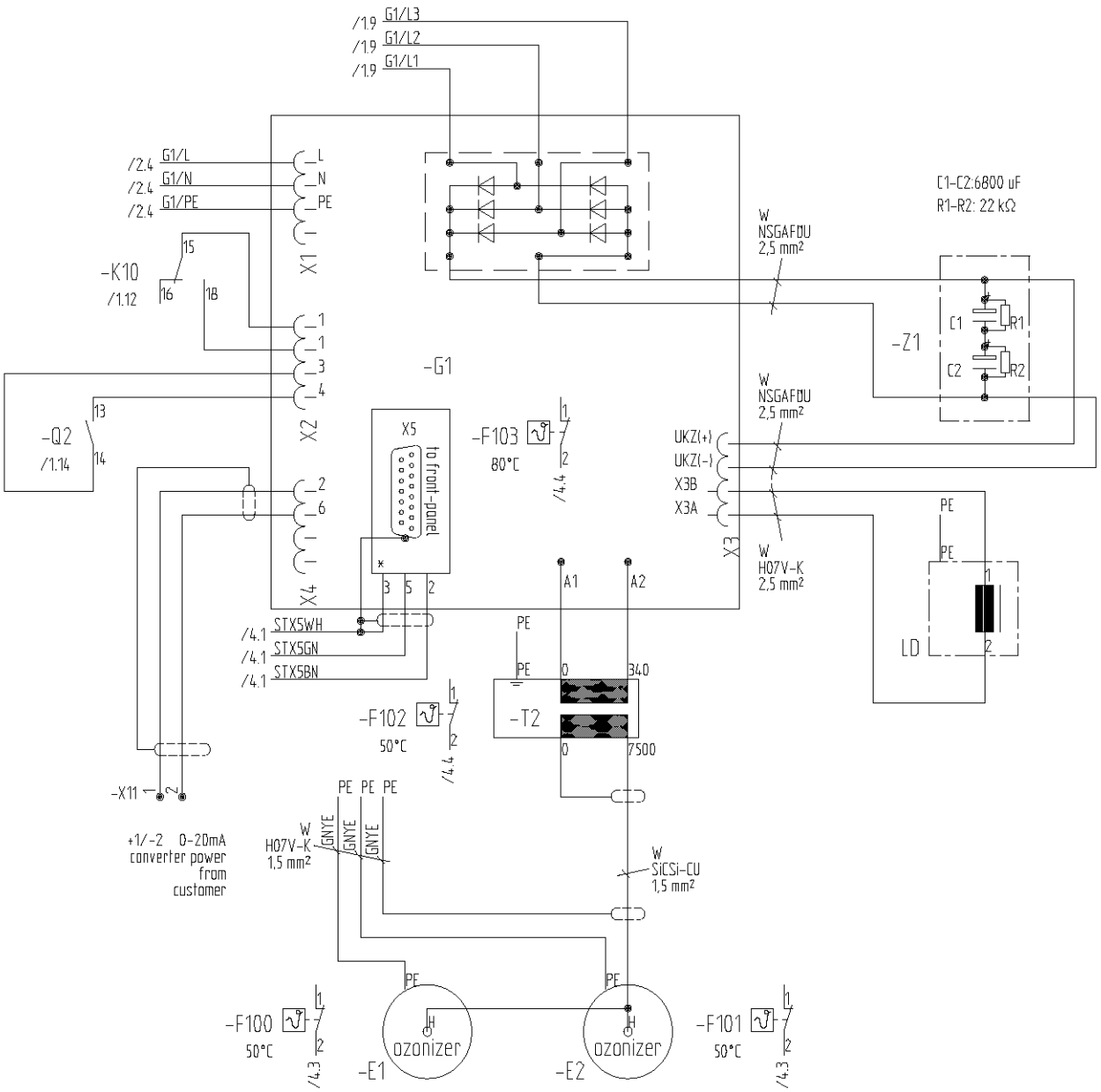


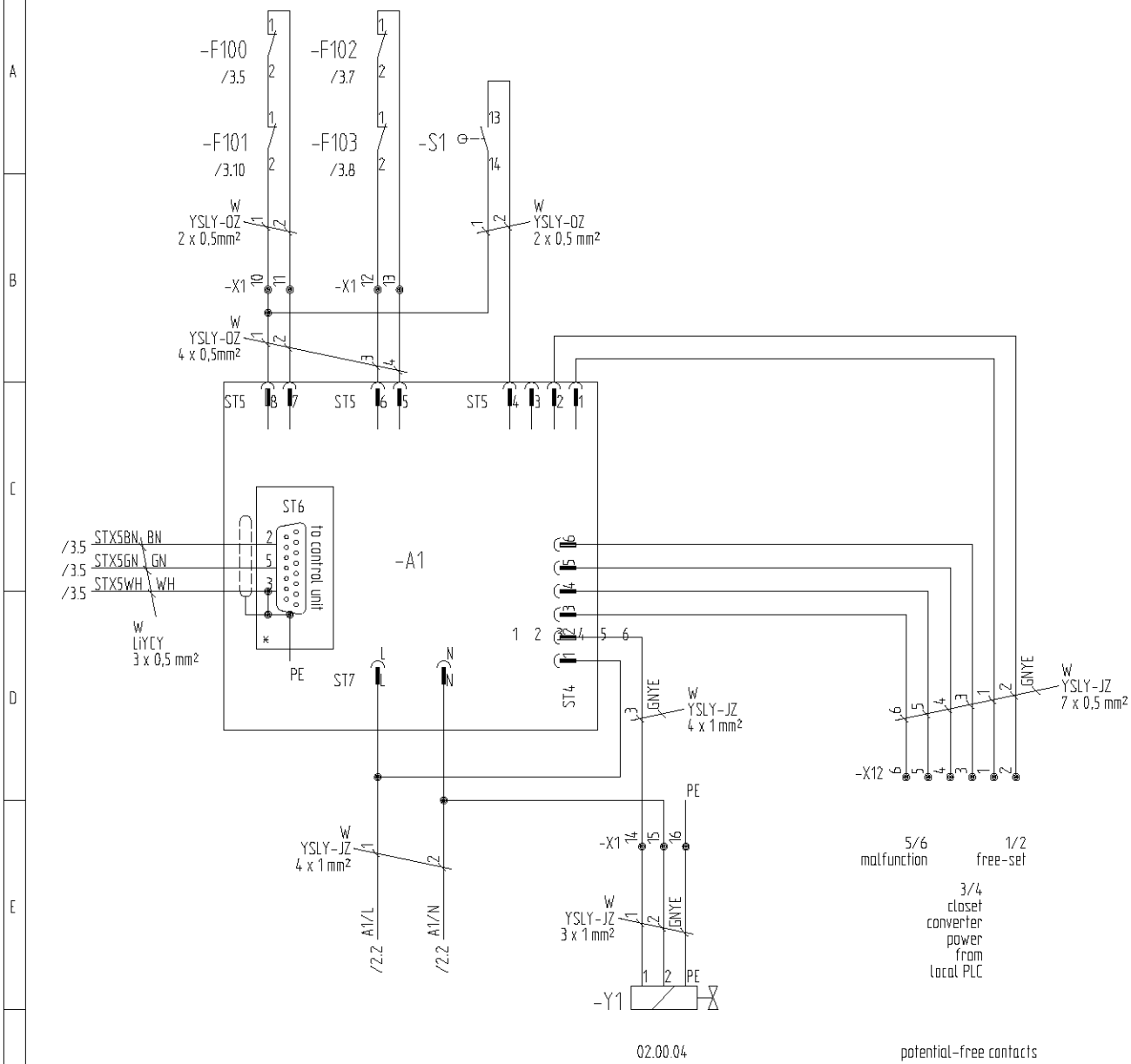
				date	02.07.2001	WEDECO Umwelttechnologie		Desinfection by Ozoneproduction	main power supply power supply converter	customer		=1.DN1	
				made by	Schönwälder							+1G1	
				checked						Project	GSO 50		sheet 1
version	change	date	name	Norm		first version	change for	changed in	circuit diagram				from 4 sh



				date	02.07.2001	WEDECO Umwelttechnologie		Desinfection by Ozoneproduction	power supply to Front-panel and control unit	customer		=1.DN1				
				made by	Schönwälder							+1G1				
				checked						Project	GSO 50				sheet 2	
version	change	date	name	Norm		first version	change for	changed in	circuit diagram						from 4 sh	



				date	02.07.2001	WEDECO Umwelttechnologie	Desinfection by Ozoneproduction	control unit	customer		=1.DN1	
				made by	Schönwälder						+1G1	
				checked					Project	GSO 50		sheet 3
version	change	date	name	Norm		first version	change for	changed in	circuit diagram			from 4 sh



				date	02.07.2001	WEDECO Umwelttechnologie	Desinfection by Ozoneproduction	Front-panel	customer		=1.DN1	
				made by	Schönwälder						+1G1	
				checked					Project	GSO 50		sheet 4
version	change	date	name	Norm		first version	change for	changed in	circuit diagram			from 4 sh

OGSI

Mid-Size

OGSI's mid-size industrial line offers a low-cost effective alternative to bottled oxygen. Designed for applications requiring outputs from 25 to 75 SCFH (0.6 to 2.0 Nm3/hour).

OGSI's plants are the most energy efficient plants on the market.
Extract oxygen directly from the atmosphere and deliver it to any medical or industrial application with an ***OGSI*** oxygen generator. Our Mid-Size line of Pressure Swing Adsorption generators can deliver a constant flow of up to 95% oxygen at 45-60 psi.

Model OG-25 and Model OG-75 Oxygen Generators

Dependable
Every PLC-controlled generator is assembled and tested in our Niagara Falls production facility. The zeolite sieve is factory sealed in solid steel tanks, and does not need replacement. With very few moving parts, our generators are built to provide thousands of hours of continuous, reliable service. Routine maintenance is as simple as changing an air filter.

Durable
From their hand-welded tank assemblies, to their oxygen-clean brass tubing and valves, our generators operate in the harsh environments of Africa, Asia, South America and the Yukon.

Economical
Eliminate the unnecessary costs of transportation, storage and cylinder rental. Our standard product line has 3 models- from 25 to 75 standard cubic feet/hour (0.66 to 2 Nm3/hour) -you'll never pay for capacity you don't need. Non standard generators are available on request.

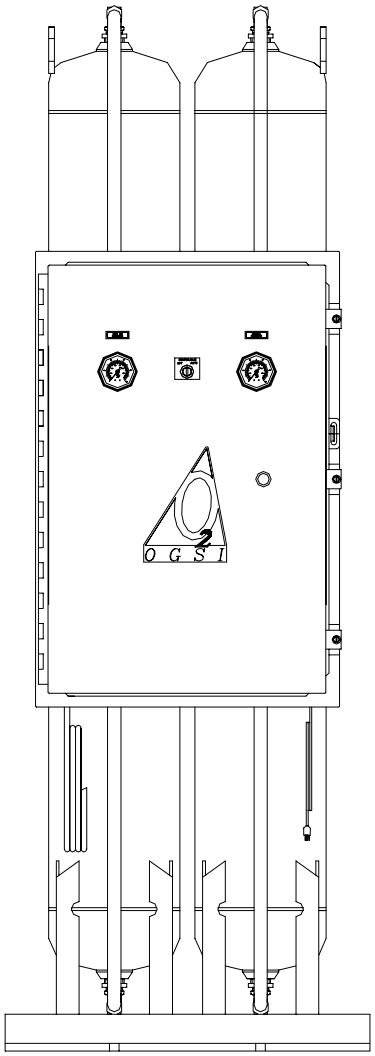
Unfamiliar with PSA oxygen systems?
Call, fax or email for a personalized quotation. ***OGSI*** can provide the proper air compressor, air dryer and storage tank combination to optimize your oxygen system. We can assemble the system and test it in our factory before shipment. All components can be mounted to a steel skid and pre-wired for easy transportation and setup.

Model	**Air Requirement**		**Oxygen Output**		**Tank Size**
Number	**SCF/min .**	**Nm3/min .**	**SCF/hour**	**Nm3/hour**	**Gallons**
OG-25	6.5	0.17	25	0.66	60
OG-50	12	0.32	50	1.3	60
OG-75	17	0.45	75	2	60

Product Specifications | Mechanical Drawings | Product Literature
Technical Information | Free Model Selection and Payback Software

Model OG-75 thru OG-750 Oxygen Generator

Installation, Operation & Maintenance Manual



OG-100

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Unpacking Instructions

The crate should be opened and inspected immediately upon delivery. If the exterior of the crate is noticeably damaged at the time of delivery, make a note on the freight bill before signing it. Unpack the unit at once and perform a visual inspection to determine if it is dented, bent or scratched. Also check to make sure the power cord is attached and that the control panel has not been damaged in any way during shipment.

Do not discard the shipping crate. If for any reason the unit should need to be returned in the future, this crate is the best way to ship it back to the manufacturer.

If any damage is discovered during the initial visual inspection, call the Freight Company immediately. ***This must usually be done within 24 hours of delivery***. Claims of damage due to freight handling can only be filed by you, the consignee, as ***OGSI*** shipping terms are Free On Board (FOB), Niagara Falls, NY USA. This means that once the equipment leaves our dock you are the owner of it. ***OGSI*** has no legal claim to make against any shipping company for damage.

At ***OGSI***, we are committed to using shipping companies with good reputations for taking care in the handling of freight and providing service in the event of damage. In our experience, we have found United Parcel Service (UPS) to be a poor carrier choice for equipment of this size and weight. Although they will accept and deliver it, we have often encountered problems with the way they handle the systems, and recommend other carriers be used.

Technical Service and Assistance

This manual is intended as a guide for operators of ***OGSI*** Oxygen Generators and Oxygen Generating Systems. It includes information on our warranty policy, on how the machines work, on proper set up and operation, and finally on how to maintain them.

It is our intention to provide complete customer satisfaction. This manual is one way in which we hope to provide you with technical assistance.

If you do not find what you need in this manual or you have other questions about this equipment, please feel free to contact us directly. This can be done in a number of ways that are listed below. We look forward to serving your oxygen needs and invite your inquiries. We will respond to you as promptly as possible.

Technical service personnel are available at ***OGSI*** from 8:00 A.M. through 5:00 P.M. Eastern (U.S.) Standard Time which is Greenwich Mean Time minus 5 hours (GMT - 5). You may reach ***OGSI*** personnel through the following means:

- **By Telephone from within the United States** two numbers may be used:
  (800) 414-6474 - our toll free number
  (716) 564-5165 - our local direct number

- **By Telephone from outside the United States** you must dial:
  Your local International Access Code (usually 0 or 00), followed by
  The Country Code for the U.S. which is (1), followed by
  Our Area Code and Number (716) 564-5165

- **By Automated Voicemail:**
  at the numbers listed above -available 24 hours/day.

- **By Fax from within or outside the United States** as above at;
  (716) 564-5173 - available 24 hours/day

- **By E-Mail or through our World Wide Web site** at**:**
  ogsimail@ogsi.com - available 24 hours/day
  http://www.ogsi.com - available 24 hours/day

- **By Mail** at:

OGSI	or	OGSI
70 John Glenn Drive		PO Box 196
Amherst, New York 14228 USA		Niagara Falls, New York 14304 USA

- **By UPS, FedEx or Common Carrier at:***(This address for return shipments)*
  OGSI
  70 John Glenn Drive
  Amherst, New York 14228 USA

We also have a list of Distributors and Authorized Service Agents available upon request.

Warranty

Oxygen ***G***enerating ***S***ystems, ***I***nc. (hereinafter ***OGSI***) provides a warranty on its products against defects in material and workmanship, under normal use and operation, as applicable in the statements below.

The ***OGSI*** Warranty provides the following:

a.) Free replacement of the product where defects in the material and/or workmanship are evident at the time of delivery, **EXCLUSIVE** of shipping damages. ***OGSI*** will pay shipping both ways**. (If shipping damage is evident, contact shipper immediately**).

b.) Free repair or replacement of product (excluding filter elements) where defects in material and/or workmanship become evident between the time of shipment and one (1) year from the date of shipment. ***OGSI*** will pay shipping one (1) way.

Note - *A Return Authorization Number must be obtained from **OGSI** prior to return shipment of equipment*

These warranties shall also become null, void and not binding on ***OGSI*** if a defect or malfunction occurs in the product or any part of the product as a result of:

a.) A failure to provide the Required Operating Conditions (see page 9)

b.) Repair, Attempted Repair, Adjustment or Servicing by anyone other than an authorized representative of ***OGSI***

c.) External Causes

Molecular Sieve Replacement:

The breakdown of the molecular sieve inside the generator (dusting of the sieve) only occurs if excess water/oil are entrained in the feed air stream. Under no circumstances is molecular sieve covered under warranty by ***OGSI***. If sieve dusting occurs on your machine, check the air compressor, air dryer and filter elements.

This warranty may be transferred to subsequent owners of a given machine only with the prior approval of ***OGSI***. The warranties above are given expressly in lieu of any other warranty stated or implied and constitute the only warranties made by ***OGSI***.

Limits of Liability

OGSI shall not be liable for any special, indirect, incidental or consequential damages resulting from the use, or as a result of the malfunction of an Oxygen Generator.

OGSI does not market or manufacture these oxygen generators for any medical or human life support purposes. In the event the buyer or leasee chooses to use the ***OGSI*** oxygen generator for medical or human life purposes, ***OGSI*** will not be liable for any special, indirect, incidental, or consequential damages resulting from such use.

Operational Warnings

OGSI Oxygen Generators are self-contained systems for the production of high concentration oxygen. Although oxygen itself is not combustible, it can be very dangerous. It greatly accelerates the burning of combustible materials.

- Precautions should be taken to avoid a fire in the area of the generator.
- Smoking should not be permitted in the area where the generator is located.
- All oxygen connections and hoses should be kept clean and free of grease, oil and other combustible materials.
- Valves controlling oxygen flow should be opened and closed slowly to avoid the possibility of fires or explosions that can result from adiabatic compression.
- When bleeding a tank or line, stand clear and do not allow oxygen to embed itself within clothing. A spark could ignite the clothing violently.
- High-pressure gasses may be present within the system. Valves should be opened and closed slowly, and safety glasses and hearing protection should be worn at all times while gasses are being vented.
- Do not attempt to modify or enhance the performance of a Generator in any way.

Safe Handling of Compressed Gas Cylinders

Many of the following procedures for the handling, storage, and utilization of compressed gas in cylinders are taken from material furnished by the Compressed Gas Association, which complies with OSHA standards.

- If visual inspection indicates obvious damage, the cylinder should be returned to the supplier without any attempt at using the machine.

- If a cylinder leaks, other than normal venting, and the leak cannot be corrected by tightening a valve gland or packing nut, the valve should be closed and a tag attached stating that the cylinder is not serviceable. Remove the cylinder outdoors to a well-ventilated or open area, notify the supplier, and follow the supplier's instructions for the return of the cylinder.

- Keep the cylinder valve closed at all times except when in active use. When removable caps are provided for valve protection, they should not be removed except for active use. Remember to replace removable caps when not in use.

- Do not place cylinders in a position where they might become part of an electric circuit. When electric welding is taking place, precautions should be taken to prevent accidental grounding of cylinders, permitting them to be burned by electric welding arc.

- Cylinders should not be dropped or permitted to strike each other or any other surface. Do not drag or slide cylinders; use a suitable hand truck, fork truck, roll platform or similar device, firmly securing the cylinders for transporting.

- Always ensure that compressed gas cylinders be securely strapped or chained in place to prevent tipping or falling. Do not store near elevators, stairs, or passageways.

- Do not store oxygen cylinders with flammable gas cylinders. Stored oxygen and fuel gas cylinders should be at least 20 feet apart; preferably separated by a fire resistant partition.

- For additional information refer to the CGA publications that can be found at http://www.cganet.com

- See also ISO publication 10083, available by request at OGSI, or online at http://www.iso.ch

Pressure Swing Adsorption (PSA) Technology

The ***OGSI*** Oxygen Generator is an on-site oxygen-generating machine capable of producing oxygen on demand in accordance with your requirements. It requires less than 600 Watts of electrical power to control its operation.

In effect, it separates the Oxygen (21% of air) from the air it is provided and returns the Nitrogen (78% of air) to the atmosphere through a waste gas muffler. The separation process employs a technology called Pressure Swing Adsorption (PSA). At the heart of this technology is a material called Molecular Sieve.

This Molecular Sieve is an inert, ceramic-like material that is designed to adsorb Nitrogen more readily than Oxygen. Each of the two beds that make up the generator contain this sieve. As air is fed into one of the beds, the sieve in that bed holds the Nitrogen to it and allows the Oxygen to flow through it and out to the surge tank as product gas. Eventually the sieve becomes saturated with Nitrogen. When this occurs, the feed air is directed to the other bed where the oxygen production/separation process continues. While the second bed is being fed air, the first is depressurized and safely releases the Nitrogen it has trapped through the waste gas muffler. This regenerates the sieve in the first bed and prepares it to accept feed air again continuing the process. The two beds continue to work in this alternating fashion to provide a continuous supply of Oxygen.

This air separation process is reliable and virtually maintenance free. The Molecular Sieve will last indefinitely, as long as it does not become contaminated with water and oil vapors. This is why regular filter element replacement is critical to trouble free operation. The filter elements are very inexpensive, semi-annual maintenance.

OG-75 Thru OG-750 Oxygen Generator Specifications

Model	Oxygen Output		Air Required		Power
	*SCF/Hour	**NM³/Hour	SCF/Minute	NM³/Minute	Watts/Hour
OG-75	75	2.0	17	0.45	120
OG-100	100	2.6	22	0.58	120
OG-175	175	4.6	32	0.84	120
OG-250	250	6.6	45	1.18	120
OG-375	375	9.9	68	1.78	120
OG-500	500	13.1	88	2.31	120
OG-650	650	17	118	3.10	120
OG-750	750	19.7	133	3.50	120

Model	Dimensions (D x W x H)		Weight	
	Inches	Centimeters	Pounds	Kilograms
OG-75	21 x 21.5 x 67	53 x 54 x 170	310	141
OG-100	24 x 24 x 69	61 x 61 x 175	500	227
OG-175	25 x 26 x 72	64 x 66 x 183	775	351
OG-250	26 x 32 x 72	66 x 81 x 183	1100	499
OG-375	30 x 36 x 84	76 x 91 x 213	1350	612
OG-500	36 x 48 x 83	91 x 122 x 211	1800	816
OG-650	48 x 55 x 83	122 x 140 x 211	2400	1625
OG-750	38 x 52 x 88	97 x 132 x 224	2600	10888

The Oxygen Purity Specification is 93% (± 3%) for all models.
The Minimum Feed Air Pressure Required is 90 PSIG (621 kPa) for all models.
The Minimum Oxygen Pressure Delivered is 45 PSIG (310 kPa) for all models.
For domestic models the Power Configuration is 110 VAC/60 Hz, for export models 220 VAC/50 Hz.

* - A Standard Cubic Foot (SCF) is a cubic foot of gas at 14.7 psia (sea level atmospheric pressure) and 60 degrees Fahrenheit
** - A Normal Cubic Meter (NM^3) is a cubic meter of gas at 760 mm-Hg (sea level atmospheric pressure) and 0 degrees Celsius

Required Operating Conditions

Location of Machine: The standard Oxygen Generator is intended for use indoors. It comes with a NEMA 12 enclosure box, which provides a degree of protection against dust, falling dirt and non-corrosive liquids. A NEMA 4X enclosure package is optionally available if outdoor location is required. The NEMA 4X package will provide a degree of protection against corrosion, windblown dust and rain and splashing or hose-directed water.

Feed Air/Ambient Air Quality: The useful life expectancy of any PSA Oxygen Generator is directly related to the air quality that is fed into it. Hot, humid, dirty, oily air deteriorates and degrades the performance of molecular sieve. In order to preserve the effectiveness and extend the useful life of the generator, all precautions should be taken to insure that Cool, Dry, Clean, Oil-Free air is provided to it.

Changing the inlet air filter is a simple and easy way to provide the unit with some protection. Where possible, it would be advantageous to locate the unit in an air-conditioned space, or at least a well-ventilated area. The room should also be free of toxic gases and high concentrations of hydrocarbons, especially carbon monoxide. Additionally, to the degree possible, humid, oily areas should be avoided as installation sites.

Ambient Air Temperature: The machine is designed for use over a temperature range of 40°F to 100°F (5°C to 38°C). Since hot air has the ability to hold much more water, in the form of humidity, than cool air, operating the units in hot areas will reduce the effective life of the molecular sieve.

Note: Operation outside of this temperature range will not be warranted by ***OGSI***.

Feed Air Requirements:

The pressure of the incoming feed air supply should be at least 90 PSIG (620 kPa). Pressure below this level will not allow the machines to run at the oxygen purity, production capacity and efficiency levels they were designed to meet.

The compressed air that is fed into the Oxygen Generator should be no hotter than 100°F (38°C). Air temperatures higher than this will immediately reduce the efficiency of the machines and can damage the molecular sieve over time. Hot air is also able to hold much more water than cool air and water ruins sieve.

The use of aftercoolers on feed air compressors and refrigerated air dryers between the air compressor and the oxygen generator is highly recommended and will improve the performance and lifetime of the oxygen generator.

Pipe scale, oil carryover from the compressor and water vapor should all be minimized to ensure long and trouble-free Oxygen Generator operation. These things can be accomplished with a few regular procedures. First, it is important to recognize that the air compressor is a critical component in the Oxygen Generating process. It needs to be maintained in accordance with the instructions provided in its operating manual. Second, condensation needs to be removed from the air receiver tank and air distribution lines at regular intervals to keep it from flowing into the generator. Finally, as already mentioned in a few areas, the filter element inside the Oxygen Generator needs to be replaced every six months.

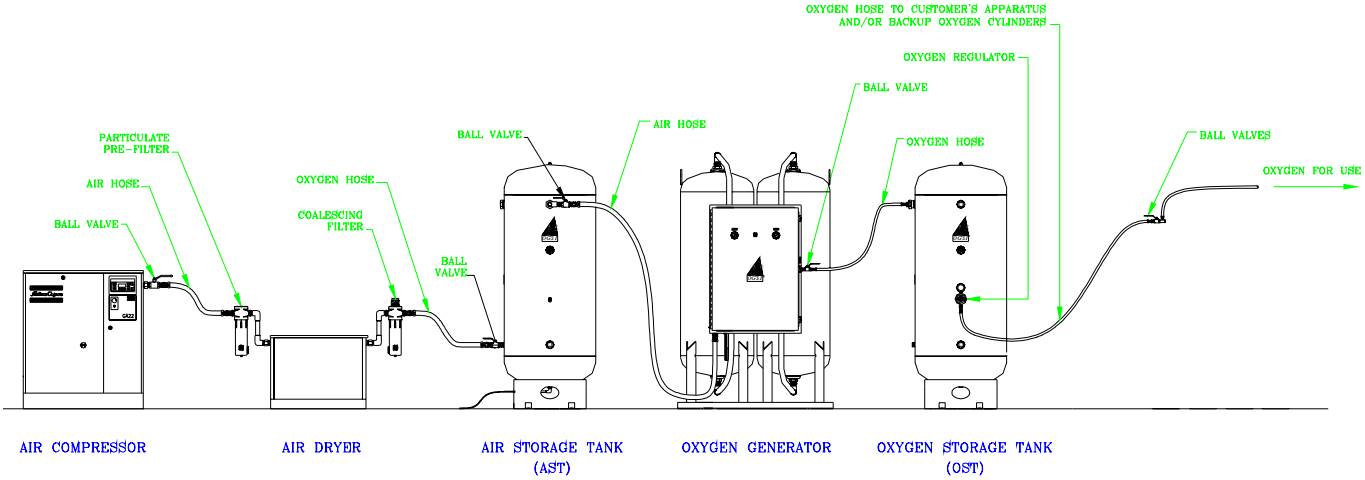
Electrical Power: On U.S. models, the power for the control circuitry of the Oxygen Generator is a single-phase electrical supply of 120 Volts AC and less than 1 Amp at a frequency of 60 Hz. This equates to fewer than 120 Watts of power.

On Export models, the power for the control circuitry of the Oxygen Generator is a single-phase electrical supply of 220 Volts AC and less than 500 milliAmps (0.5 Amps) at a frequency of 50 Hz. This also equates to less than 120 Watts of power.

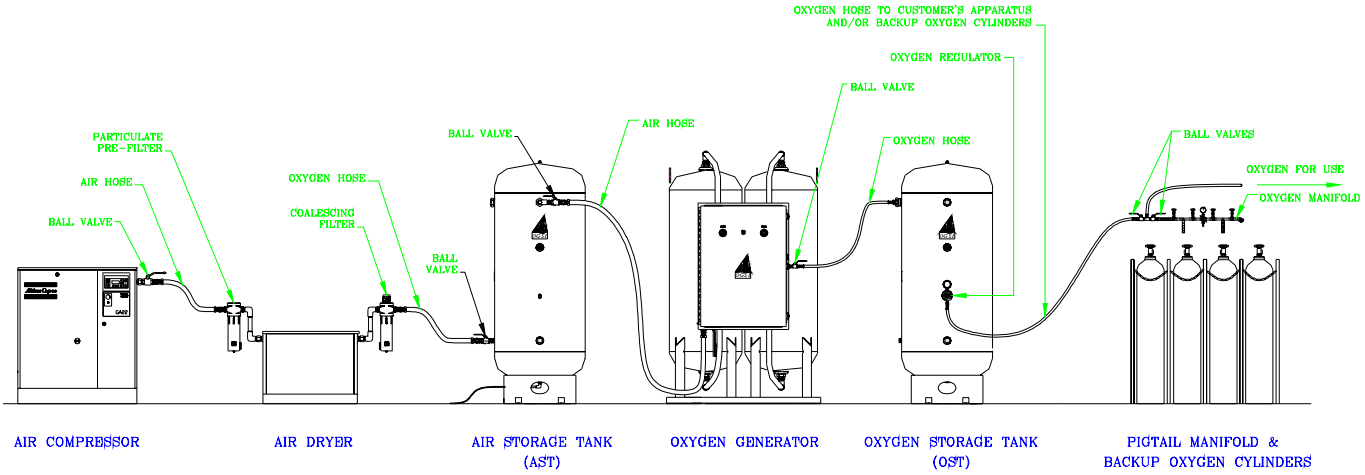
Positioning: The unit must be operated in an upright position only, with no obstruction blocking airflow around the unit.

Typical Setup Diagrams

Shown immediately below is a sample drawing that depicts how a typical system could look when connected.



Occasionally a user may choose to maintain a liquid or cylinder backup and keep it connected to his system for critical applications. This is a precaution that ensures uninterrupted oxygen flow if the power supply should be lost or the compressor or generator malfunction.



Pre-Installation Check Instructions

Although every Oxygen Generator is thoroughly tested and checked before it is shipped from our factory, the following checks are necessary to insure that none of the internal components have been damaged in shipment. This check should take less than five minutes to perform.

1.) Make a visual inspection of the machine and make sure all parts are properly attached.

2.) These checks are for machines with the touchscreen option:

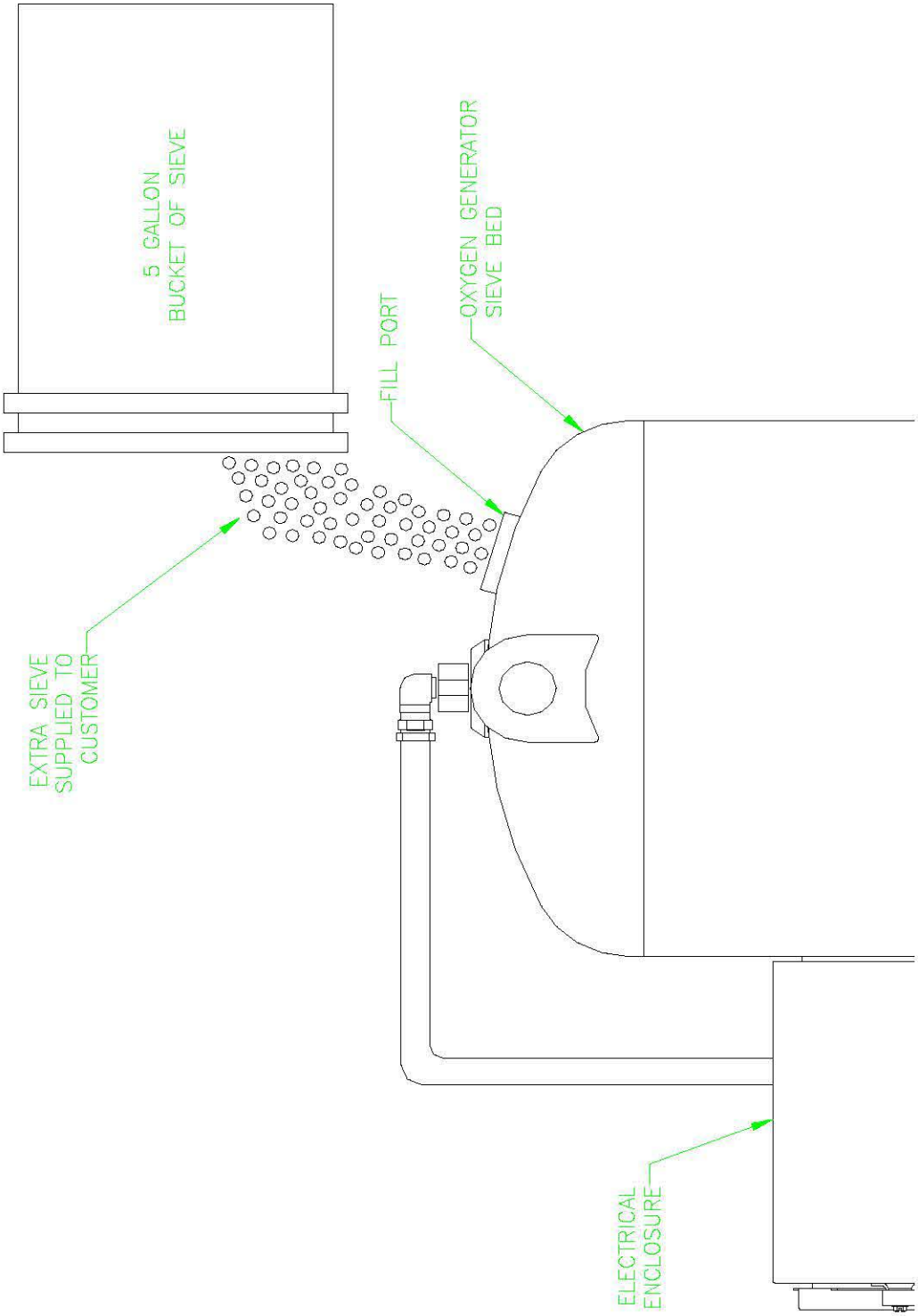
a. Ensure the touch screen is powered, and a display is visible. Consult the troubleshooting guide in this manual (see page 14) for any problems encountered.

b. After selecting a language and entering a password, start the machine by pressing both the **OPERATING MODE** (Automatic), and then the **ON/OFF** pushbuttons.

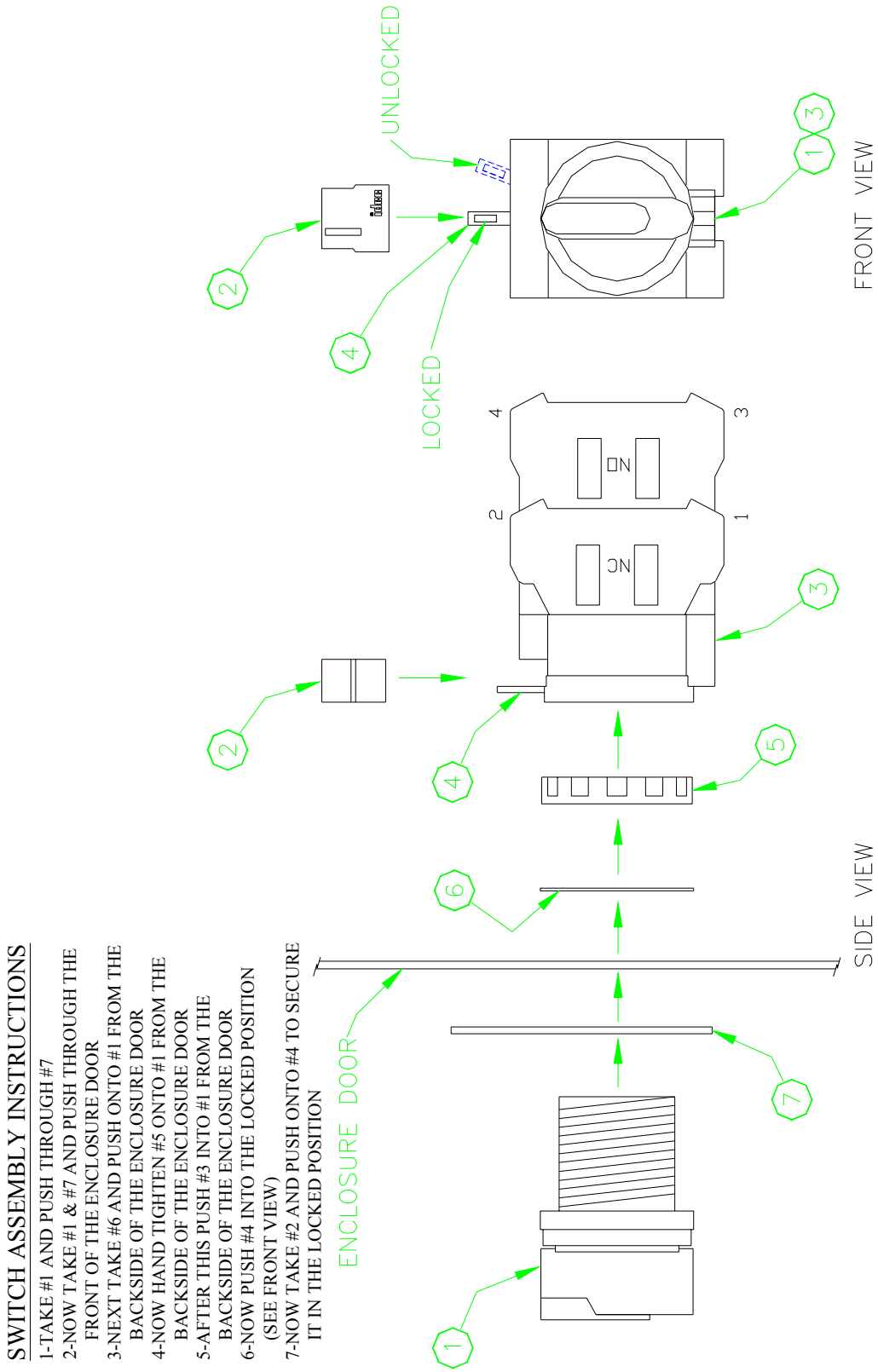
3.) Sieve settles during shipment, therefore it is important to re-pack the supplied sieve to the top of the sieve beds making sure no empty voids are left in the beds. The sieve can be harmed by exposure to air and caution must be taken to keep the sieve in the oxygen generator & the container sealed as much as possible. (See page 12 for diagram.)

4.) The ON/CONTINUOUS/AUTO switch will need to be attached to the enclosure door. (See page 13 or 14 for a diagram depending on the type of switch you have.)

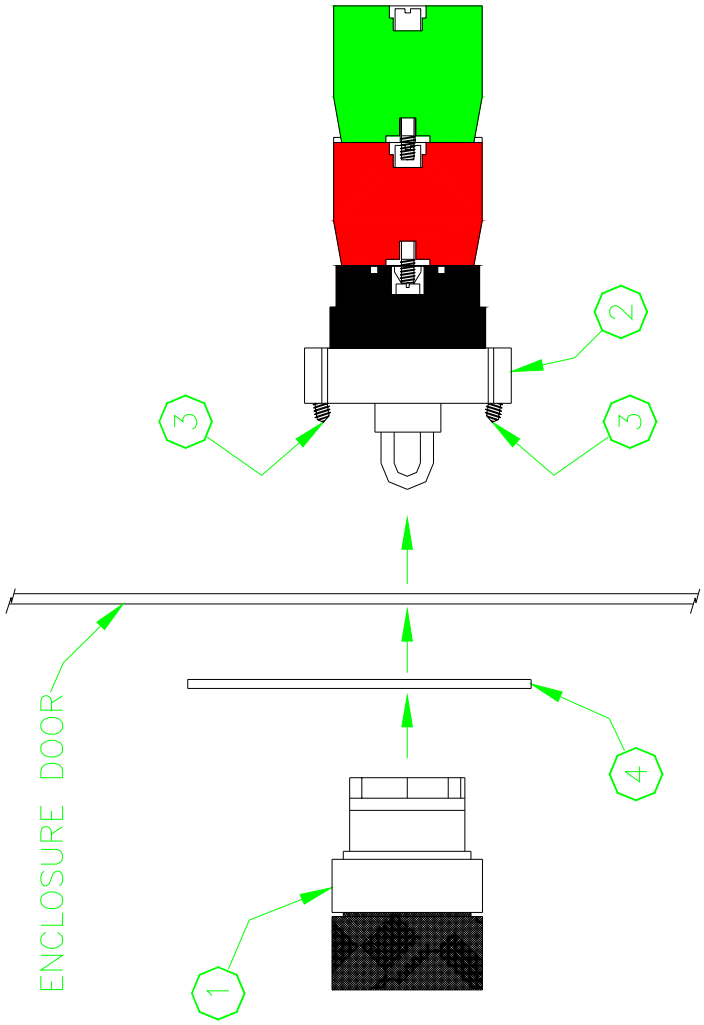
Sieve Re-packing Diagram



Type 1 Switch Connection Diagram



Type 2 Switch Connection Diagram



SWITCH ASSEMBLY INSTRUCTIONS

1-TAKE #1 AND PUSH THROUGH #4
2-NOW TAKE #1 & #4 AND PUSH THROUGH THE FRONT OF THE ENCLOSURE DOOR
3-PUSH #2 ONTO #1 AND TURN IT TO LOCK THEM TOGETHER
4-NOW MAKING SURE THE ASSEMBLED PARTS ARE STRAIGHT TAKE A SCREW DRIVER AND TIGHTEN BOTH #3's

Setup Instructions

These instructions are intended as a general guideline for a typical system installation. If you feel you have an unusual situation or would like additional assistance in determining the appropriateness of a particular setup, please do not hesitate to contact us. *See Page 2 for details on how that can be done.*

1.) Connect a Ball Valve Between Your Air Supply and the Feed Air (Black) Hose Provided -

This valve will be used to shut off the air supply to the generator for filter replacement. If you do not have a valve on hand at this time, skip this step as one can be installed at this point at a later date.

OGSI does stock valves that can be used for this purpose. If you need one you can reach our sales department at (716) 564-5165.

2.) Connect the Feed Air to the Ball Valve Mentioned Above (or directly to) Your Air Supply and to the Left Side of the Generator -

On systems this size, a hose is not included as installation setups vary greatly. The left side of the generator has a fitting that is labeled 'Air In'. This fitting will be either a 37°-flared JIC fitting or a male pipe thread depending on which model you have. Connections to these are readily available worldwide through the Parker distribution network or from ***OGSI***.

3.) Unroll and Direct the Filter Drain (Clear) Hose into a Bucket or Floor Drain (if available) -

This drain hose is provided with each unit and can be used to alleviate the potential problem of having water and material trapped by the filter blown directly on to the floor. If this hose is not going to be used it should be disconnected from the machine and discarded.

4.) Connect the Oxygen (Green) Hose to the Oxygen Outlet Connection on the Right Side of the Generator and to the Oxygen Storage Tank -

The green hose is the Oxygen hose. The Oxygen Outlet Connection is on the right hand side of the machine and is Labeled 'O_2 Out'. This Oxygen Hose has threaded fittings that swivel on each end of it. Either side can be connected to the generator, as the fittings are the same on each end.

If your storage tank was purchased from ***OGSI***, it will have an appropriate fitting in place for this connection. It will be attached to the same tee fitting that holds the safety relief valve. If the tank was not purchased from ***OGSI***, you must insure that it has the appropriate size fitting to accept this hose assembly.

OGSI *can provide these fittings, if necessary.*

5.) Connect Your Oxygen Hose to the Oxygen Pressure Regulator on the Oxygen Storage Tank -

If you are using an Oxygen Manifold as in one of the previous drawings, we recommend another ball valve between the hose that is connected to the Oxygen Regulator and the Oxygen Manifold. This Ball Valve can then be used as your primary supply or shut off valve between the generator and your application. Closing this valve nightly before turning the generator off will ensure that the storage tank is full the next day.

As before, this Oxygen Hose and Ball Valve are not included with the generator because the connections used from location to location can vary greatly. We can provide these Ball Valves and Hose Assemblies, if required, but intentionally do not include them with every machine so that we may provide you with the best price for the basic package.

6.) Plug the Electrical Cord into an Outlet -

It is preferable that the outlet used be one that cannot be accidentally turned off. Generators shipped within North America can be plugged into any typical 110 Volt outlet while those shipped outside North America will typically be wired to accept a single phase 220 Volt supply.

Once connected you should be ready to begin to produce your own Oxygen.

Safety Precautions

It is very important that you read the precautions below and make yourself aware of the hazards of oxygen in general. While it can be handled and used very safely it can also be mishandled or applied incorrectly causing dangerous situations.

1.) ***Oxygen is a fire hazard.*** It can be very dangerous as it vigorously accelerates the burning of combustible materials. To avoid fire and/or the possibilities of an explosion, oil, grease or any other easily combustible materials must not be used on or near the oxygen generator. Smoking, heat and open flames are also not recommended near the unit. Individuals who have experience handling oxygen systems should become the designated operators of the oxygen generator within your facility***.***

2.) ***Ensure that the oxygen outlet stream is not directed toward anyone's clothing.*** Oxygen will embed itself in the material and one spark or hot ash from a cigarette could ignite the clothing vigorously.

3.) In critical applications it is important to have a backup supply of oxygen, as it should be remembered that the generator does not come with any reserve storage tank and it does require electrical power to operate. Therefore ***during power outages oxygen will not be produced.***

4.) As previously mentioned, ***do not use extension cords to bring power to the generator.*** The current draw into the unit is high and could overheat some extension cords. It is also important to use only a properly grounded outlet***.***

5.) ***High Pressure Oxygen may present a Hazard****.* Always follow proper operating procedures, and ***open valves slowly***. Rapid pressurization may result in personal injury. Safety glasses and hearing protection are required when venting oxygen under high pressure.

Start Up Procedures

Prior to attempting to run the Oxygen Generator it is important to check to connections that have been made to it. Make sure that they are all tight as leaks will be detrimental to the generator's performance and increase your operating expenses.

Also be sure to review the 'Setup Instructions' (pages 15-16) before starting the unit to be sure that all connections have been made properly. If your system does not respond as described below check the contact our facility for possible causes and fixes.

1.) Start Your Air Compressor -

Allow it fill its surge tank to at least 90 PSIG (620 kPa) before starting the generator.

2.) Open the Ball Valve that Supplies Air to the Generator (if you have one in place) and Check the Regulated Feed Air Pressure Gauge (on the left side of the Generator) -

The regulated feed air pressure gauge should read about 70 PSIG (480 kPa).

3.) Turn the Generator Control Switch to 'Continuous' -

This turns the unit on and begins the generation process. The light inside the switch will always be on as well. For the first 5 seconds the filter bowl drain will open and condensation or material trapped in the bowl will be blown out the drain valve on the bottom of the cabinet. If after 5 seconds air is not blowing out the filter drain, then manually depress the filter drain push button on the lower left-hand side of the cabinet until the bowl is completely empty of fluid. This drain will vent for 5 seconds every 15 minutes while the unit is operating.

If this is the first time the generator is being run or it has not run for a few days, the Oxygen Storage tank will be full of air. Oxygen will fill the tank but since it is being mixed with the air that was trapped in it at the start of operations the oxygen purity will be less than optimal. This problem is easily corrected and can be avoided in the future if proper shut down procedures are used.

To correct this allow the surge tank to reach 50 PSIG (345 kPa) (the gauge on the right side of the machine will indicate storage tank pressure). This will take only a few minutes depending on the production capacity of the generator and storage tank size you have. Once this pressure is reached vent oxygen from the tank for about 5 minutes or until the storage tank pressure drops to about 40 PSIG (280 kPa).

Caution: While Venting the Tank Make Sure There Is No Smoking Or Open Flame within 10 Feet of the Generator and Do Not Allow Venting Oxygen To Come In Contact With Any Clothing!!

After venting the tank the switch can be turned to 'Automatic'.

4.) If the Storage Tank Pressure is Above 30 PSIG (210 kPa), the Generator Switch can be Immediately Turned to 'Automatic' -

This should be the case upon arriving in the morning to a system that was properly shut down the evening before or after starting up the first time and having vented the storage tank down to 40 PSIG (280 kPa).

The generator will now fill the tank to about 60 PSIG (420 kPa) and then remain in a standby mode until the storage tank pressure drops to about 45 PSIG (310 kPa). It will then begin to cycle again attempting to keep the storage tank pressure between 45 PSIG (310 kPa) and 60 PSIG (420 kPa). While in this mode, the light inside the control switch will be on whenever the unit is cycling.

5.) Open the Valve that Allows Oxygen to Flow to Your Manifold or Application -

This valve, although not included in our standard accessory package, should be in place to ensure a proper shut down and avoid the possibility of wasting oxygen through an improperly closed torch valve.

6.) If An Average Oxygen Pressure Greater than 45 PSIG (310 kPa) is Required or Demand is at a Peak -

It would be preferable to run in the continuous mode. Please keep in mind that our specification for the maximum oxygen pressure available from a system is 45 PSIG (310 kPa). Pressures higher than 45 PSIG (310 kPa) will only be available for short periods of time if Oxygen is drawn from the storage tank at or above the specified production rates for the machines. If the demand is for a higher pressure but a lower flow rate or only for a short period of time up to 60 PSIG (420 kPa) can usually be provided.

Caution: If your application involves metal cutting, welding, brazing, etc. We highly recommend the use of flash guard check valves inserted as close to the torch head in the system as possible.

Shut Down Procedures

Following these few simple steps will allow you to avoid having to run the generator while venting the storage tank every day or every time you want to use it.

1.) Close the Valve that Allows Oxygen to Flow to Your Manifold or Application -This will keep the storage tank from being depressurized while oxygen is not being used.

2A.) Turn the Control Switch to 'Off' -This should really only be done if the storage tank is already pressurized to at least 40 PSIG (280 kPa).

OR

2B.) Leave the Control Switch in the 'AUTO' Position and Allow the Generator to Cycle Until it Refills the Storage Tank to 60 PSIG (420 kPa)-

You will now be ready to go the next day or time you need to use Oxygen.

Note: When in the "AUTO" mode the generator will take approximately 15 minutes to build back up to maximum oxygen purity every time it turns back on causing the average purity in the storage tank to be lower than the maximum purity.

Troubleshooting Guide

No Power:

1.) Ensure that power is available from the 110 vac supply

2.) Visually inspect the electrical wiring. Reconnect any loose wires to their appropriately labeled location.

Oxygen purity is low:

1.) Check the system for leaks, using a leak testing solution.

2.) Ensure that operating environment is conducive to oxygen generation. Environments with extremely high temperature or humidity will inhibit the system from effectively producing oxygen of high purity.

The following troubling shooting checks are for machines equipped with the optional Touchscreen Control system only

System fails to start:

1.) If in manual mode, press the additional start pushbutton.

2.) By checking the Gauge Screen, ensure that the current High Oxygen pressure is not greater than the set Low-point.

3.) Check the Alarm screen for any faults. A “Warning active” indication should appear at the bottom of each screen if a fault has occurred.

System shuts down inadvertently:

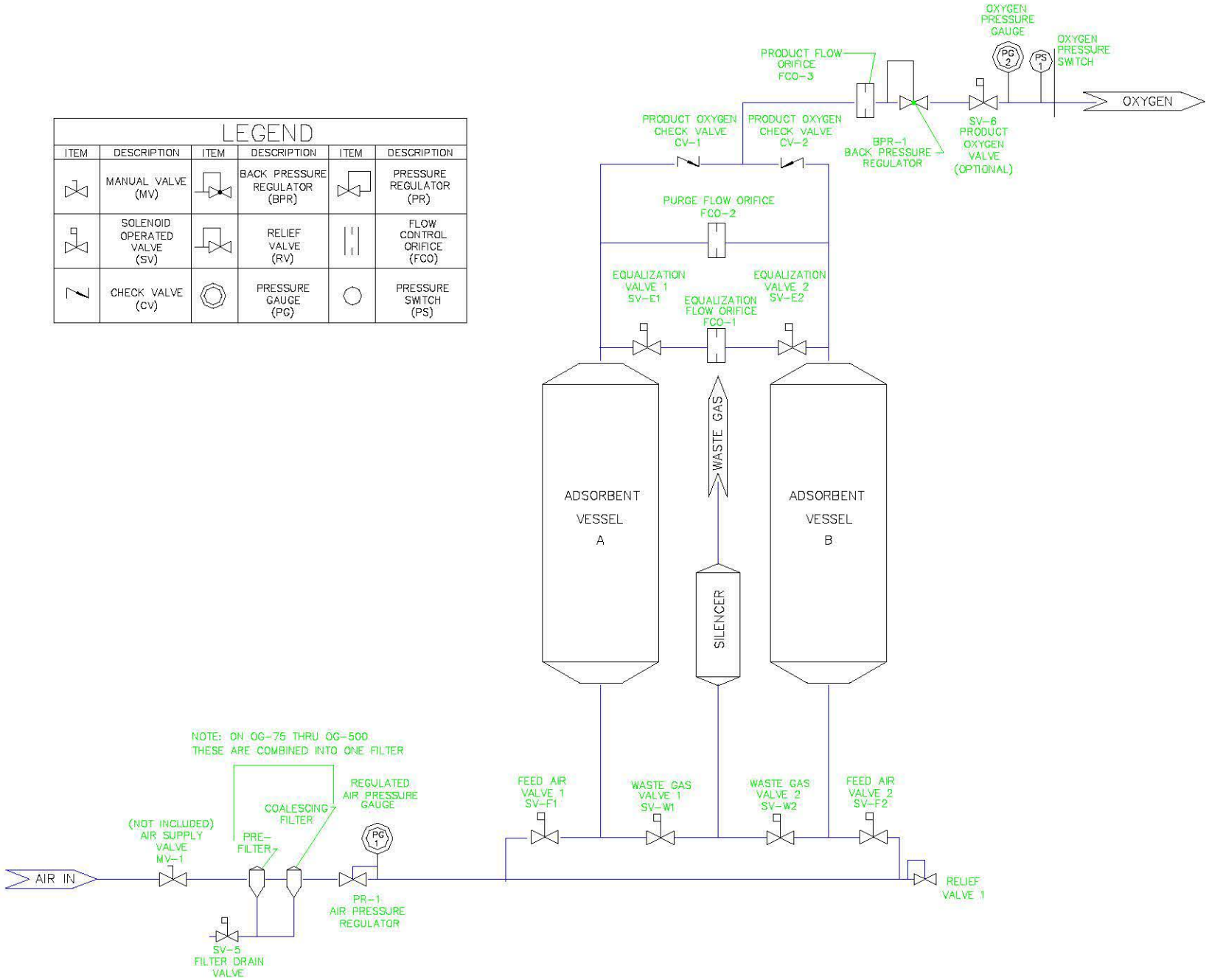
1.) Check the alarm screen. If a warning is active follow the instructions.

2.) Check the high oxygen pressure gauge. If the reading is equal to the set point, the machine has been programmed to shut down.

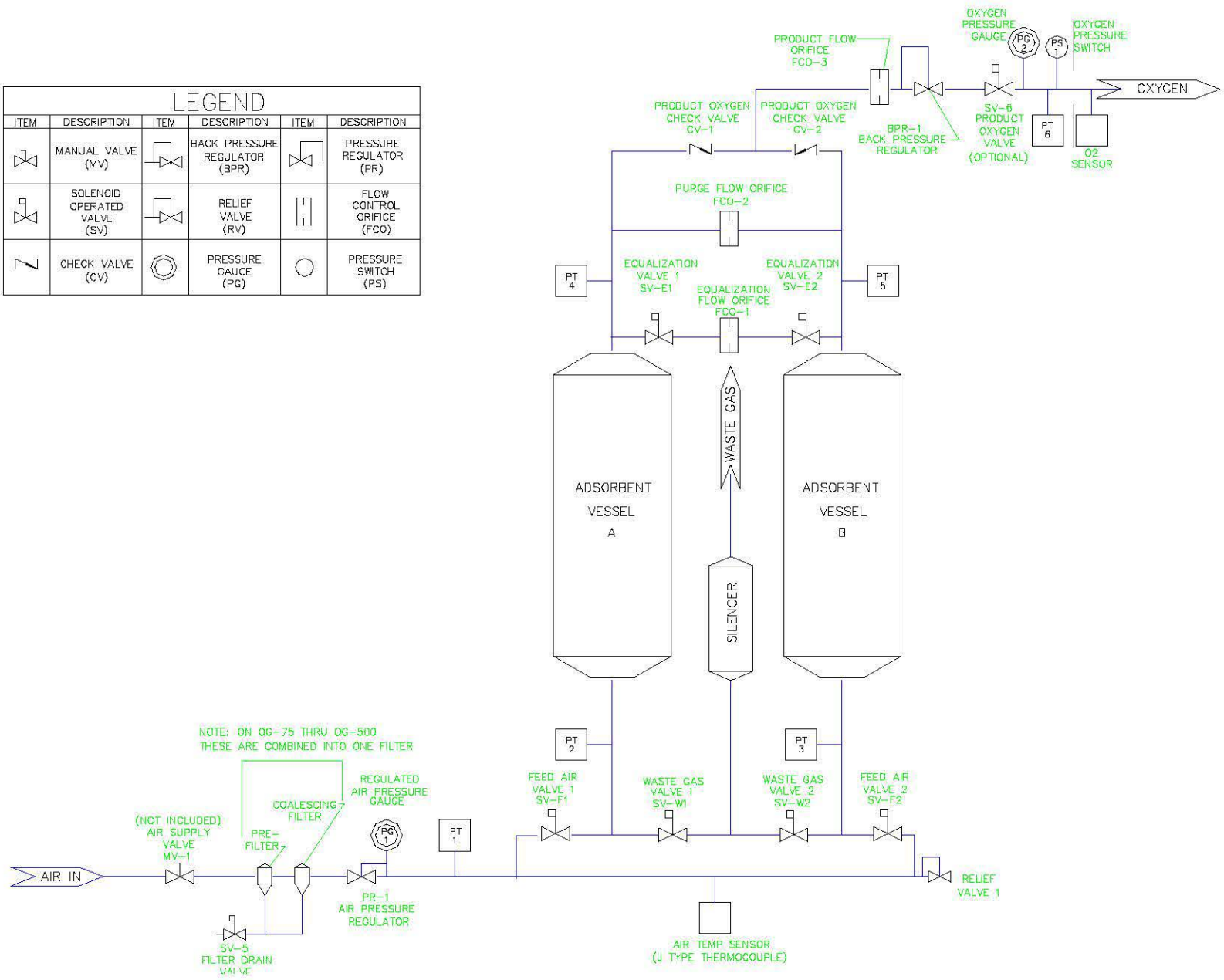
Detailed Warning Description

Thermal switch Warning (touchscreen option)-	The appropriate thermal overload switch must be reset (by pressing it), and the “Clear Warning” pushbutton must be pressed. Normal operation can then be resumed.
Pressure Switch Warning (touchscreen option)-	If the pressure switch has tripped, this is an indication of the high pressure transducer failure. By design, the high pressure transducer should de-energize the system prior to the pressure switch, which is set to 50 psig higher than the maximum setting for normal system operation. High pressure transducer replacement will be necessary if this fault occurs.
Low Oxygen Pressure-	This may be a result of a leak in the system. Use a leak testing solution to locate and repair any air leaks.
The machine has run for 30 minutes and Purity has not yet been Reached-	This may be a result of a leak in the system. Use a leak testing solution to locate and repair any air leaks. (On touchscreen option this warning must be cleared to re-activate the machine.)
Oxygen purity has Fallen below Acceptable limits-	This may be an indication of a leak within the system. Use a leak testing solution to locate and repair any leaks.

Process Flow Schematic



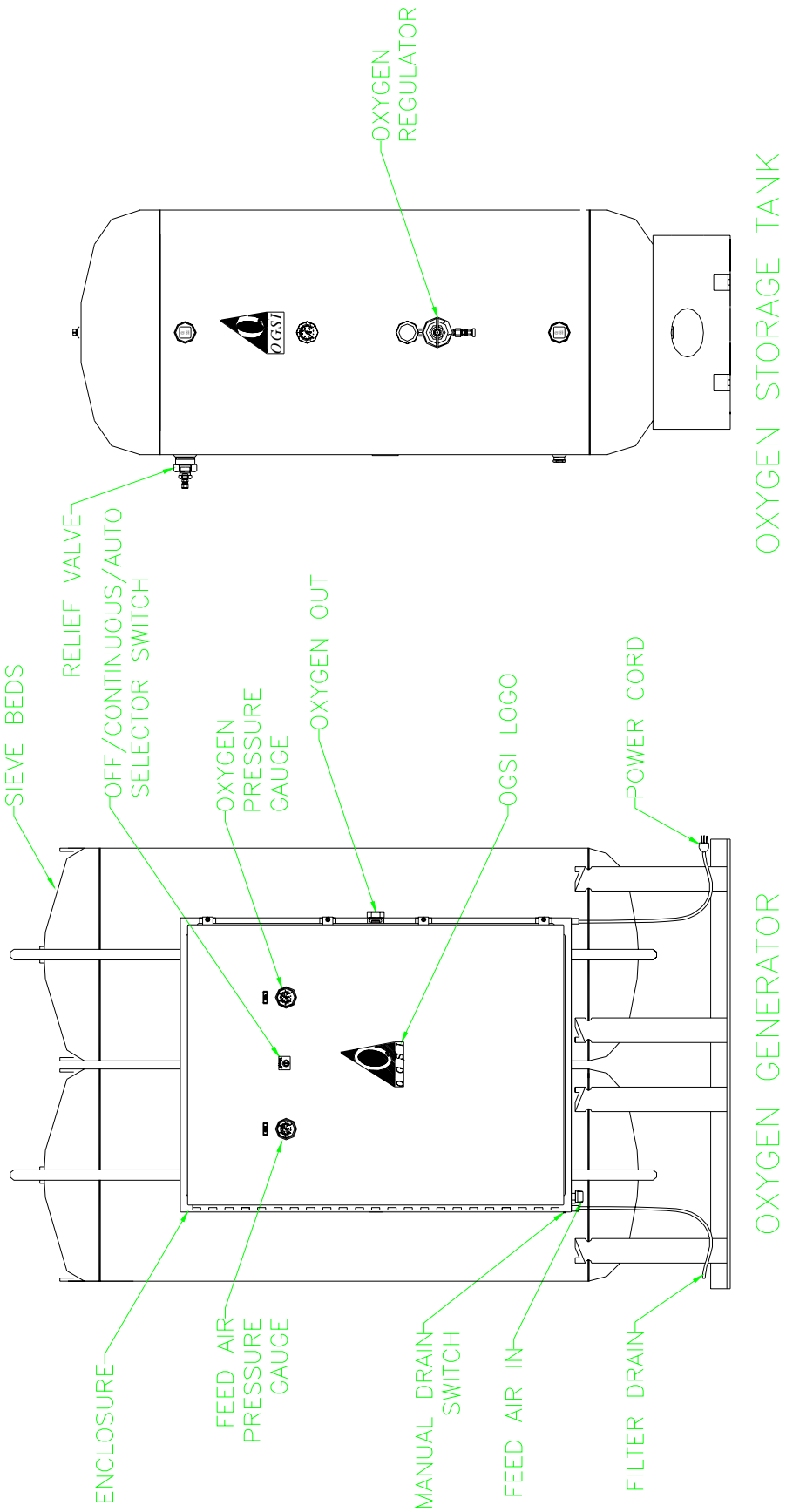
Process Flow Schematic: Touchscreen Option



Process Flow Description

The normal flow of air through the Oxygen Generating System is shown on the previous 2 pages in the Process Flow Schematic Drawings. As you can see once the incoming air is filtered and compressed to proper pressure it is directed into one of the two sieve beds. As the air enters the bed, the nitrogen is adsorbed by the sieve and the oxygen passes through as product gas. Each bed produces Oxygen until the sieve in that bed is saturated with Nitrogen. When that occurs, the feed airflow is directed to the other bed, which continues the production process. While the second bed is producing oxygen the first is venting the nitrogen it adsorbed to the atmosphere through a waste gas muffler.

External Components Drawing



External Components Description

Feed Air In -

This connection is used to supply the feed air to the oxygen generator. It is located on the left side of the machine as you face it. A hose or pipe should be attached to this fitting. It should be of adequate diameter to supply air at a sufficient pressure and flow rate to feed the generator. ***OGSI*** can assist in sizing this line, if necessary.

Feed Air Pressure Gauge -

This gauge indicates the pressure of the air supplied to the beds after its has been regulated and filtered. While the generator is cycling, this gauge should vary between 35 PSIG and 70 PSIG (240 kPa and 480 kPa).

Off /Continuous /Automatic Selector Switch -

The control switch is used to turn power to the generator on and off and to select the mode of operation desired. Naturally, in the off position there is no power to the unit and the light inside the switch remains off.

When the switch is turned one position to the right (so that it points straight up and down), the 'Continuous' mode has been selected and the unit will cycle regardless of whether or not oxygen is being drawn from the storage tank. The light inside the switch will always be on as well. The advantage to operating in this mode is that oxygen should be available at a slightly higher pressure than if in the automatic mode. How much higher depends on the demand for it. The disadvantage to operating in this mode is that your compressor will run more often.

Turning the switch to the far right position puts the generator in the 'Automatic' mode. In this mode a pressure switch is engaged to sense the oxygen storage tank pressure. Once that pressure reaches about 60 PSIG (420 kPa) the generator will stop cycling. When the pressure in the storage tank falls to about 45 PSIG (310 kPa), the generator will begin to cycle again attempting to refill the storage tank. While in this mode, the light inside the control switch will be on whenever the unit is cycling.

Oxygen Pressure Gauge -

This gauge indicates the pressure of the Oxygen in the storage tank. While this level can vary between 0 PSIG and 65 PSIG (0 kPa and 450 kPa), it should remain between 40 PSIG and 65 PSIG (280 kPa and 450 kPa) during normal operation. The exception, of course, is when the unit is first started and it needs to fill the storage tank. This does not take more than a few minutes.

Oxygen Out -

The Oxygen Outlet Connection is on the right hand side of the machine. There is an appropriately sized fitting to which the GREEN interconnecting Oxygen Hose Assembly should be attached. This Oxygen Hose Assembly has a female threaded fitting that swivels on each end of it. The other side of this Oxygen Hose Assembly should be connected to the inlet fitting of the Oxygen Storage Tank that you are using. If the storage tank was purchased from ***OGSI***, it will have an appropriately sized fitting in place for this connection. If the tank was not purchased from ***OGSI***, you must insure that it has the appropriate size fitting to accept the hose assembly

Power Cord -

On generators sold within North America, this cord can be plugged into any standard 120 VAC/60 Hz electrical outlet. The generators do not draw much current (less than 1 amp) and have internal protection for short circuiting (either a fuse or circuit breaker depending on which model you have).

Generators shipped outside North America will have an electrical plug suitable for use in the location to which it is shipped or have bare wires ready to accept such a plug. Typically, this will be a three-pronged jack intended to accept a 220 VAC/50 Hz supply but may vary as required.

Manual Drain Switch -

The manual filter bowl drain can be used at any time to empty the contents of the filter bowl and is especially useful during the filter element replacement procedure. It is a momentary switch so it will only hold the drain valve open as long as it is pressed. Upon release, it returns the valve to its normally closed position. This button has a rubber cover protecting it from external contamination. Do not attempt to remove this cover.

Filter Drain Hose -

A small hose is provided with each unit and can be run directly into a drain. This hose will alleviate the potential problem of having water and material trapped by the filter blown directly on to the floor. Using this hose/connection is strictly up to the user.

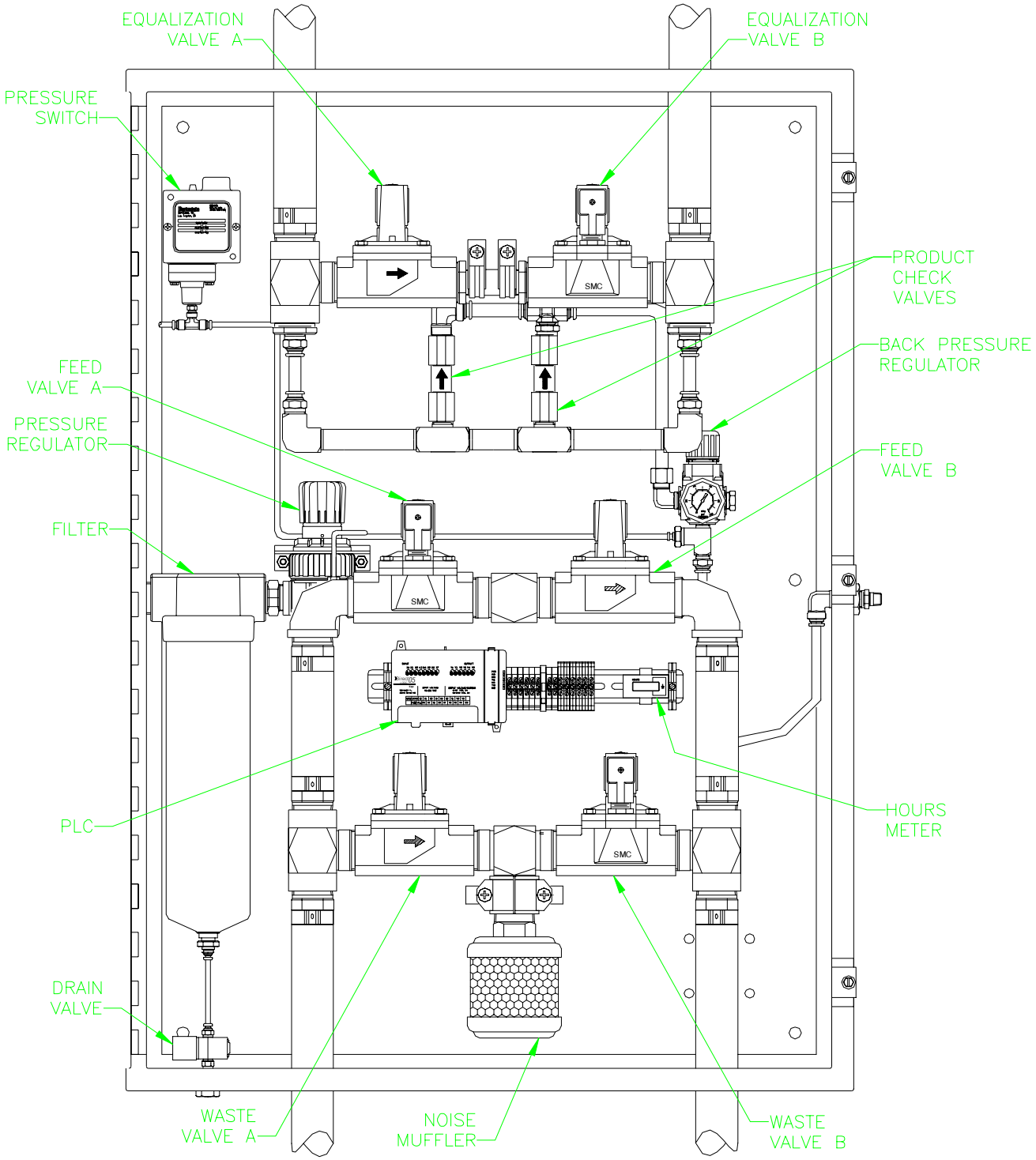
Relief Valve -

This valve is in place to insure that the oxygen storage tank does not become overpressured. It will only open in the event of a serious malfunction. It is connected to the same tee fitting to which the interconnecting oxygen hose should be attached.

Oxygen Regulator -

If your storage tank came from ***OGSI***, there will be an Oxygen Regulator, which you should attach to it. It can be used to set the regulated Oxygen pressure out of the storage tank at any level up to 60 PSIG (420 kPa). Please keep in mind that our specification for the maximum oxygen pressure available from a system is 45 PSIG (310 kPa). Pressures higher than 45 PSIG (310 kPa) will only be available for short periods of time if Oxygen is drawn from the storage tank at or above the specified production rates for the machines. If the demand is for a higher pressure but a lower flow rate or only for a short period of time 60 PSIG (420 kPa) can usually be provided.

Internal Components Drawing



Internal Component Description

Equalization Valve A & B –

The Equalization Valves allow gas to pass between the beds at the end of each pressurization cycle in order to increase the efficiency of the machine by reducing the amount air needed to produce a unit of Oxygen.

Feed Valve A & B –

The Feed Valves allow Air to enter the machine and pressurize the beds beginning the air separation/oxygen generation process. Only one of these valves is open at any point in time.

Waste Valve A & B –

The Waste Valves allow the Nitrogen gas that has been trapped during the previous adsorption cycle to be discharged back to the air. As with the Feed Valves only one of these valves will be open at a time. They operate in conjunction with the opposite side Feed Valve. For example, whenever the Feed Valve on the A side of the machine is open, the Waste Valve on the B side will also be open. The reverse is also true.

Drain Valve –

The Drain Valve allows condensate and waste material trapped in the filter to be discharged automatically at fixed intervals by the PLC or at any time by depressing the Manual Drain button.

Pressure Switch –

The Pressure Switch senses the Oxygen Pressure in the Oxygen Storage Tank and will turn the Oxygen Generator On and Off automatically when it is in the 'Automatic' mode. The Pressure Switch comes set from the factory with a 'Turn Off' point at 60 psig and a 'Turn On' point at 45 psig. Both the dead band (difference between the Turn Off and Turn On points) and the points themselves can be adjusted in the field or by our factory technicians prior to shipment. Please call the factory for assistance in this area if you want to make changes.

Filter –

The filter keeps dust, dirt, and moisture from entering the sieve beds and damaging the sieve.

Pressure Regulator –

The regulator controls the air pressure into the machine. This should be set around 70 psi. Turning it clockwise increases the delivery pressure while turning it counter-clockwise decreases the delivery pressure.

Product Check Valves –

The check valves insure that the oxygen flow stays directed in the right direction by not allowing any back flow through the opposite bed.

PLC –

The PLC (Programmable Logic Controller) controls the operation of the machine and communicates with the touchscreen (on machines equipped with this option).

Hours Meter –

The hours meter increments time while the unit is running. It provides an indication as to when service intervals are due.

Noise Muffler -

The noise muffler is used to silence the exhaust noise that occurs as a result of the sieve beds rapidly depressurizing to atmospheric pressure, venting their nitrogen. For installations where a lower noise level is required, ***OGSI*** offers an optional alternative muffler system that can decrease the emitted noise even further.

Back Pressure Regulator –

The back pressure regulator controls the flow of oxygen from the machine. Turning it clockwise increases the oxygen flow rate from the machine (while reducing the oxygen concentration). Turning it counter-clockwise decreases the oxygen flow rate from the machine (while increasing the oxygen concentration).

Touchscreen General Introduction

(This is an optional control center and may not be included on your machine)

Before running the Generator be sure to look through the user manual on the follow pages. General information on button usage, and screens is listed below. Please read carefully.

Initially there must be power supplied to the generator.
Once there is power to the generator the screen will need to boot up. At first there will be many errors on the bottom of the screen do not worry about the warnings as of yet. As you already know the generator needs to be cycling for at least 15 minutes before it begins to function properly.

Once that phase is over the Language screen will be the first viewable screen. English is the default language, Spanish is available, and French is an option upon request. Any one of these buttons may be pressed as per the language that is appropriate for the user. Once one of these buttons has been selected, and the go to the Security Screen Button has been touched, the Password Screen will be active.

The user must touch the yellow password area, to get a numeric entry system in which the user must enter their password. After the proper password is entered, the next screen will appear. OGSI will supply you with your own password, specified upon your request.

The next screen is the Control Screen. This screen contains the modes of operation, and indicator buttons. For the machine to start cycling one of the Mode of Operation Buttons must be selected, either Continuous or Automatic. There are indicator lights on the screen that are explained above, on screen 4. Once that has been taken care of, you will be ready to move onto the next screen which is the main screen.

The Main screen (5) contains the adjustable pressure switch for the machine. If you are running the Generator in Automatic mode it is possible to adjust the pressure switch. The only way to do this is to deactivate the SET DEFAULT FOR PRESSURE SWITCH. If that touch area reads Off, you may proceed to adjust the Default Pressures. If the area reads On, all that has to be done is to touch the Green Area. Once that has been taken care of the touch area should be red, and the words OFF centered on the button. Note: That the value in SET LOW POINT FOR PRESSURE SWITCH must be less than the value in SET LOW POINT FOR PRESSURE SWITCH. If this condition does not hold true the machine stops cycling, and errors will begin to pop up. If this error does occur change the Pressure Switch settings immediately. If this is not taken care of immediately the machine will stop cycling. Recommended areas for the Pressure switch is to have a 17 psi difference between high and low points, and the default is 45 (low) psi and 62 (high) psi. There is also a real time clock on this screen, which can be adjusted by 1 hour either up or down.

The next screen is the Gauge Screen, which shows all the gauges of operation. The Regulated Air guage is in psig, the normal variance of this gauge is between 40 (low) and 80 (high) psig. The Waste Gas guage is in psig, the normal variance of this gauge is between 0 (low) and 20 (high) psig. The Oxygen Pressure guage is in psig, the normal variance of this gauge is between 45 (low) and 65 (high) psig. Oxygen Purity is in psig, the normal variance of this gauge is between 85 (low) and 98 (high) psig.

The Pressure Screen is the next screen, this screen contains a graph of the 4 gauges over time. Every five minutes a reading is taken. The legend on the bottom of the screen contains the coordinating colors of the meters..

The Alarm Screen contains 7 triggered alarms that only occur when the machine is cycling. These must be ignored when the generator is initially started up because the machine must warm up. The same principle holds true for the alarms on the bottom of the screen. The button that says Touch To View Alarm History, displays the database of the warnings on the bottom of the screen, which tells you to go to the alarm screen, and the triggered errors will be displayed if the machine is cycling.

This Final Screen contains all the general information of the generator, and how to contact OGSI.

USER TOUCH SCREEN

SCREEN 1

If you want ENGLISH as your default language, touch anywhere in the Yellow Area.

If you want SPANISH as your default language, touch anywhere in the Yellow Area.

Once a language has been chosen press this button to advance to the next screen. If you want ENGLISH as your default language, or you have already entered your password, and chosen a default language you may advance to the Password Screen.

SCREEN 2

To initialize the password entry system, touch anywhere in the Yellow Area.

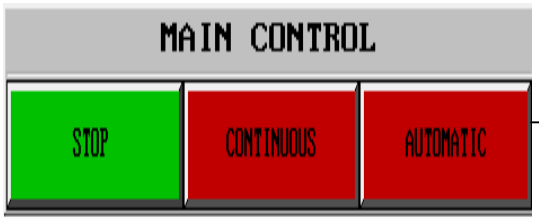
After pressing the Yellow area Numeric Entry System will come up partially overlapping the password area titled Enter Numeric Entry. When this appears enter your numeric password given to you by OGSI.

Note: The user will not be allowed to change their default password, so keep it secure!

Press Enter to advance to the Next Screen which is the Main Control Screen.

Note: That once you have entered the Password Screen you can't leave until a proper password has been entered.

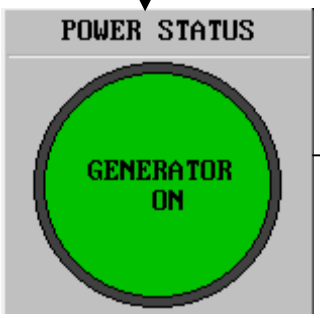
SCREEN 3



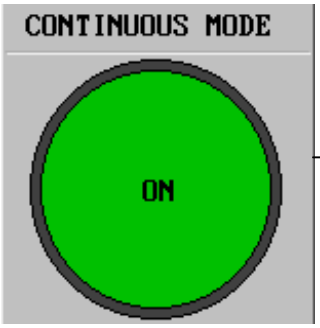
In order to activate the MAIN CONTROL you must chose either CONTINUOUS or AUTOMATIC. Selecting either one will cause the Generator to begin Cycling. To stop the Generator from cycling Press STOP.

If CONTINUOUS is selected, the generator will run in Continuous Mode, in this case the generator will cycle (producing Oxygen) as long as the generator is ON! If the AUTOMATIC is selected, the generator will run in Automatic Mode. This mode allows a pressure switch to be set which can be adjusted on the next screen.

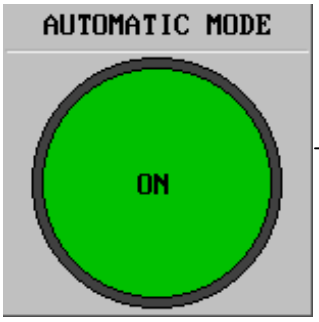
NOTE: That whenever the Generator has Power supplied to it the Power Status will Read GENERATOR ON.



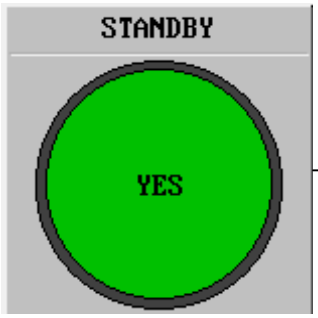
The Indicator Button; POWER STATUS represents the Generator having proper supplied power.



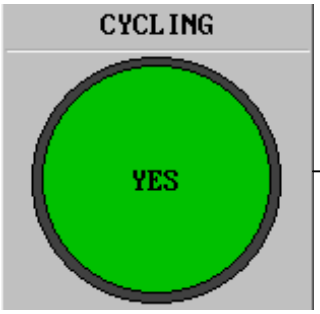
The Indicator Button; CONTINUOUS MODE represents if CONTINUOUS is selected in the main control. If any other option is selected on the MAIN CONTROL Switch CONTINUOUS MODE will read off.



The Indicator Button; AUTOMATIC MODE represents if AUTOMATIC is selected in the main control. If any other option is selected on the MAIN CONTROL Switch AUTOMATIC MODE will read off.



The Indicator Button; STANDBY represents if the Generator is in STANDBY MODE, meaning the Pressure switch has gone active meaning the machine is NOT Cycling, but the Generator is still in Automatic Mode.

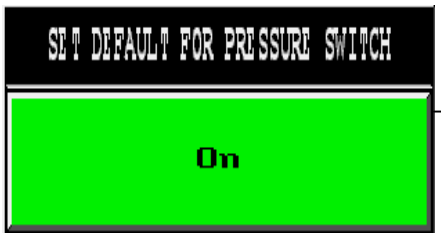


The Indicator Button; CYCLING represents if the generator is cycling, either in Automatic or Continuous Mode.

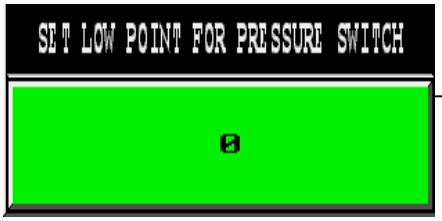
If you want to go back to the Previous Screen/Password Screen all you have to do is touch the Blue area.

If you want to advance to the Next Screen/Main Screen all you have to do is touch the Blue area.

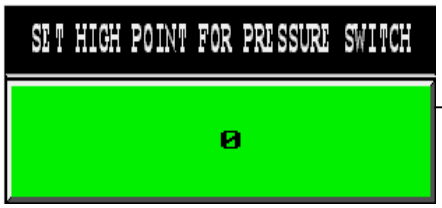
SCREEN 4



This Switch; SET DEFAULT FOR PRESSURE SWITCH is only for use in the Automatic Mode of Operation. If the button reads ON, the Pressure Switch has its default Pressures placed into SET LOW POINT FOR PRESSURE SWITCH at 45 psi and SET HIGH POINT FOR PRESSURE SWITCH at 62 psi. As long as SET DEFAULT FOR PRESSURE SWITCH indicates being ON the user cannot change the variable Pressure Switch. If you want to adjust the Pressure Switch simply touch the green area so it reads OFF. Once the area reads OFF and the area is red instead of green you may adjust the Pressure Switch according to OGSI specifications.



The Button; SET LOW POINT FOR PRESSURE SWITCH allows you to set the LOW point for your Pressure Switch in Automatic Mode. Simply touch any where in the green area, and a numeric keypad will appear to enter the low point. Only 2 digits can be placed into the keypad. Some limitations are in the top right corner of the keypad. Also, do not set the low point greater than the high point. An error will appear and the machine will stop cycling.



The Buttons; SET HIGH POINT FOR PRESSURE SWITCH allows you to set the HIGH point for your Pressure Switch in Automatic Mode. Simply touch any where in the green area, and a numeric keypad will appear to enter the low point. Only 2 digits can be placed into the keypad. Some limitations are in the top right corner of the keypad. Also, do not set the high point less than the low point. An error will appear and the machine will stop cycling.

Both have ranges from 0 – 70 psi.

CAUTION! INVALID ENTRY

The Set High Point is less than the Set Low Point CHANGE IMMEDIATELY or the machine WILL NOT CYCLE!

If user enters:
Set Point Low > Set Point High this warning will appear, and the machine will stop cycling. To get rid of the error just make the proper adjustment.

Warning the machine has run over 4000 or 8000 hours your filters need to be changed.

This alarm is triggered when the machine has run either 4000 and/or 8000 hours. This message will be displayed for 1 cycling hour. So that you will be reminded to change your filters.

HOURS METER

0.0

This Numeric Display; HOURS METER displays the amount of hours that the machine has been running. The HOURS METER is reset at 10,000 hours.

REALTIME CLOCK

02:29:41 PM

23-JUL-01

The Digital Clock; REALTIME CLOCK is a digital display which has default time and date.

TIME ADJUSTMENT

1 HOUR UP

You may adjust the REALTIME CLOCK by increasing it one hour accordingly.

TIME ADJUSTMENT

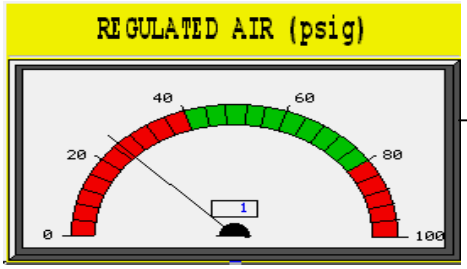
1 HOUR DOWN

You may adjust the REALTIME CLOCK by decreasing it one hour accordingly.

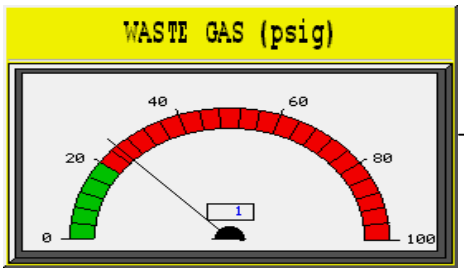
If you want to go back to the Previous Screen/Control Screen all you have to do is touch the Blue Area.

If you want to advance to the Next Screen/Gauge Screen all you have to do is touch the Blue Area.

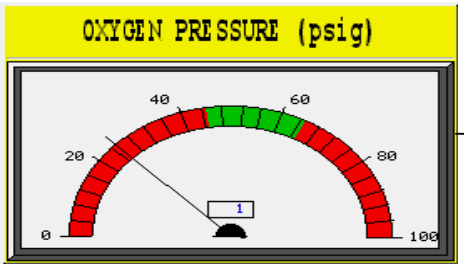
SCREEN 5



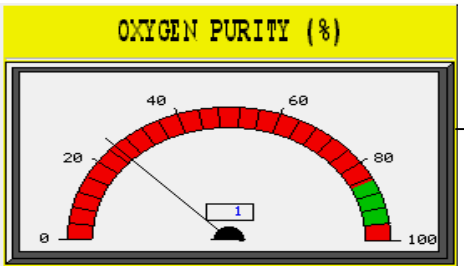
This Meter; REGULATED AIR involves reading your incoming Regulated Air from the compressor. Measurements are in psig, there is both a analog reading and a digital gauge. The digital reading is exact, while the analog meter acts as a real meter. If the dial falls out of the green area an error will appear. The normal operating variance is between 40 and 75 psi.



This Meter; WASTE GAS measures the psig of your Waste Gas. The same details hold true for this gauge as in the REGULATED AIR gauge except for the normal operating variance that is between 0 and 20 psi.



This Meter; OXYGEN PRESSURE measures the Oxygen Pressure (psig) in your back pressure regulator. The same details hold true for this gauge as in the REGULATED AIR gauge except for the normal operating variance which is 45 – 62 psi.

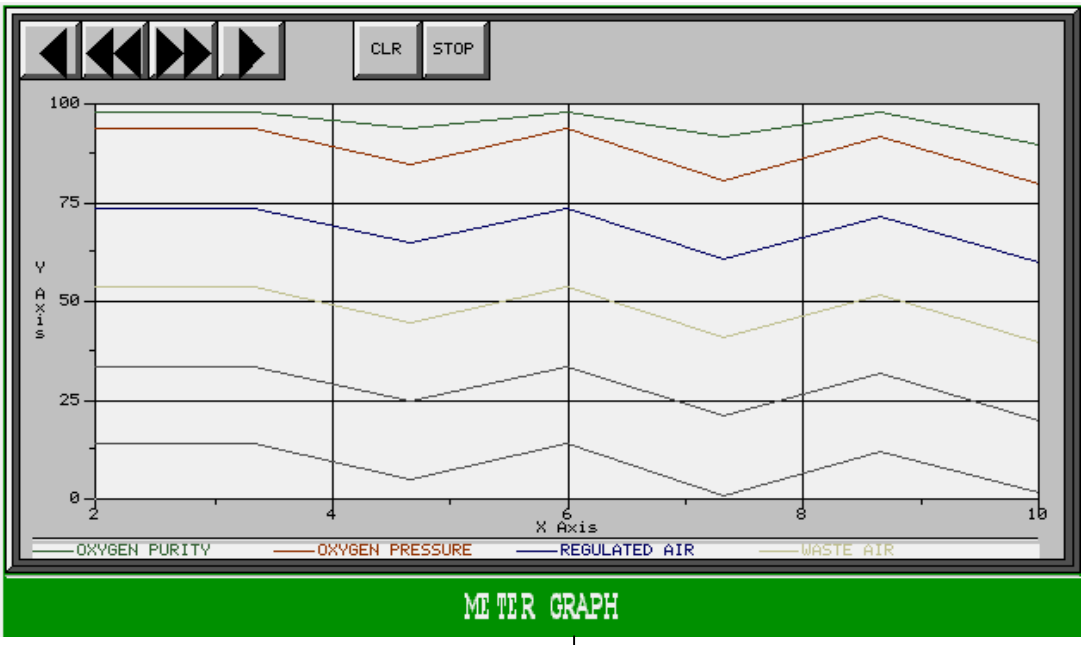


This Meter; OXYGEN PURITY measures the Oxygen Purity that the generator is producing. The same details hold true for this gauge as in the REGULATED AIR gauge except that the Oxygen being generated should be between 85 – 98%.

If you want to go back to the Previous Screen/Main Screen all you have to do is touch the Blue Area.

If you want to advance to the Next Screen/Pressure Screen all you have to do is touch the Blue Area.

SCREEN 6

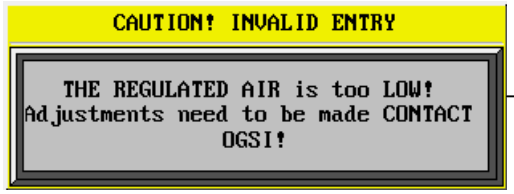


The Line Graph; METER GRAPH displays the activity of the Oxygen Purity, Oxygen Pressure, Waste Gas, and Regulated Air every 5 minutes as long as the generator is on. You can clear the readings, and if the generator is not cycling you can stop the graph from reading. Using the CLR and Stop Buttons. Also you can scroll through the graph using the 4 buttons in the upper left corner.

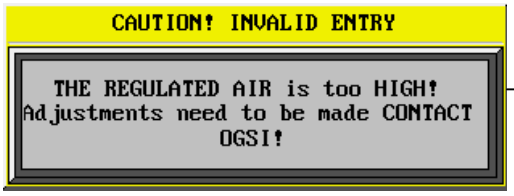
If you want to go back to the Previous Screen/Gauge Screen all you have to do is touch the Blue Area.

If you want to advance to the Next Screen/Alarm Screen all you have to do is touch the Blue Area.

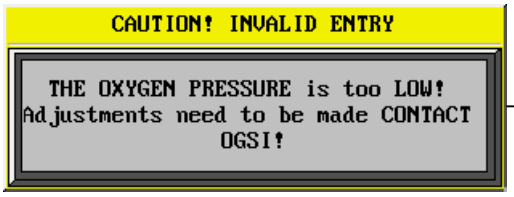
SCREEN 7



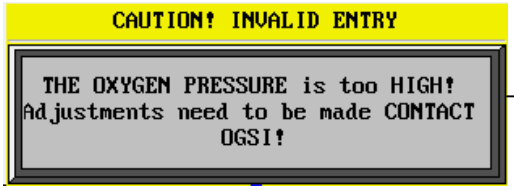
This particular alarm is triggered when the Regulated Air is below 40 psi.



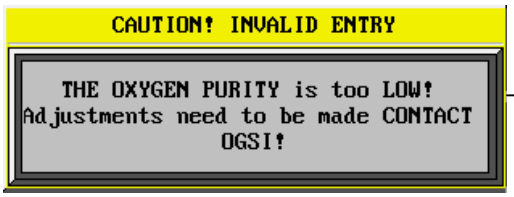
This particular alarm is triggered when the Regulated Air is above 80 psi.



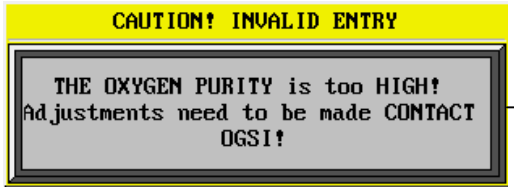
This particular alarm is triggered when the Oxygen Pressure is below 40 psi.



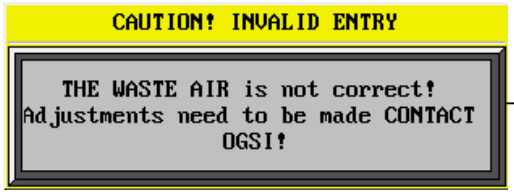
This particular alarm is triggered when the Oxygen Pressure is above 65 psi.



This particular alarm is triggered when the Oxygen Purity is below 85%.



This particular alarm is triggered when the Oxygen Purity is above 96%.



This particular alarm is triggered when the dispersed gas from the muffler is out of the range of 0 – 20 psi

NOTE! These are triggered alarms that will only flash when the machine is cycling. Initially when the generator begins cycling these errors will occur.

This button allows you to look at what caused the errors in the system. This is a database of errors.

If you want to go back to the Previous Screen/Pressure Screen all you have to do is touch the Blue Area.

If you want to advance to the Next Screen/Final Screen all you have to do is touch the Blue Area.

SCREEN 8

MODEL NUMBER - OG 250

OGSI model number of your Generator.

SERIAL NUMBER - 00000000

Serial Number

OXYGEN PURITY - ?%

This is the AVERAGE purity of your OGSI Generator.

DATE OF COMPLETION - 00/00/01

This is the date that your machine was shipped.

If there are problems with the system call
OGSI at
(800) 414-6474 OR Fax (716) 731-1358 OR
Phone (716) 731-1455
OR
VISIT our website at www.ogsi.com
e-mail www.ogsimail.com

General Information

PREVIOUS SCREEN

GO TO THE ALARM SCREEN

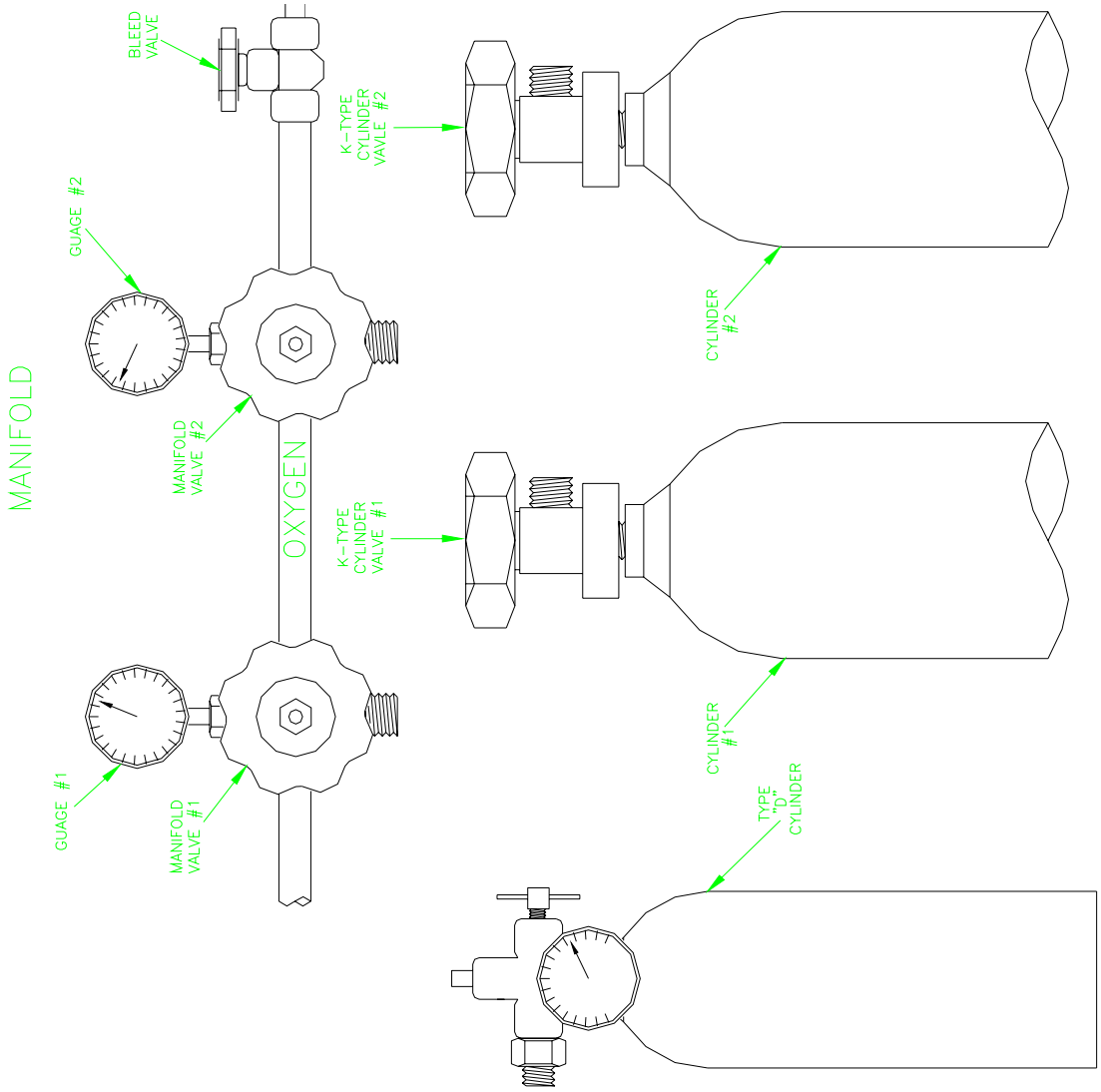
If you want to go back to the Previous Screen/Alarm Screen all you have to do is touch the Blue Area.

NEXT SCREEN

GO TO LANGUAGE CHOICE SCREEN

If you want to advance to the Next Screen/Language Screen all you have to do is touch the Blue Area.

Manifold Drawing



Manifold Operating Procedures

Warning:
High Pressure Oxygen may present a Hazard. Always follow proper operating procedures, and open valves slowly. Rapid pressurization may result in personal injury. Safety glasses and hearing protection are required when venting oxygen under high pressure.

Attaching and filling a K-type cylinder:
With all valves initially closed, connect the steel whip between a manifold valve and a cylinder valve, and tighten both connections using a 1 1/8" wrench. Slowly open the cylinder valve first, and the manifold valve second. Fully open both valves, backing off ¼ turn to prevent the valve from sticking in the open position and appearing closed. At this point, the gauge on the top of the manifold will read the pressure contained within the cylinder. Now, cylinder filling can be initiated by starting the machine, (see start-up procedures).

Detaching a K-type cylinder:
Close each of the appropriate manifold and cylinder valves.

Warning:
Oxygen under high-pressure is present. The use of safety glasses and hearing protection is required. Slowly disconnect the steel whip from the cylinder valve, using a 1 1/8" wrench. Be aware of the venting of oxygen under high pressure. If difficulty is encountered while attempting to remove the steel whip, open the appropriate manifold valve, then slowly open the bleed valve to vent the pressure. This will allow easier removal of the steel whip. Ensure both manifold and bleed valves are closed after venting pressure.

Attaching and filling an M-type cylinder:
It is intended that M-type cylinders be filled from K-type cylinders. With all valves closed, attach the steel whip between the M and K type valves (see Attaching and filling a K-type cylinder outlined above). Slowly open the K-type Cylinder valve, followed by the M-type cylinder valve. Allow pressure to vent from the K-type into the M-type. When the desired pressure is reached in the M-type cylinder, close both valves.

Warning:
Oxygen under high-pressure is present. The use of safety glasses and hearing protection is required. Disconnect the steel whip following the procedure outlined in Detaching a K-type cylinder above.

Routine Maintenance Instructions

Filter Drain:

Make sure the filter drain is working properly and not blocked by anything. When the unit first begins to cycle in the morning the filter drain should open for 5 seconds and then for 5-second periods once every 15 minutes. Do this daily.

Filter Element Replacement:

The filter element provided with the Oxygen Generator must be replaced every six (6) months. The element helps to maintain the quality of the feed air supply and preserve the molecular sieve inside of the oxygen generators. **Failure to replace the filter element on schedule will result in the warranties becoming invalid.**

Cabinet & Power Cord:

The cabinet and power cord should be occasionally washed down with a sponge or clean rag and some soapy water. Avoid the use of ammonia or other strong chemical based cleaning solvents. The intention is to avoid dust and dirt from building up on the machine.

Air Distribution System:

Especially in locations where air is piped over long runs, condensation inside the pipes can be a big problem. The solution is to have traps and drains opened regularly, automatically if practical, to keep the water from reaching your Oxygen Generator

Long Term Maintenance

Air Compressor:

You should consider your air compressor an important part of your Oxygen Generating System and as such maintain it in accordance with the instructions provided in its manual. This will include keeping it properly oiled and changing its filter elements regularly, at a minimum.

The air compressor should last at least two years under normal operating conditions. In many cases it will last five or six years. Eventually, however, it will need to be re-built or replaced. Oxygen purity and flow rate along with feed air pressure delivered to the sieve beds will all be indicators that the air compressor has expended its useful life. Replacement in the field is possible but return of the unit to the factory or an authorized service center is recommended, as by that time a complete maintenance check will be in order.

Valve Replacements:

As with compressor repairs the best practice will be to return the unit to the factory or to an authorized service center for repair.

Filter Element Replacement Instructions

1.) Place the Generator in the 'Continuous' Mode

2.) Close the Valve that Supplies Air to the Generator

3.) Press the Manual Filter Drain Push Button until the Regulated Air Pressure Gauge Reads 0 PSIG

4.) Place the Generator in the 'Off' Mode

5.) Open the Cabinet Door

6.) Disconnect the Plastic Tube from the Brass Prestolok Fitting holding it in Place. This is really the only tricky part in the operation. To disconnect the tube from the fitting the white collar around the tube must be pushed back into the fitting. This releases the tube. It can now be easily pulled out of the fitting. If it is not easy to pull it out of the fitting the collar of the Prestolok fitting is probably not being pushed back into the fitting hard enough. The tube should come out easily once it is released from the fitting.

7.) Remove the Filter Bowls by unscrewing the connecting Allen Head Bolts Holding them together.

8.) Carefully remove them from the Cabinet

9.) Clean out the Inside of the Bowls with Some Soap and Water

10.) Remove the Existing Filter Elements by Unscrewing the Units from the upper threads that are holding them in place

11.) Insert the New Filter Elements

12.) Replace the Filter Bowls

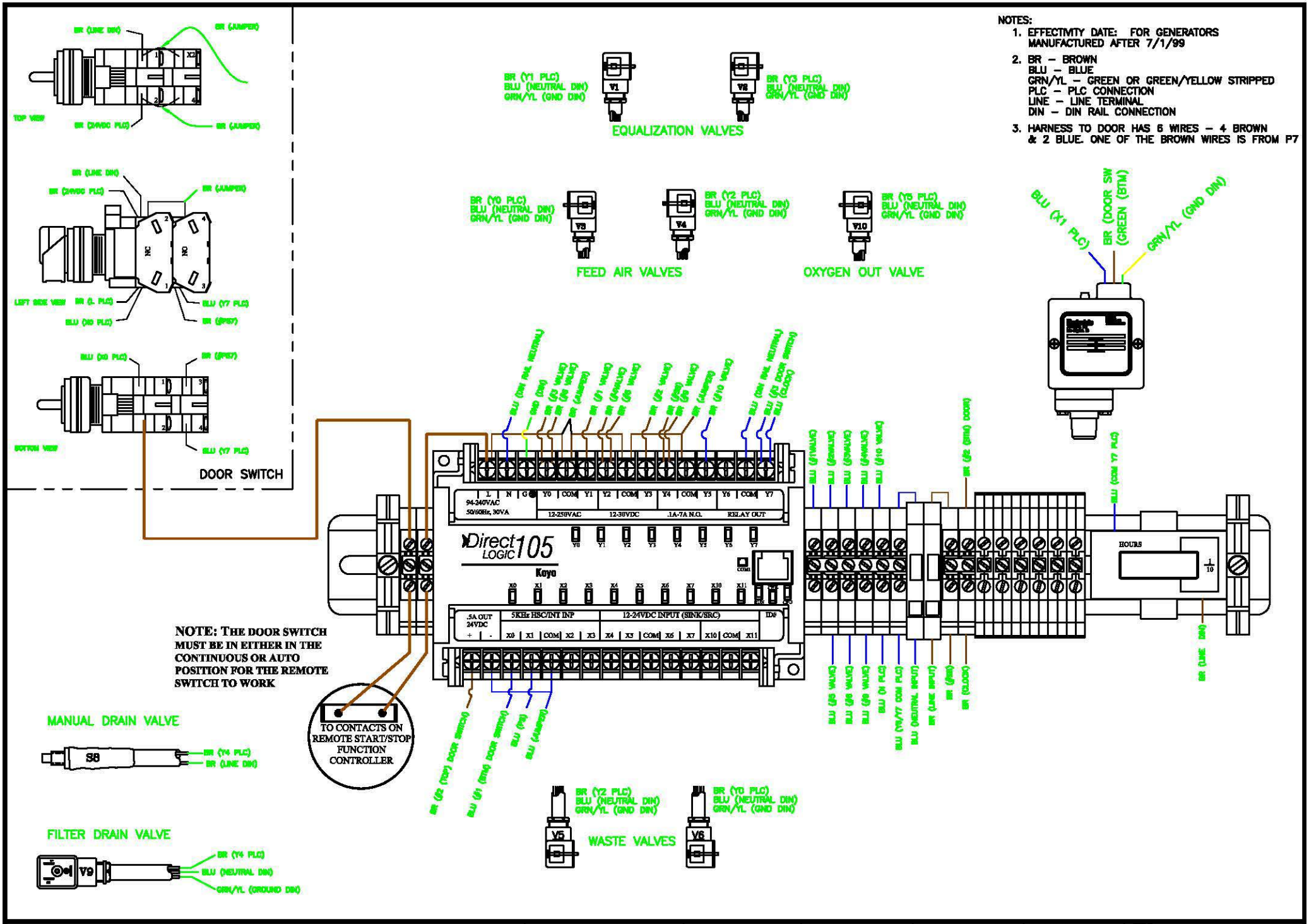
13.) Reconnect the Drain Tubes

14.) Check to see that the Tube Has Been Replaced Securely By Opening the Valve that Supplies Air to the Generator If the tube blows out of the fitting, close the valve again and go back to step 13

15.) Close the Cabinet Door and Begin Operating, If Desired

NOTES:

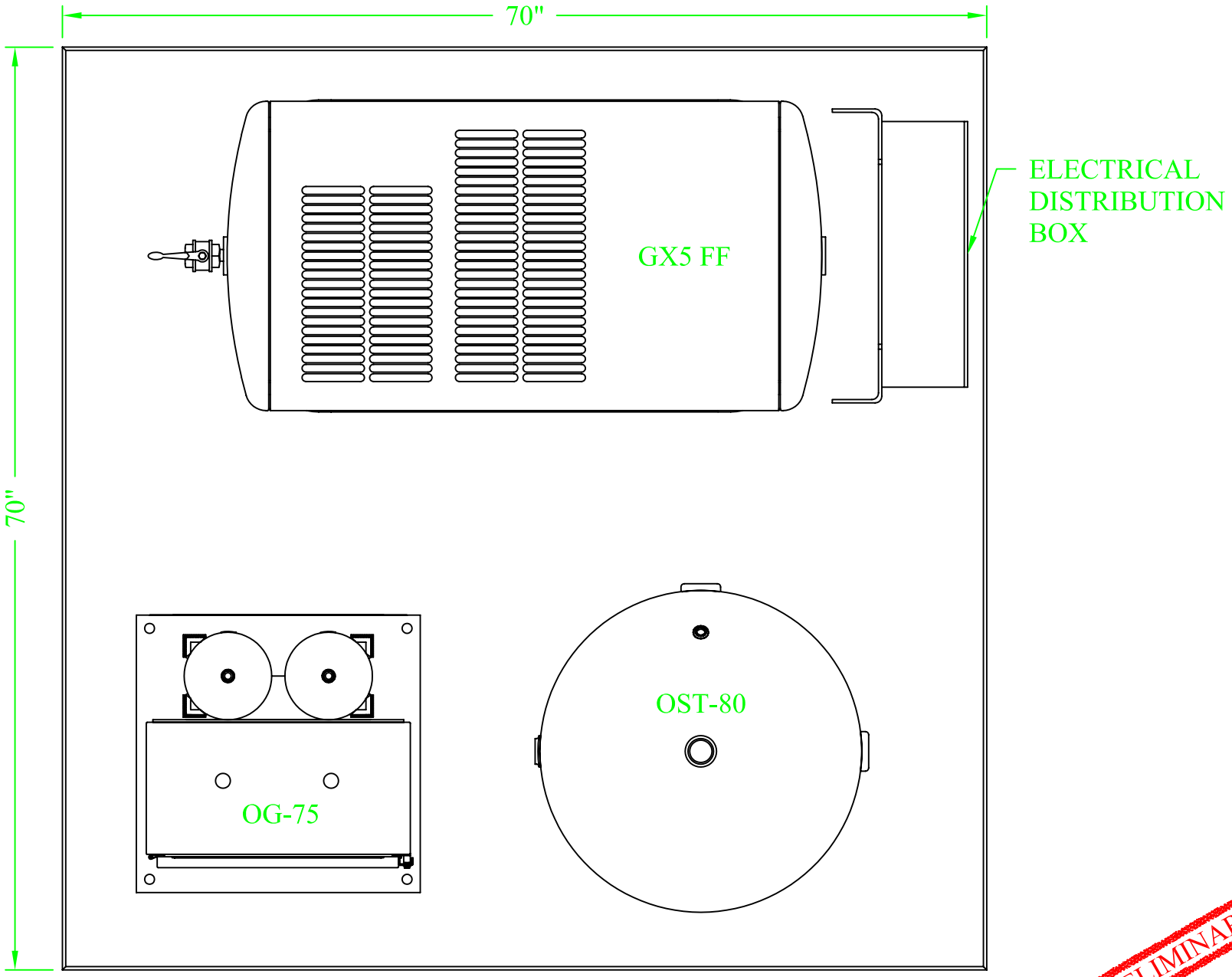
1. EFFECTIVITY DATE: FOR GENERATORS MANUFACTURED AFTER 7/1/99
2. BR – BROWN
   BLU – BLUE
   GRN/YL – GREEN OR GREEN/YELLOW STRIPPED
   PLC – PLC CONNECTION
   LINE – LINE TERMINAL
   DIN – DIN RAIL CONNECTION
3. HARNESS TO DOOR HAS 6 WIRES – 4 BROWN & 2 BLUE. ONE OF THE BROWN WIRES IS FROM P7



REVISIONS				
REV	DESCRIPTION	DATE	CHK	ECN #

OGSI
70 John Glenn Drive
Amherst, New York 14228
Phone: (716) 564-5165
Fax: (716) 564-5173

FILE NAME	PLOT SCALE	EFFECTIVITY OR SERIAL NO.	DRAWN BY	TITLE
DL105 W-REMOTE SWITCH	NTS		J.C. PALONE	WIRING FOR DL 105 WITH REMOTE SWITCH
	ENGINEER: J. M. McMAHON	DATE: 09/20/05	PAGE: 1 OF 1	



PRELIMINARY

REVISIONS				
REV	DESCRIPTION	DATE	CHK	ECN #

OGSI
70 John Glenn Drive
Amherst, New York 14226
Phone: (716) 564-5165
Fax: (716) 564-5173

FILE NAME	PLOT SCALE	EFFECTIVITY OR SERIAL NO.	DRAWN BY	TITLE
PPT OG-75 EQUIP LAYOUT	NTS		J.C. PALONE	EQUIPMENT LAYOUT
	ENGINEER: J. M. McMAHON	DATE: 08/01/05	PAGE: 1 OF 1	PIERSON PROCESS TECH

INNOVATION INSIDE

NEW CR 1, 3, and 5

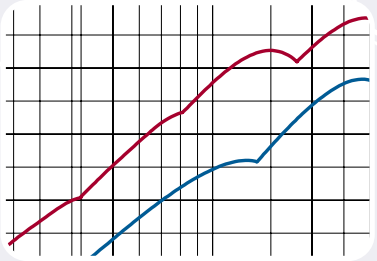
We've redesigned our CR line for increased economy and performance

Grundfos is known for our strong commitment to research and cutting-edge technology. To that end, we've redesigned our multistage CR pumps. The CR has long been the industry standard for reliability and economy. Even so, important improvements come from talking with the people who work with our pumps every day. We've replaced the CR/CRN 2 and 4 with four pump sizes ideally suited to your applications: CR1s, 1, 3, and 5, all in material versions CR/CRI/CRN. New features you'll appreciate:

A hard-wearing, easy-to-replace cartridge seal minimizes downtime

Superior reliability with added protection against dry-running

More standard connections, including threaded and flanged, plus customized connections.



Unmatched operating economy from state-of-the-art pump efficiency

New sizes

We've heard that 15% of CR2 pumps are used for flows under 5 gpm, so we've designed the CR1s with an optimal duty point of 4 gpm.

The new narrower interval between pump sizes and wider range results in a better match with pump capacity, motor size, and system requirements. This cuts investment and operating costs.

New sizes, features, and the available materials provide thousands of possible configurations to ensure you get the right pump for the job.

Connections

We offer additional standard connections, including threaded and flanged, plus victaulic, clamp, and union. Customized connections are available.

Dimensions

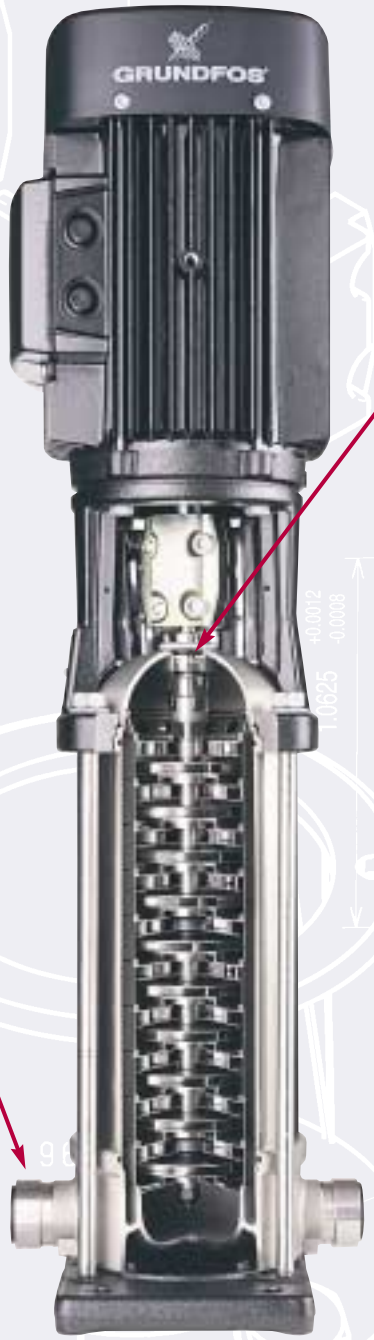
Connection dimensions haven't changed and are 100% interchangeable. However, improvements resulted in minor changes in pump height, which could affect your system. We're ready to assist you in the transition to the new CR line.

Conversion software

We've enclosed a CD-ROM with software to help you select the CR that matches your requirements. You can compare the performance and dimensions of the new CR line with those of the CR/CRN 2 and 4. The CD-ROM provides downloadable CAD drawings.

Superior reliability

Dry-running is the most common cause of pump failure. The new Grundfos LiqTec™ pump accessory shuts the pump down the instant it runs dry. Plus, we've improved pump components to better withstand brief periods of dry-running.



New cartridge seal increases reliability and allows easier access

Hard-wearing materials prolong the life of the seal and minimize downtime for your system. Seal components are combined into a single cartridge unit for fast replacement when the seal finally wears out.

With the cartridge seal, there's no risk of assembling seal components incorrectly. Plus, the seal surfaces are protected against impurities.

Connection options

A broad range of connections match any system requirement.

Oval flange

Flexiclamp

Unmatched operating economy

85% of the cost of owning and operating a pump is for the electricity to run it. Redesigning our CR pumps resulted in a 10% increase in efficiency and a resulting decrease in power consumption costs.

Everything you need is in this brochure:

Performance curves

We've included performance curves for each of the new pumps compared with the CR/CRN 2 and 4. See the following pages for:

CR/CRI/CRN 50 and 60 Hz

CR 2 / CR 1s

CR 2 / CR 1

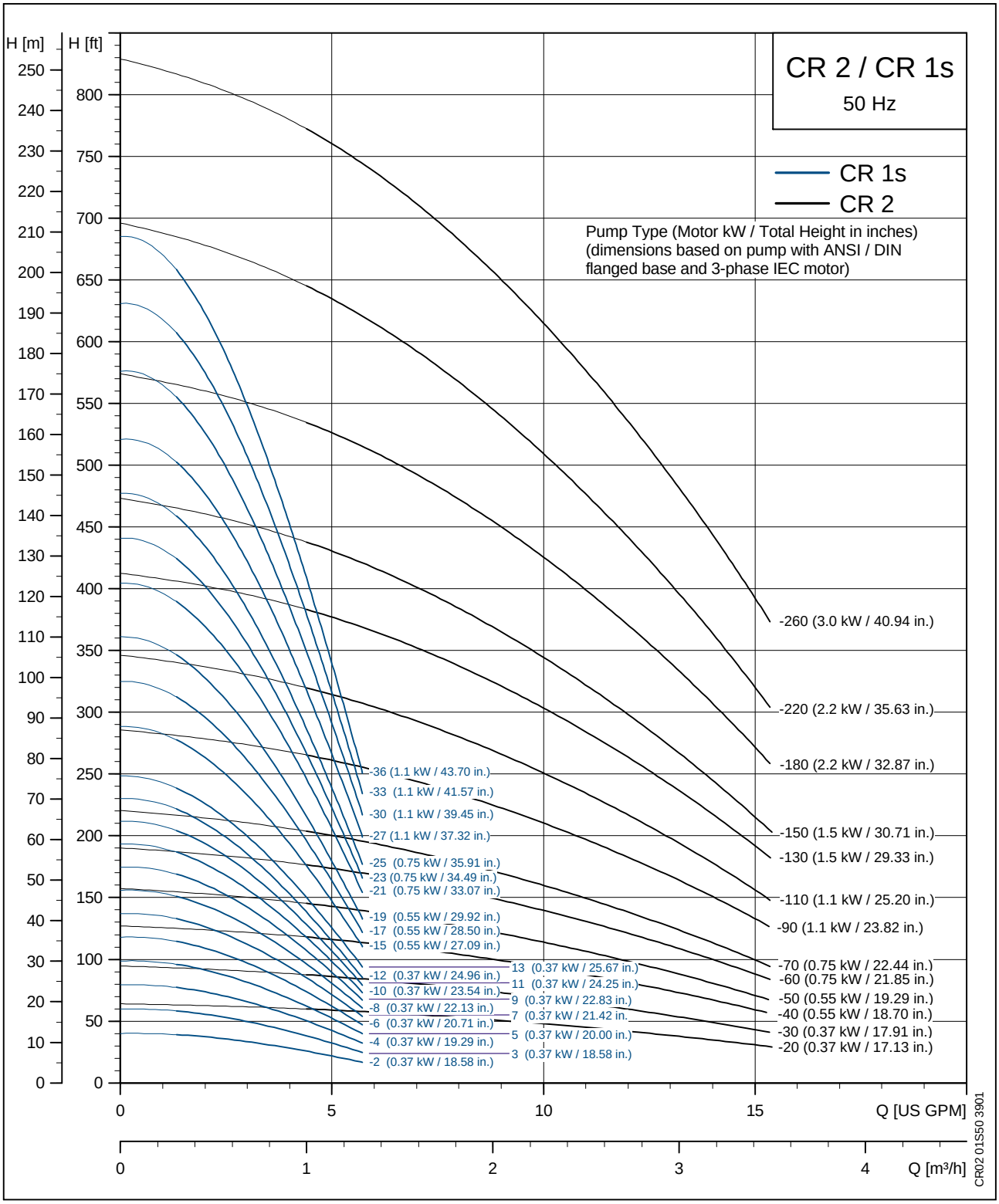
CR 2 / CR 3

CR 4 / CR 3

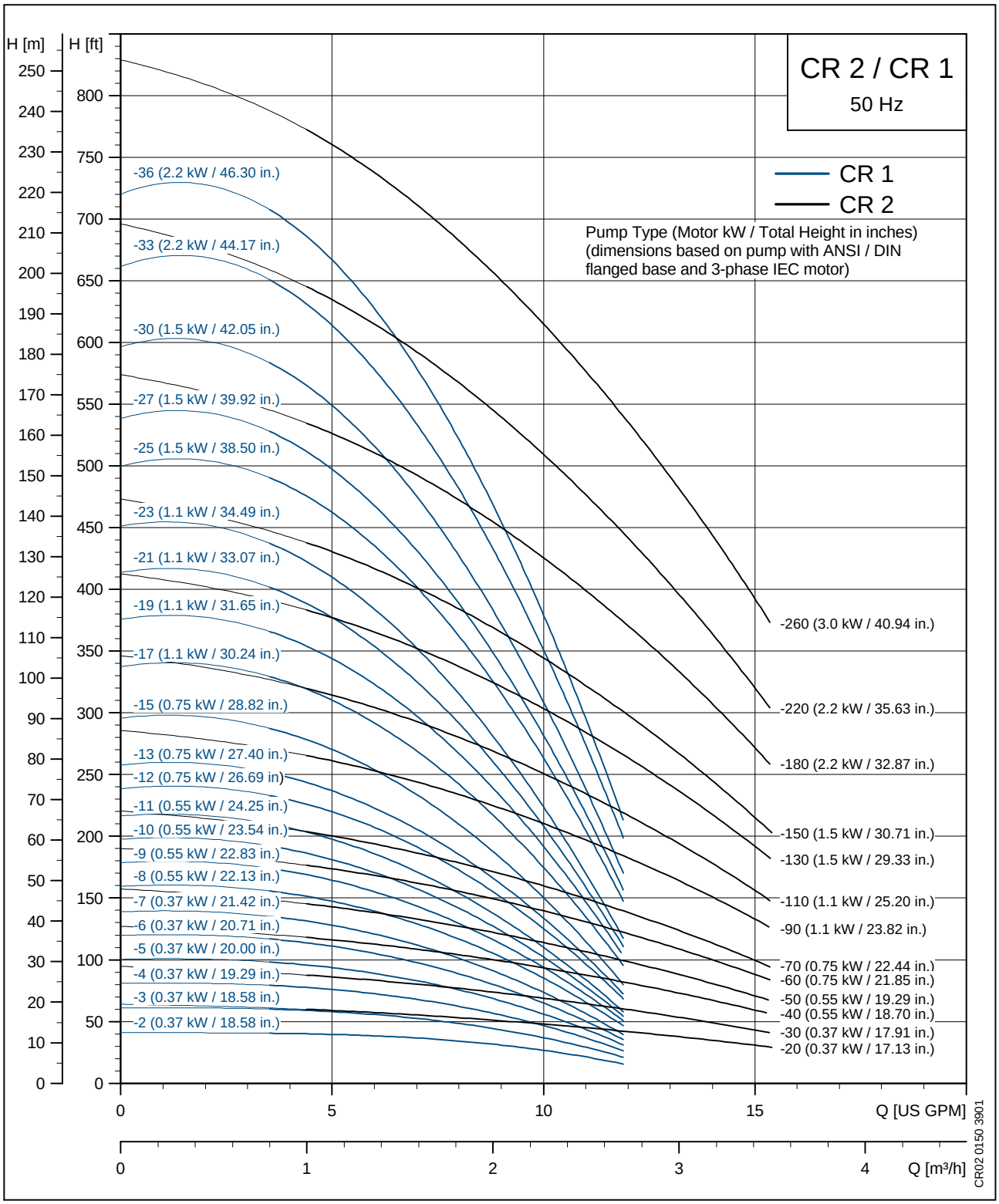
CR 4 / CR 5

Pump conversion software

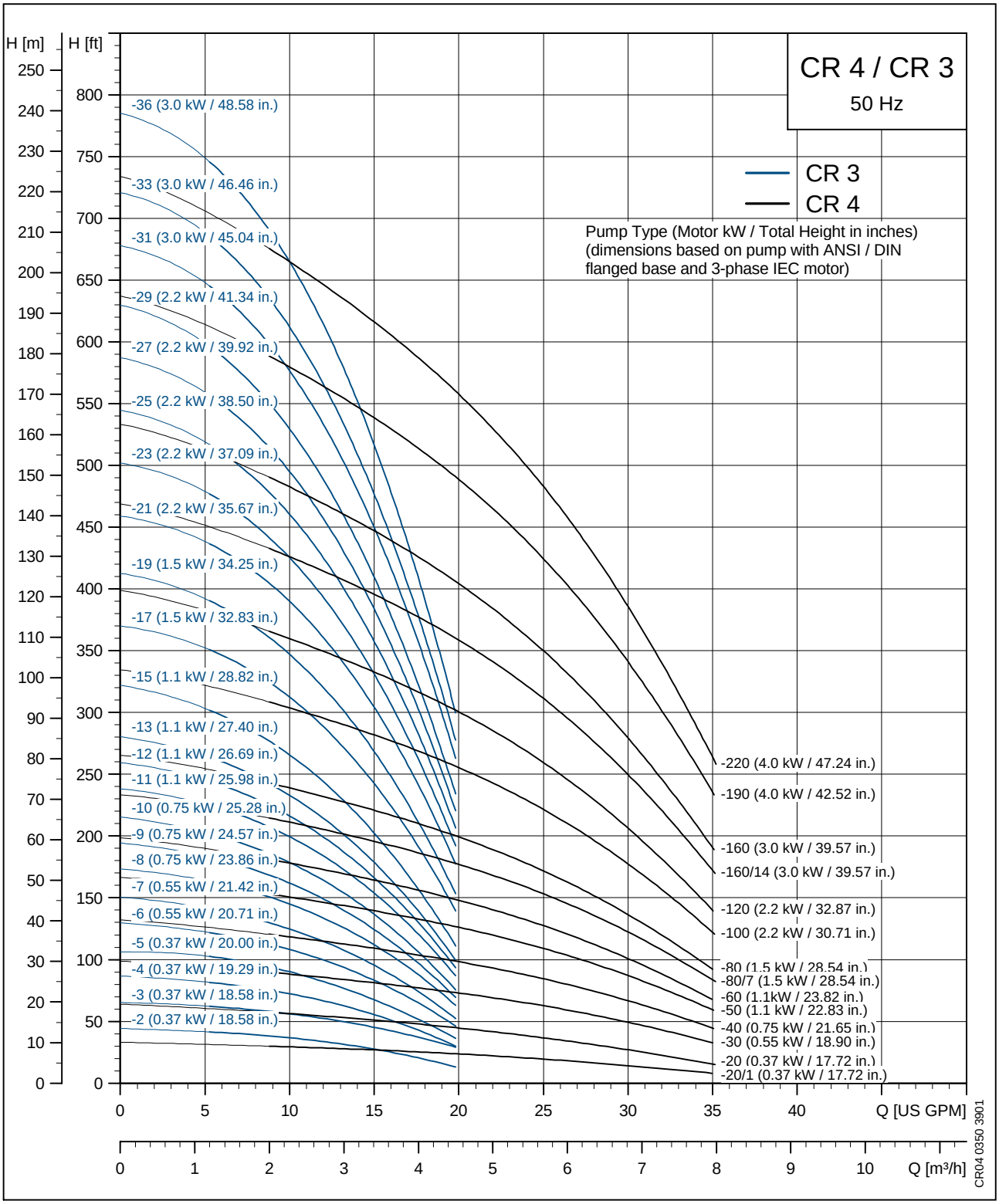
Inside back cover holds a downloadable CD with details on the redesigned CR line.

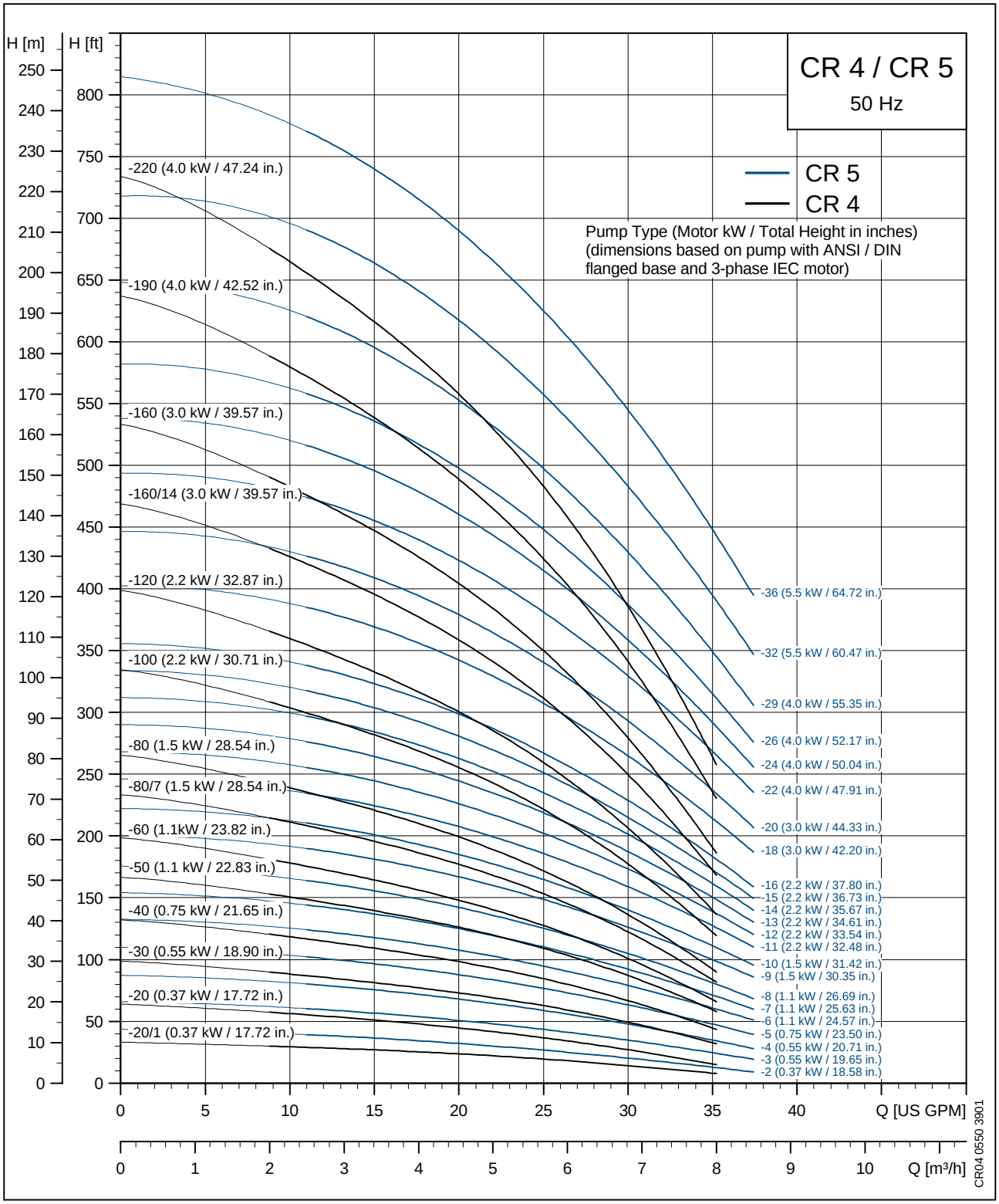

CR 2 / CR 1s
50 Hz
CR 1s
CR 2
Pump Type (Motor kW / Total Height in inches)
(dimensions based on pump with ANSI / DIN
flanged base and 3-phase IEC motor)
H [m]
H [ft]
Q [US GPM]
Q [m³/h]
-260 (3.0 kW / 40.94 in.)
-220 (2.2 kW / 35.63 in.)
-180 (2.2 kW / 32.87 in.)
-150 (1.5 kW / 30.71 in.)
-130 (1.5 kW / 29.33 in.)
-110 (1.1 kW / 25.20 in.)
-90 (1.1 kW / 23.82 in.)
-70 (0.75 kW / 22.44 in.)
-60 (0.75 kW / 21.85 in.)
-50 (0.55 kW / 19.29 in.)
-40 (0.55 kW / 18.70 in.)
-30 (0.37 kW / 17.91 in.)
-20 (0.37 kW / 17.13 in.)
-36 (1.1 kW / 43.70 in.)
-33 (1.1 kW / 41.57 in.)
-30 (1.1 kW / 39.45 in.)
-27 (1.1 kW / 37.32 in.)
-25 (0.75 kW / 35.91 in.)
-23 (0.75 kW / 34.49 in.)
-21 (0.75 kW / 33.07 in.)
-19 (0.55 kW / 29.92 in.)
-17 (0.55 kW / 28.50 in.)
-15 (0.55 kW / 27.09 in.)
13 (0.37 kW / 25.67 in.)
-12 (0.37 kW / 24.96 in.)
11 (0.37 kW / 24.25 in.)
-10 (0.37 kW / 23.54 in.)
9 (0.37 kW / 22.83 in.)
-8 (0.37 kW / 22.13 in.)
7 (0.37 kW / 21.42 in.)
-6 (0.37 kW / 20.71 in.)
5 (0.37 kW / 20.00 in.)
-4 (0.37 kW / 19.29 in.)
3 (0.37 kW / 18.58 in.)
-2 (0.37 kW / 18.58 in.)
CR02 01S50 3901

PERFORMANCE CR 2/CR 1 50 Hz

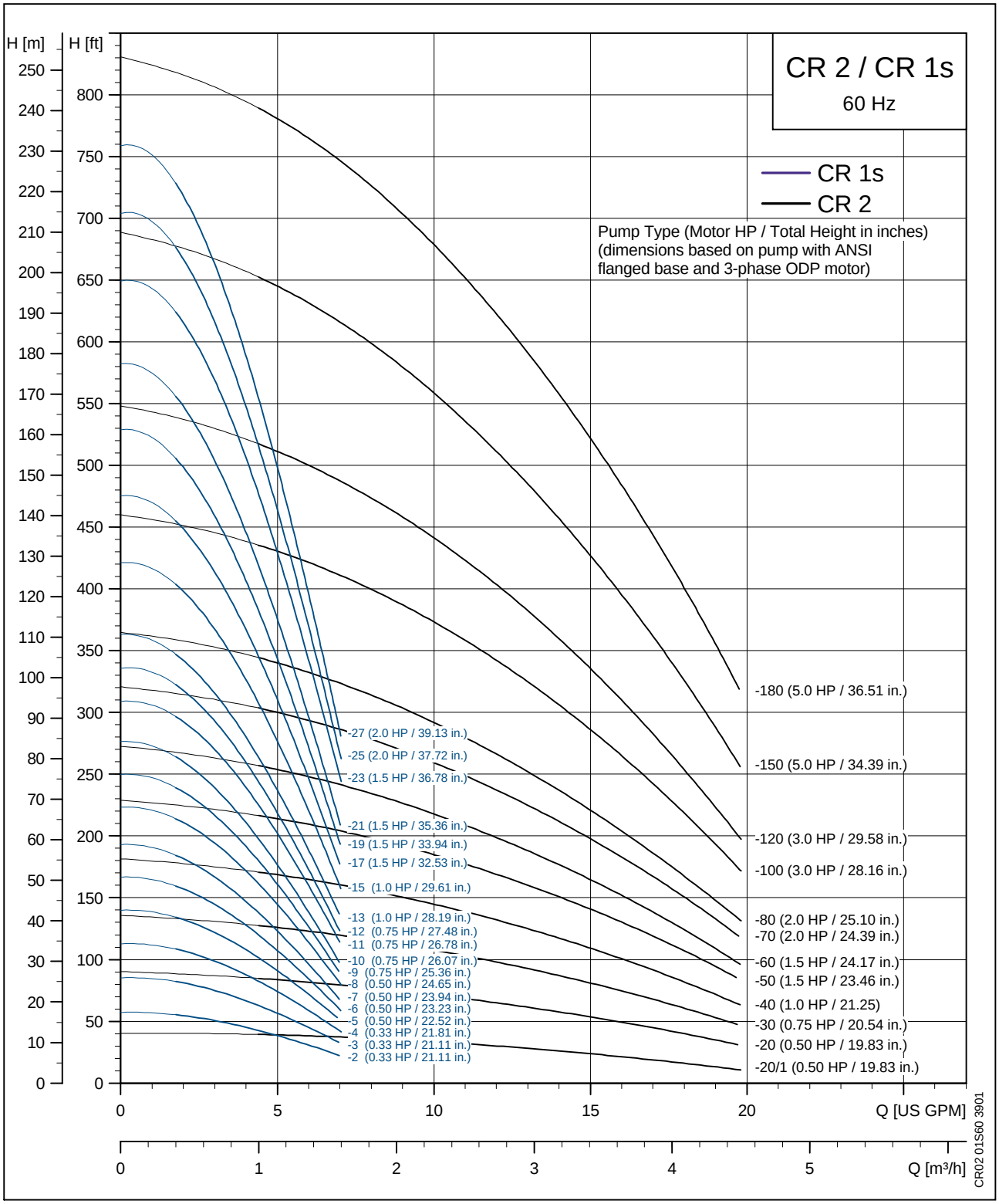


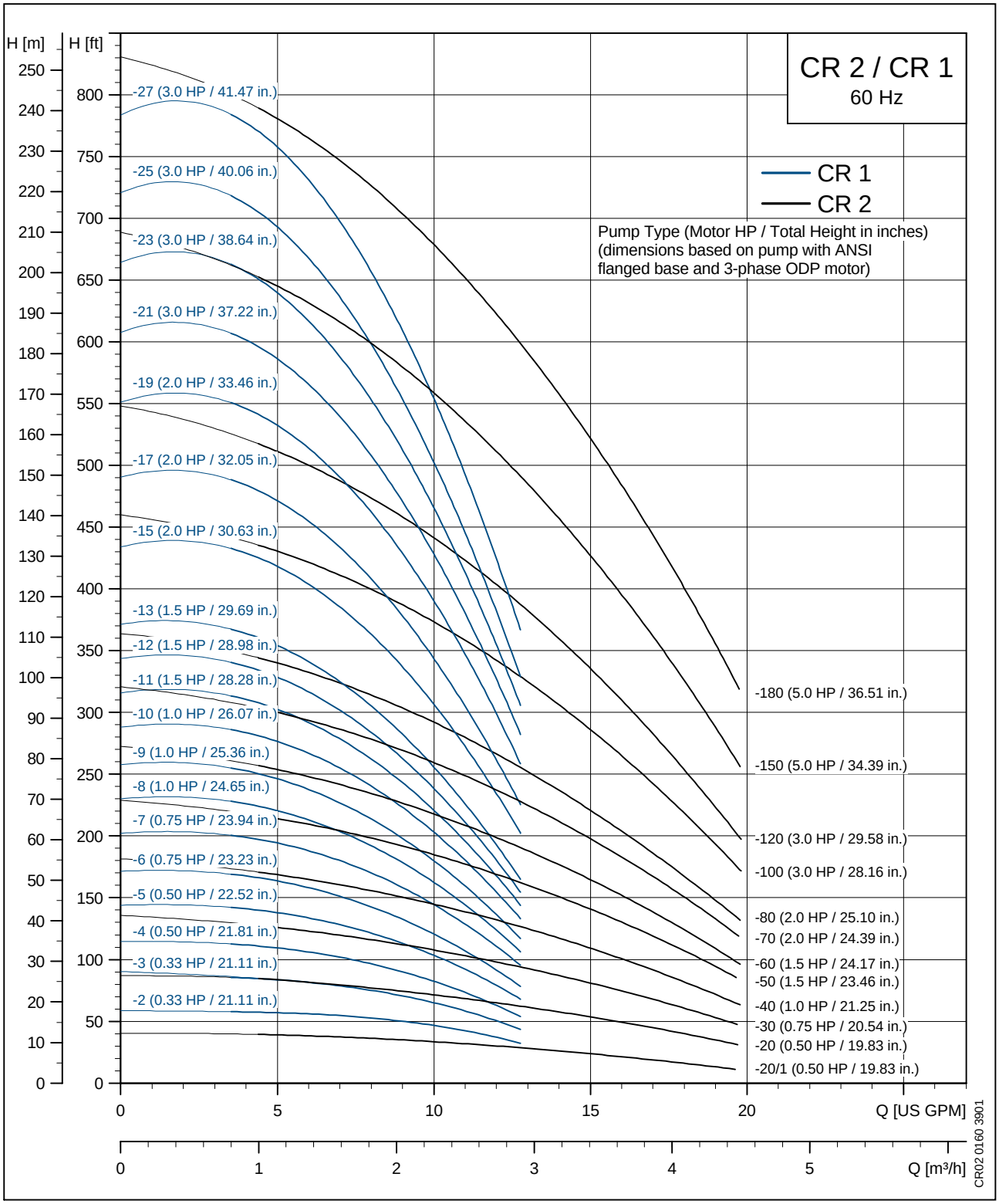
PERFORMANCE CR 4/CR 3 50 Hz



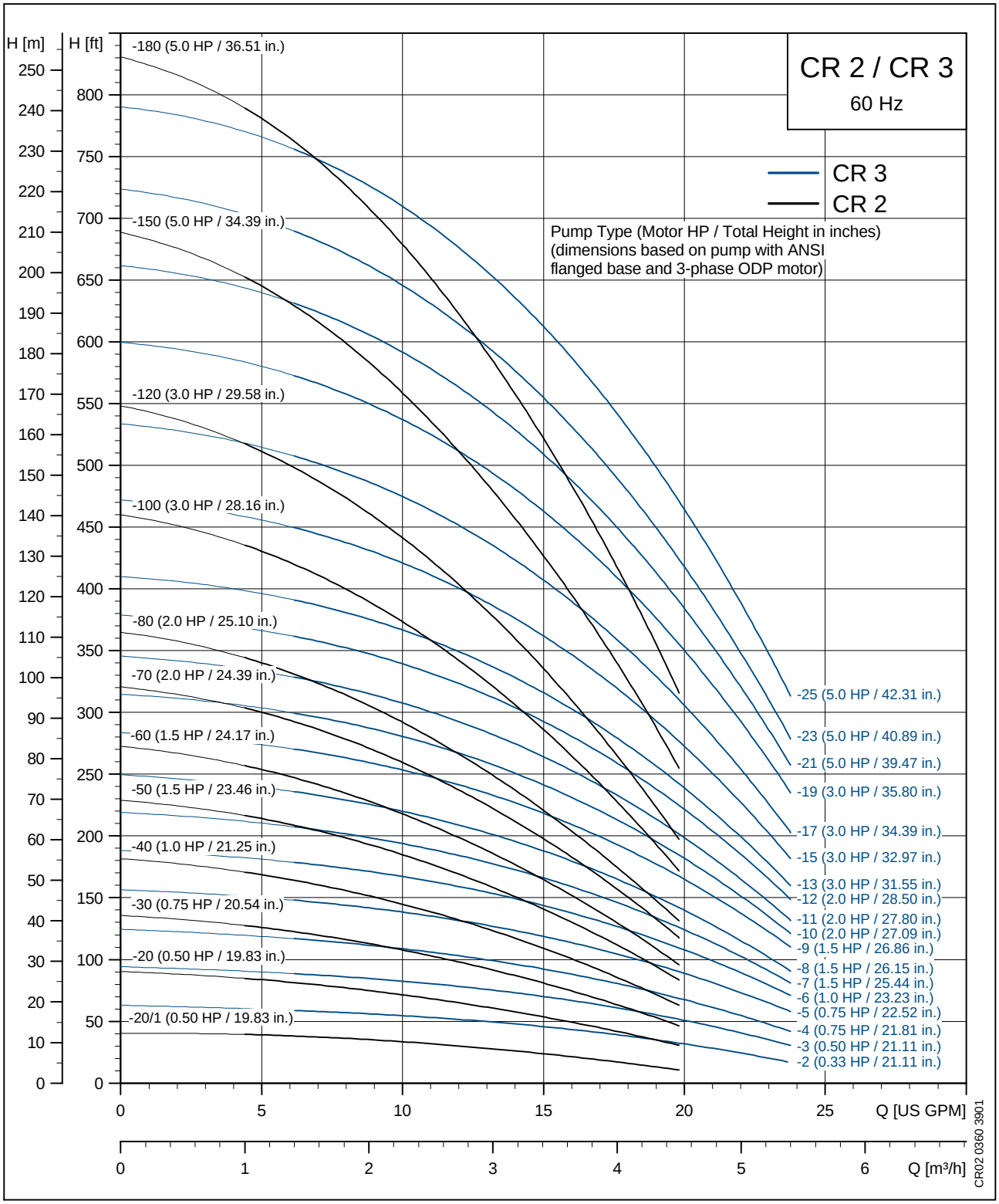

CR 4 / CR 5
50 Hz
CR 5
CR 4
Pump Type (Motor kW / Total Height in inches)
(dimensions based on pump with ANSI / DIN
flanged base and 3-phase IEC motor)
H [m]
H [ft]
Q [US GPM]
Q [m³/h]
-220 (4.0 kW / 47.24 in.)
-190 (4.0 kW / 42.52 in.)
-160 (3.0 kW / 39.57 in.)
-160/14 (3.0 kW / 39.57 in.)
-120 (2.2 kW / 32.87 in.)
-100 (2.2 kW / 30.71 in.)
-80 (1.5 kW / 28.54 in.)
-80/7 (1.5 kW / 28.54 in.)
-60 (1.1kW / 23.82 in.)
-50 (1.1 kW / 22.83 in.)
-40 (0.75 kW / 21.65 in.)
-30 (0.55 kW / 18.90 in.)
-20 (0.37 kW / 17.72 in.)
-20/1 (0.37 kW / 17.72 in.)
-36 (5.5 kW / 64.72 in.)
-32 (5.5 kW / 60.47 in.)
-29 (4.0 kW / 55.35 in.)
-26 (4.0 kW / 52.17 in.)
-24 (4.0 kW / 50.04 in.)
-22 (4.0 kW / 47.91 in.)
-20 (3.0 kW / 44.33 in.)
-18 (3.0 kW / 42.20 in.)
-16 (2.2 kW / 37.80 in.)
-15 (2.2 kW / 36.73 in.)
-14 (2.2 kW / 35.67 in.)
-13 (2.2 kW / 34.61 in.)
-12 (2.2 kW / 33.54 in.)
-11 (2.2 kW / 32.48 in.)
-10 (1.5 kW / 31.42 in.)
-9 (1.5 kW / 30.35 in.)
-8 (1.1 kW / 26.69 in.)
-7 (1.1 kW / 25.63 in.)
-6 (1.1 kW / 24.57 in.)
-5 (0.75 kW / 23.50 in.)
-4 (0.55 kW / 20.71 in.)
-3 (0.55 kW / 19.65 in.)
-2 (0.37 kW / 18.58 in.)
CR04 0550 3901

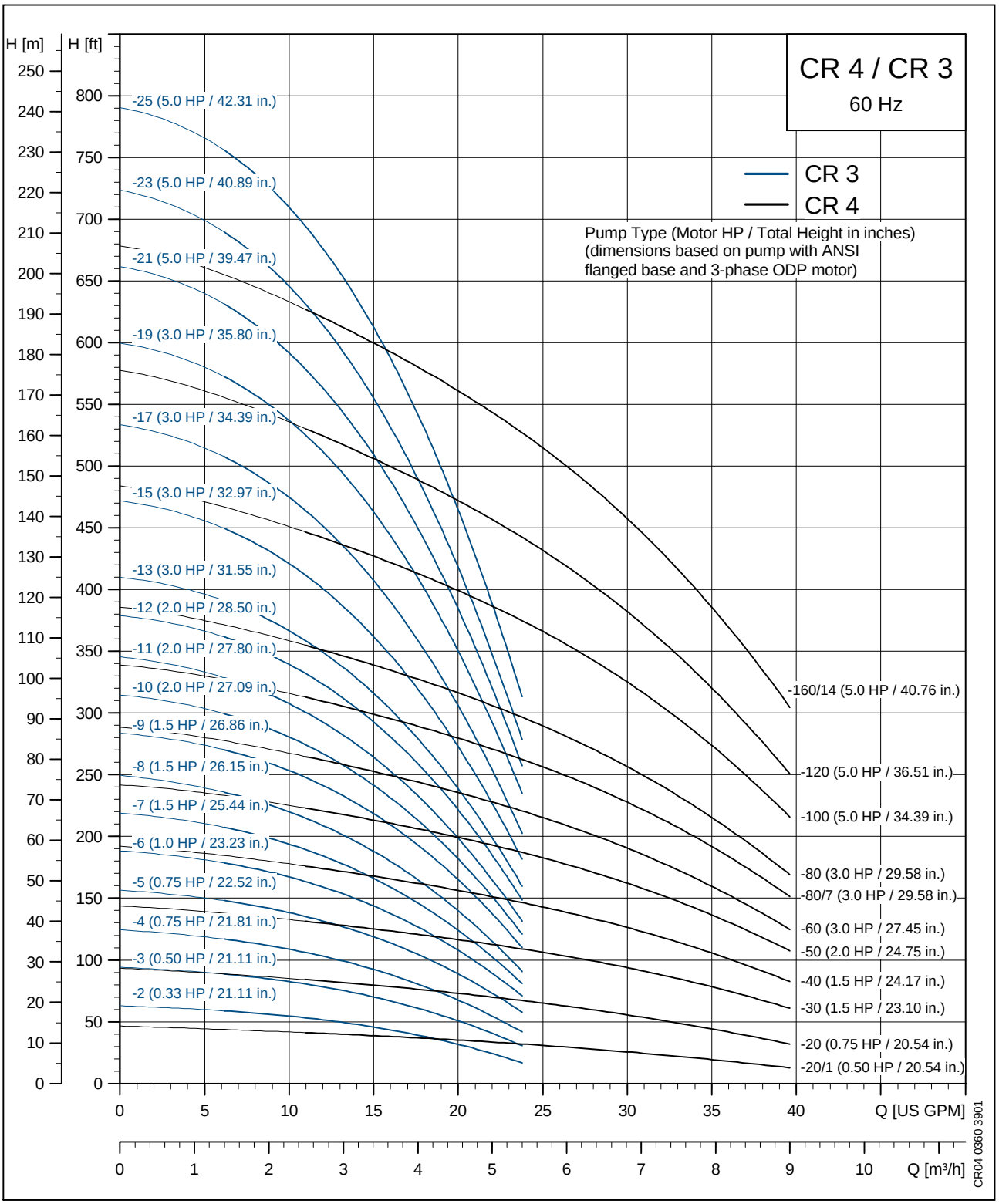
PERFORMANCE CR 2/CR 1 s 60 Hz



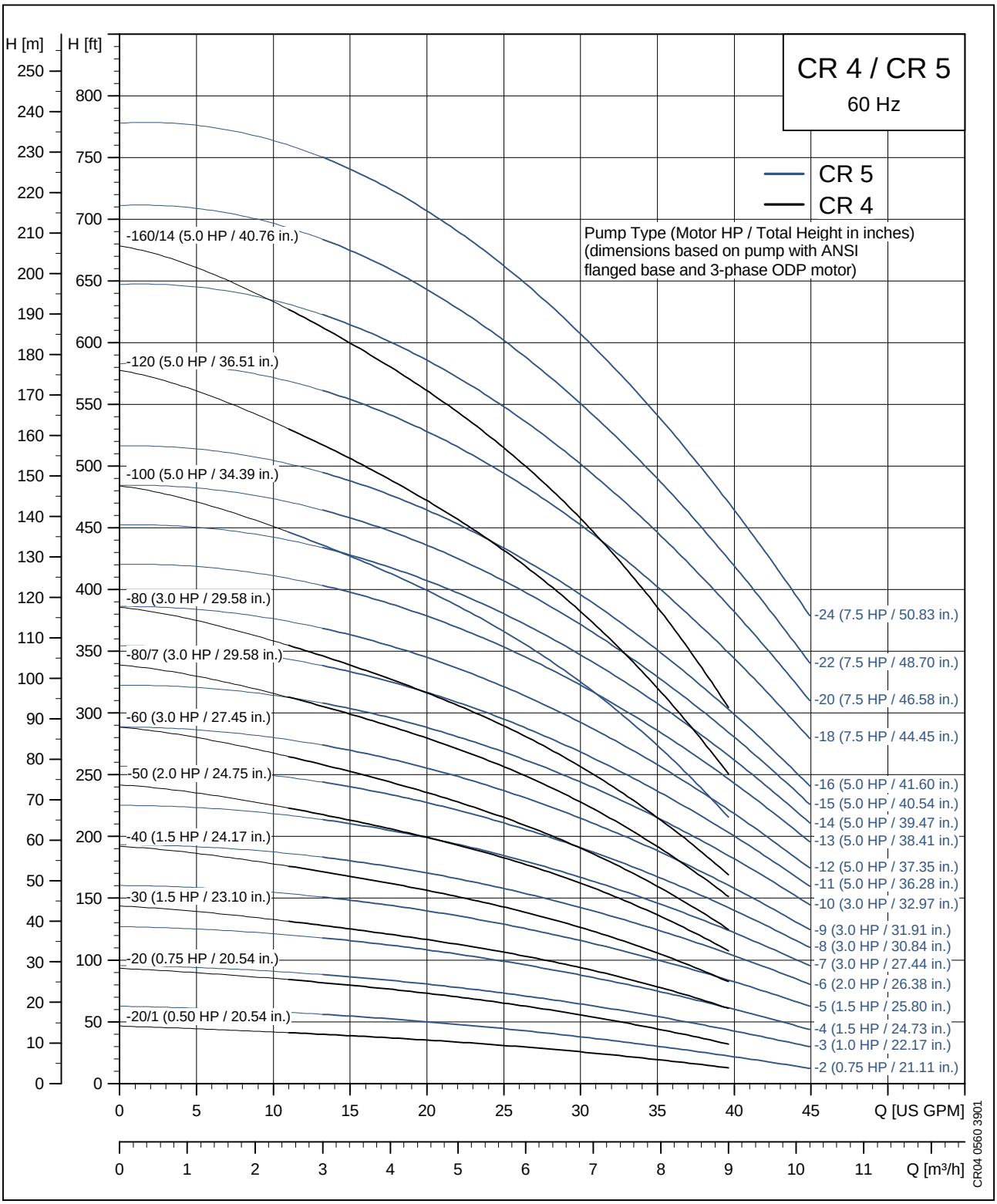

CR 2 / CR 1
60 Hz
CR 1
CR 2
Pump Type (Motor HP / Total Height in inches)
(dimensions based on pump with ANSI
flanged base and 3-phase ODP motor)
H [m]
H [ft]
-27 (3.0 HP / 41.47 in.)
-25 (3.0 HP / 40.06 in.)
-23 (3.0 HP / 38.64 in.)
-21 (3.0 HP / 37.22 in.)
-19 (2.0 HP / 33.46 in.)
-17 (2.0 HP / 32.05 in.)
-15 (2.0 HP / 30.63 in.)
-13 (1.5 HP / 29.69 in.)
-12 (1.5 HP / 28.98 in.)
-11 (1.5 HP / 28.28 in.)
-10 (1.0 HP / 26.07 in.)
-9 (1.0 HP / 25.36 in.)
-8 (1.0 HP / 24.65 in.)
-7 (0.75 HP / 23.94 in.)
-6 (0.75 HP / 23.23 in.)
-5 (0.50 HP / 22.52 in.)
-4 (0.50 HP / 21.81 in.)
-3 (0.33 HP / 21.11 in.)
-2 (0.33 HP / 21.11 in.)
-180 (5.0 HP / 36.51 in.)
-150 (5.0 HP / 34.39 in.)
-120 (3.0 HP / 29.58 in.)
-100 (3.0 HP / 28.16 in.)
-80 (2.0 HP / 25.10 in.)
-70 (2.0 HP / 24.39 in.)
-60 (1.5 HP / 24.17 in.)
-50 (1.5 HP / 23.46 in.)
-40 (1.0 HP / 21.25 in.)
-30 (0.75 HP / 20.54 in.)
-20 (0.50 HP / 19.83 in.)
-20/1 (0.50 HP / 19.83 in.)
Q [US GPM]
Q [m³/h]
CR02 0160 3901

PERFORMANCE CR 2/CR 3 60 Hz




CR 4 / CR 3
60 Hz
CR 3
CR 4
Pump Type (Motor HP / Total Height in inches)
(dimensions based on pump with ANSI
flanged base and 3-phase ODP motor)
H [m]
H [ft]
-25 (5.0 HP / 42.31 in.)
-23 (5.0 HP / 40.89 in.)
-21 (5.0 HP / 39.47 in.)
-19 (3.0 HP / 35.80 in.)
-17 (3.0 HP / 34.39 in.)
-15 (3.0 HP / 32.97 in.)
-13 (3.0 HP / 31.55 in.)
-12 (2.0 HP / 28.50 in.)
-11 (2.0 HP / 27.80 in.)
-10 (2.0 HP / 27.09 in.)
-9 (1.5 HP / 26.86 in.)
-8 (1.5 HP / 26.15 in.)
-7 (1.5 HP / 25.44 in.)
-6 (1.0 HP / 23.23 in.)
-5 (0.75 HP / 22.52 in.)
-4 (0.75 HP / 21.81 in.)
-3 (0.50 HP / 21.11 in.)
-2 (0.33 HP / 21.11 in.)
-160/14 (5.0 HP / 40.76 in.)
-120 (5.0 HP / 36.51 in.)
-100 (5.0 HP / 34.39 in.)
-80 (3.0 HP / 29.58 in.)
-80/7 (3.0 HP / 29.58 in.)
-60 (3.0 HP / 27.45 in.)
-50 (2.0 HP / 24.75 in.)
-40 (1.5 HP / 24.17 in.)
-30 (1.5 HP / 23.10 in.)
-20 (0.75 HP / 20.54 in.)
-20/1 (0.50 HP / 20.54 in.)
Q [US GPM]
Q [m³/h]
CR04 0360 3901

PERFORMANCE CR 4/CR 5 60 Hz

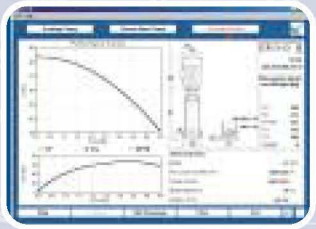


Pump conversion software

Load the CD-ROM onto your computer and follow the instructions that appear on your screen. Within seconds you will have details on the redesigned CR line.

Enter the pump type, flow and connection type of your existing CR. Click “Choose new pump.”

Consult the performance curves and select the new CR which best matches your needs from the list. Click “Technical Data.”



Technical data and exportable CAD drawings are presented here.

BE > THINK > INNOVATE >

BEING RESPONSIBLE IS OUR FOUNDATION
THINKING AHEAD MAKES IT POSSIBLE
INNOVATION IS THE ESSENCE

Innovation inside: **Grundfos new CR**

Grundfos engineers gave our CR pumps a makeover:

- **Four new CR pumps** make it easier for you to find the right pump size
- **A redesigned cartridge seal** integrates seal components into a single unit that's easy to replace
- **Hard-wearing materials** prolong the life of the seal and the pump itself
- **Our new LiqTec™ dry-run detector** shuts down the pump before damage occurs
- **Increased reliability and operating economy** give you more peace of mind

We're proud to introduce a new generation of our pioneering CR pumps you and your customers will appreciate.

L-CR-SL-002 | 10/01
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GRUNDFOS®

GRUNDFOS **INSTRUCTIONS**
Installation and Operation

CR, CRI, CRX, CRN, CRT

Vertical Multistage Centrifugal Pumps

Please leave these instructions with the pump for future reference

BE > THINK > INNOVATE >

GRUNDFOS®

SAFETY WARNING

Electrical Work

All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.

Shock Hazard

A faulty motor or wiring can cause electrical shock that could be fatal, whether touched directly or conducted through standing water. For this reason, proper grounding of the pump to the power supply's grounding terminal is required for safe installation and operation.

In all installations, the above-ground metal plumbing should be connected to the power supply ground as described in Article 250-80 of the National Electrical Code.

Nameplate Data

Type key

CR, CRI, CRN 1s, 1, 3, 5, 10, 15, and 20

Example CR 3 -10 A FGJ A E HQQE

- Type range: CR, CRI, CRN
- Rated flow rate in [m³/h] (x 5=GPM)
- Number of impellers
- Code for pump version
- Code for pipe connection
- Code for materials
- Code for rubber parts
- Code for shaft seal

CR, CRX, CRN 8 and 16

Example CR 16 - 30 /2 U G A AUUE

- Type range: CR, CRN
- Rated flow rate in [m³/h] (x 5=GPM)
- Number of stages x 10
- Number of impellers (used only if the pump has fewer impellers than stages)
- Code for pump version
- Code for pipe connection
- Code for materials
- Code for shaft seal and rubber parts

CR, CRN 32, 45, 64, AND 90

Example CR 32 -2 -1 U G A E KUHE

- Type range: CR, CRN
- Rated flow rate in [m³/h] (x 5=GPM)
- Number of impellers
- Number of reduced diameter impellers
- Code for pump version
- Code for pipe connection
- Code for materials
- Code for rubber pump parts
- Code for shaft seal

Codes

Example U FGJ A E HQQE

Pump version

A	*Basic version pump
U	*NEMA version pump
B	Oversize motor, one flange size bigger
F	CR pump for high temperatures (Cool-Top™)
H	Horizontal version
HS	High pressure pump with over-synchronous speed and reversed direction of rotation
I	Different pressure rating
K	Low NPSH
M	Magnetic drive
P	Undersize motor
R	Horizontal version with bearing bracket
SF	High pressure pump with reversed chamber stack and direction of rotation
T	Oversize motor, two flange sizes bigger
X	**Special version

Pipe connection

A	Oval flange
B	NPT thread
C	Clamp coupling
CA	FlexiClamp
CX	TriClamp
F	DIN flange
G	ANSI flange
J	JIS flange
N	Changed diameter of ports
O	Externally threaded, union
P	PJE coupling
X	Special version

Materials

A	Basic version
D	Carbon-graphite filled PTFE (bearings)
G	Stainless steel parts of 316 SS
GI	Base plate and flanges of 316 SS
I	Stainless steel parts of 304 SS
II	Base plate and flange of 304 SS
K	Bronze (bearings)
S	SiC bearing ring + PTFE neck ring (only CR, CRN 32 to 90)
T	Titanium
X	Special version

Code for rubber parts

E	EPDM
F	FXM (Flouraz®)
K	FFKM (Kalrez®)
V	FKM (Viton®)

Shaft seal H Q Q E

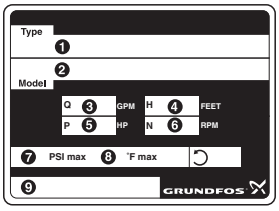
A	O-ring seal with fixed driver
B	Rubber bellows seal
D	O-ring seal, balanced
E	Cartridge seal with O-ring
H	Balanced cartridge seal with O-ring
K	Cartridge shaft seal with metal bellows
O	Double seal, back to back
P	Double seal, tandem
R	O-ring seal with reduced face
X	Special version

B	Carbon, synthetic resin-impregnated
H	Cemented tungsten carbide, embedded hybrid
Q	Silicon carbide
U	Cemented tungsten carbide

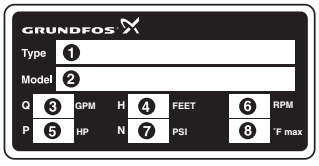
E	EPDM
F	FXM (Flouraz®)
K	FFKM (Kalrez®)
V	FKM (Viton®)

* In August 2003 the NEMA pump code was discontinued for all material numbers created by GRUNDFOS manufacturing companies in North America. The NEMA version pump code will still remain in effect for existing material numbers. NEMA version pumps built in North America after this change will have either an A or U as the pump version code depending on the date the material number was created.

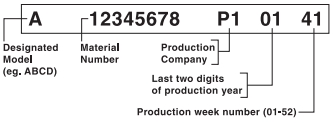
** If a pump incorporates more than two pump versions, the code for the pump version is X. X also indicates special pump versions not listed above.



1. Type designation
2. Model, material number, production code
3. Gallons per minute at rated RPM
4. Head in feet at nameplate flow
5. Pump horsepower
6. Rated RPM
7. Maximum PSI
8. Maximum fluid temperature
9. Production country



Model Key



Pre-installation Checklist

1. Confirm you have the right pump

Read the pump nameplate to make sure it is the one you ordered.

CR	—	Centrifugal pump with standard cast iron and 304 stainless steel construction
CRI or CRX	—	Centrifugal pump; all parts in contact with water are 304 stainless steel construction
CRN	—	Centrifugal pump; all parts in contact with water are 316 stainless steel construction
CRT	—	Centrifugal pump; all parts in contact with water are titanium construction
CRE	—	Centrifugal pump with a Grundfos MLE VFD motor attached

2. Check the condition of the pump

The shipping carton your pump came in is specially designed around your pump during production to prevent damage. As a precaution, the pump should remain in the carton until you are ready to install it. Examine the pump for any damage that may have occurred during shipping. Examine any other parts of the shipment as well for any visible damage.

If the pump is shipped as a complete unit (motor attached to pump end), the position of the coupling (that connects the pump shaft to the motor shaft) is set at factory specifications. No adjustment is required. If the unit is delivered as a pump end only, follow the adjustment procedures on pages 10-11.

Pump without Motor (CR(I)(N) 1s, 1, 3, 5, 10, 15, and 20 Only): If you purchased a pump without a motor, the shaft seal has been set by the factory. Do not loosen the three set screws on the shaft seal when attaching the motor.

Pump without Motor (CR(N) 32, 45, 64 & 90 Only): If you purchased a pump without a motor, you must install the seal. The seal is protected in its own sub boxing within the pump packaging crate. To protect the shaft and bearings during shipment, a shaft holder protective device is used. This device must be removed prior to installation of the seal. Read the seal installation instructions which are included in the pump package.

3. Verify electrical requirements

Verification of the electrical supply should be made to be certain the voltage, phase and frequency match that of the pump motor. The proper operating voltage and other electrical information can be found on the motor nameplate. These motors are designed to run on ±10% of the nameplate-rated voltage. For dual-voltage motors, the motor should be internally connected to operate on the voltage closest to the 10% rating, i.e., a 208 voltage motor wired per the 208 volt connection diagram. The wiring connection diagram can be found on either a plate attached to the motor or on a diagram inside the terminal box cover. If voltage variations are larger than ±10%, do not operate the pump.

4. Is the application correct for this pump?

Compare the pump's nameplate data or its performance curve with the application in which you plan to install it. Will it perform the way you want it to perform? Also, make sure the application falls within the following limits:

Type	Designed to pump...
CR	Hot and chilled water, boiler feed, condensate return, glycols and solar thermal fluids.
CRI/CRN/CRX	Deionized, demineralized and distilled water. Brackish water and other liquids unsuitable for contact with iron or copper alloys. (Consult manufacturer for specific liquid compatibilities.)
CRN-SF	High pressure washdown, reverse osmosis, or other high pressure applications.
CRT	Salt water, chloride based fluids and fluids approved for titanium.

Operating Conditions

Pump	Fluid Temperatures
CR(I)(N) 1s, 3, 5, 10, 15, and 20	-4 to +248°F (-20 to +120°C)
*CR(N) 32, 45, 64, and 90	-22 TO +248°F (-30 TO +120°C)
CR(N)(X)(T) 2, 4, 8, 16	-4 to +248°F (-20 to +120°C)
CRN-SF	-4 to +221°F (-15 to +105°C)
with Cool-Top™	up to +356°F (+180°C)

All motors are designed for continuous duty in +104°F (+40°C) ambient air conditions. For higher ambient temperature conditions consult Grundfos.

* xUBE Shaft Seals are recommended for temperatures above +200°F. Pumps with hybrid shaft seals can only operate up to +200°F (+90°C). Pumps with xUUE shaft seals can be operated down to -40°F (-40°C) (where "x" is the seal type).

Pre-installation Checklist (continued)

Minimum Inlet Pressures

All CR, CRI, CRX, CRN	NPSHR + 2 feet
CRN-SF	29 psi (2 bar)

Maximum Inlet Pressures

Pump Type	50 Hz Stages	60 Hz Stages	Max psi/bar
CR, CRI, CRN 1s	2 to 36	2 to 25	145 / 10
		27	217 / 15
CR, CRI, CRN 1	2 to 36	2 to 25	145 / 10
		27	217 / 15
CR, CRI, CRN 3	2 to 29	2 to 15	145 / 10
	31 to 36	17 to 25	217 / 15
CR, CRI, CRN 5	3 to 16	2 to 9	145 / 10
	18 to 36	10 to 24	217 / 15
CR, CRI, CRN 10	1 to 6	1 to 5	116 / 8
	7 to 22	6 to 18	145 / 10
CR, CRI, CRN 15	1 to 3	1 to 2	116 / 8
	4 to 17	3 to 12	145 / 10
CR, CRI, CRN 20	1 to 3	1	116 / 8
	4 to 17	2 to 10	145 / 10
CR, CRN 32	1-1 to 4	1-1 to 2	58 / 4
	5-2 to 10	3-2 to 6	145 / 10
	11 to 14	7-2 to 11-2	217 / 15
CR, CRN 45	1-1 to 2	1-1 to 1	58 / 4
	3-2 to 5	2-2 to 3	145 / 10
	6-2 to 13-2	4-2 to 8-1	217 / 15
CR, CRN 64	1-1 to 2-2	1-1	58 / 4
	2-1 to 4-2	1 to 2-1	145 / 10
	4-1 to 8-1	2 to 5-2	217 / 15
CR, CRN 90	1-1 to 1		58 / 4
	2-2 to 3-2	1-1 to 1	145 / 10
	3 to 6	2-2 to 4-1	217 / 15
CRT 2	2 to 11	2 to 6	145 / 10
	13 to 26	7 to 18	217 / 15
CRT 4	1 to 12	1 to 7	145 / 10
	14 to 22	8 to 16	217 / 15
CRT 8	1 to 20	1 to 16	145 / 10
CRT 16	2 to 16	2 to 10	145 / 10
CR, CRX, CRN 8	1 to 6	1 to 4	87 / 6
	7 to 20	5 to 16	145 / 10
CR, CRX, CRN 16	2 to 3	2 to 3	87 / 6
	4 to 16	4 to 10	145 / 10
CRN-SF	all	all	72 / 5*
			362 / 25**

* while pump is off or during start-up
** during operation

Maximum Operating Pressures

at 250° F (194° F for CRN-SF)

Pump type/ connection	50 Hz Stages	60 Hz Stages	Max psi/bar
CR, CRI, CRN 1s			
Oval flange	1 to 23	1 to 17	232 / 16
FGJ, PJE	1 to 36	1 to 27	362 / 25
CR, CRI, CRN 1			
Oval flange	1 to 23	1 to 17	232 / 16
FGJ, PJE	1 to 36	1 to 27	362 / 25
CR, CRI, CRN 3			
Oval flange	1 to 23	1 to 17	232 / 16
FGJ, PJE	1 to 36	1 to 27	362 / 25
CR, CRI, CRN 5			
Oval flange	1 to 22	1 to 16	232 / 16
FGJ, PJE	1 to 36	1 to 24	362 / 25
CR, CRI, CRN 10			
Oval flange		1 to 10	145 / 10
Oval flange	1 to 16		232 / 16
FGJ, GJ, PJE	1 to 16	1 to 10	232 / 16
FGJ, GJ, PJE	17 to 22	12 to 17	362 / 25
CR, CRI, CRN 15			
Oval flange	1 to 7	1 to 5	145 / 10
FGJ, GJ, PJE	1 to 10	1 to 8	232 / 16
FGJ, GJ, PJE	12 to 17	9 to 12	362 / 25
CR, CRI, CRN 20			
Oval flange	1 to 7	1 to 5	145 / 10
FGJ, GJ, PJE	1 to 10	1 to 7	232 / 16
FGJ, GJ, PJE	12 to 17	8 to 10	362 / 25
CR, CRN 32	1-1 to 7	1-1 to 5	232 / 16
	8-2 to 12	6-2 to 8	362 / 25
	13-2 to 14	9-2 to 11-2	580 / 40
CR, CRN 45	1-1 to 5	1-1 to 4-2	232 / 16
	6-2 to 9	4-1 to 6	362 / 25
	10-2 to 13-2	7-2 to 8-1	580 / 40
CR, CRN 64	1-1 to 5	1-1 to 3	232 / 16
	6-2 to 8-1	4-2 to 5-2	362 / 25
CR, CRN 90	1-1 to 4	1-1 to 3	232 / 16
	5-2 to 6	4-2 to 4-1	362 / 25
CRT 2	2 to 26	2 to 18	305 / 21
CRT 4	1 to 22	1 to 16	305 / 21
CR, CRX, CRN, CRT 8	1 to 12	1 to 8	232 / 16
	14 to 20	10 to 16	362 / 25
CR, CRX, CRN, CRT 16	1 to 8	1 to 8	232 / 16
	10 to 16	10 to 12	362 / 25

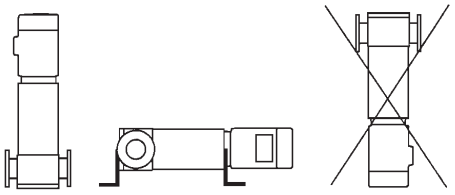
Consult Grundfos for other working conditions.

Select pump location

The pump should be located in a dry, well-ventilated area which is not subject to freezing or extreme variation in temperature. Care must be taken to ensure the pump is mounted at least 6 inches (150 mm) clear of any obstruction or hot surfaces. The motor requires an adequate air supply to prevent overheating and adequate vertical space to remove the motor for repair. For open systems requiring suction lift the pump should be located as close to the water source as possible to reduce piping losses.

Foundation

Concrete or similar foundation material should be used to provide a secure, stable mounting base for the pump. Bolt hole center line dimensions for the various pump types are given in Figure 1. Secure the pump to the foundation using all four bolts and shim pump base to assure the pump is vertical and all four pads on the base are properly supported. Uneven surfaces can result in pump base breakage when mounting bolts are tightened.



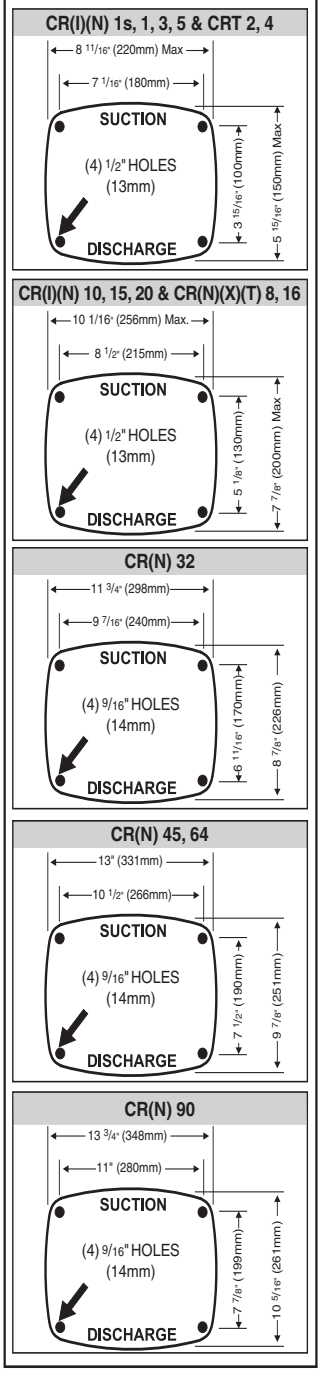
The pump can be installed vertically or horizontally (see drawing at right). Ensure that an adequate supply of cool air reaches the motor cooling fan. The motor must never fall below the horizontal plane.

Arrows on the pump base show the direction of flow of liquid through the pump.

To minimize possible noise from the pump, it is advisable to fit expansion joints on either side of the pump and anti-vibration mountings between the foundation and the pump.

Isolating valves should be fitted either side of the pump to avoid draining the system if the pump needs to be cleaned, repaired or replaced.

Figure 1: Bolt Hole Centers



Pipework

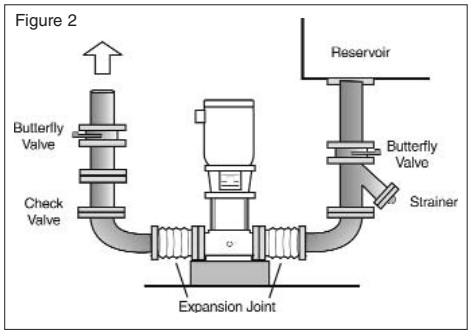
NOTE: The CR(N) pumps are shipped with covered suction and discharge. The covers must be removed before the final pipe flange to pump connections are made.

Suction pipe

The suction pipe should be adequately sized and run as straight and short as possible to keep friction losses to a minimum (minimum of four pipe diameters straight run prior to the suction flange). Avoid using unnecessary fittings, valves or accessory items. Butterfly or gate valves should only be used in the suction line when it is necessary to isolate a pump because of a flooded suction condition. This would occur if the water source is above the pump. See Figures 2 and 3. Flush piping prior to pump installation to remove loose debris.

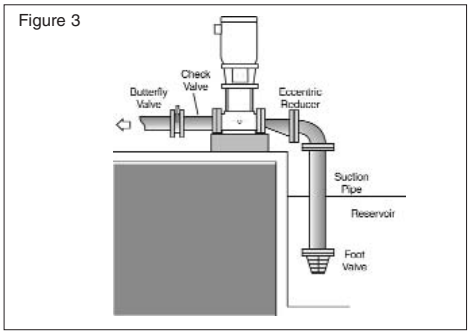
Flooded Suction

Figure 2



Suction Lift*

Figure 3



* CRN-SF pumps cannot be used for suction lift. The suction pipe should have a fitting on it for priming.

Minimum suction pipe sizes

The following recommended suction pipe sizes are the smallest sizes which should be used with any specific CR pump type. The suction pipe size should be verified with each installation to ensure good pipe practices are being observed and excess friction losses are not encountered. High temperatures may require larger diameter pipes to reduce friction and improve NPHSA.

CR(I)(N) 1s, 1, 3, CRT 2	1"	Nominal diameter sch 40 pipe
CR(I)(N) 5, CRT 4	1 1/4"	Nominal diameter sch 40 pipe
CR(I)(N)(X) 10, 15, 20, 8, 16	2"	Nominal diameter sch 40 pipe
CR(N) 32	2 1/2"	Nominal diameter sch 40 pipe
CR(N) 45	3"	Nominal diameter sch 40 pipe
CR(N) 64	4"	Nominal diameter sch 40 pipe
CR(N) 90	4"	Nominal diameter sch 40 pipe

Discharge piping

It is suggested that a check valve and isolation valve be installed in the discharge pipe. Pipe, valves and fittings should be at least the same diameter as the discharge pipe or sized in accordance with good piping practices to reduce excessive fluid velocities and pipe friction losses. **Pipe, valves and fittings must have a pressure rating equal to or greater than the maximum system pressure.** Before the pump is installed it is recommended that the discharge piping be pressure checked to at least the maximum pressure the pump is capable of generating or as required by codes or local regulations.

Whenever possible, avoid high pressure loss fittings, such as elbows or branch tees directly on either side of the pump. The piping should be adequately supported to reduce thermal and mechanical stresses on the pump. Good installation practice recommends the system be thoroughly cleaned and flushed of all foreign materials and sediment prior to pump installation. Furthermore, the pump should never be installed at the lowest point of the system due to the natural accumulation of dirt and sediment. If there is excessive sediment or suspended particles present, it is advised a strainer or filter be used. Grundfos recommends that pressure gauges be installed on inlet and discharge flanges or in pipes to check pump and system performance.

NOTE: To avoid problems with waterhammer, fast closing valves must not be used in CRN-SF applications.

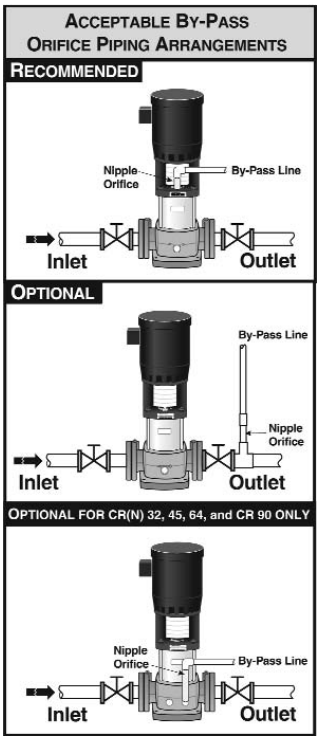


Table A
Minimum Continuous Duty Flow Rates for CR(I)(X)(N)(T)

Pump Type	Min. Flow in GPM at Liquid Temperature			Cool-Top™
	min°F to 176°F min°C to 80°C	at 210°F at 99°C	at 248°F at 120°C	at 356°F at 180°C
CR, CRI, CRN 1s	0.5	0.7	1.2	1.2*
CR, CRI, CRN 1	0.9	1.3	2.3	2.3*
CR, CRI, CRN 3	1.6	2.4	4.0	4.0*
CR, CRI, CRN 5	3.0	4.5	7.5	7.5*
CR, CRI, CRN 10	5.5	8.3	14	14*
CR, CRI, CRN 15	9.5	14	24	24*
CR, CRI, CRN 20	11	17	28	28*
CR, CRN 32	14	21	35	35*
CR, CRN 45	22	33	55	55*
CR, CRN 64	34	51	85	85*
CR, CRN 90	44	66	110	110*
CRT 2	1.3	2.0	3.3	N/A
CRT 4	3.0	4.5	7.5	N/A
CR, CRX, CRN, CRT 8	4.0	6.0	10	10*
CR, CRX, CRN, CRT 16	8.0	12	20	20*

*Grundfos Cool-Top is only available in the following pump types.

Pump Type	CR 1s	CR 1	CR 3	CR 5	CR 10	CR 15	CR 20	CR 32	CR 45	CR 64	CR 90	CR 8	CR 16
Standard (CR)								•	•	•	•		
I Version (CRI)	•	•	•	•	•	•	•						
N Version (CRN)	•	•	•	•	•	•	•	•	•	•	•	•*	•*

* CRN 8 and 16 are only available in CRN-S. A CRN-S is a CRN pump without staybolts. All rubber parts are FXM.

Check valves

A check valve may be required on the discharge side of the pump to prevent the pump's inlet pressure from being exceeded. For example, if a pump with no check valve is stopped because there is no demand on the system (all valves are closed), the high system pressure on the discharge side of the pump will "find" its way back to the inlet of the pump. If the system pressure is greater than the pump's maximum inlet pressure rating, the limits of the pump will be exceeded and a check valve needs to be fitted on the discharge side of the pump to prevent this condition. **This is especially critical for CRN-SF applications because of the very high discharge pressures involved. As a result, most CRN-SF installations require a check valve on the discharge piping.**

Bypass

A bypass should be installed in the discharge pipe if there is any possibility the pump may operate against a closed valve in the discharge line. Flow through the pump is required to ensure adequate cooling and lubrication of the pump is maintained. See Table A for minimum flow rates. Elbows should be a minimum of 12" from the orifice discharge to prevent erosion.

Temperature rise

It may sometimes be necessary to stop the flow through a pump during operation. At shut-off, the power to the pump is transferred to the pumped liquid as head, causing a temperature rise in the liquid. The result is risk of excess heating of and consequent damage to the pump. The risk depends on the temperature of the pumped liquid and for how long the pump is operating without flow. (See temperature rise chart.)

Pump Type	Time for Temperature Rise of 18° F (10°C)	
	Seconds	Minutes
CR 1s, 1, 3	210	3.5
CR 5	240	4.0
CR 10	210	3.5
CR 15	150	2.5
CR 20	120	2.0
CR 32, 45, 64, 90	60	1.0

Conditions/Reservations

The listed times are subject to the following conditions/reservations:

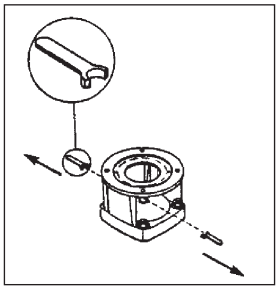
- No exchange of heat with the surroundings.
- The pumped liquid is water with a specific heat of 1.0 $\frac{Btu}{lb.°F}$ (4.18 $\frac{kJ}{kg°C}$).
- Pump parts (chambers, impellers and shaft) have the same thermal capacity as water.
- The water in the base and the pump head is not included.

These reservations should give sufficient safety margin against excessive temperature rise. The maximum temperature must not exceeed the pump maximum rating.

For Pump Ends With Bellows Seals Only (CR 2, 4, 8, 16)

Remove shaft seal protectors before installing motor (see diagram at below).

1. Remove coupling guards.
2. Remove coupling halves.
3. Remove shaft seal protectors.
4. Follow motor replacement instructions on page 10.



Electrical

WARNING

THE SAFE OPERATION OF THIS PUMP REQUIRES THAT IT BE GROUNDED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND LOCAL GOVERNING CODES OR REGULATIONS. CONNECT THE GROUND WIRE TO THE GROUNDING SCREW IN THE TERMINAL BOX AND THEN TO THE ACCEPTABLE GROUNDING POINT.

All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.

Motor

Grundfos CR pumps are supplied with heavy-duty 2-pole (3600 RPM nominal), ODP or TEFC, NEMA C frame motors selected to our rigid specifications. Motors with other enclosure types and for other voltages and frequencies are available on a special-order basis. CRN-SF pumps are supplied with an IEC (metric) type motor with a reverse thrust bearing. If you are replacing the pumping unit, but are using a motor previously used on another CR pump, be sure to read the "Motor Replacement" section on page 10 for proper adjustment of the coupling height.

Position of Terminal Box

The motor terminal box can be turned to any of four positions in 90° steps. To rotate the terminal box, remove the four bolts securing the motor to the pump but do not remove the shaft coupling; turn the motor to the desired location; replace and securely tighten the four bolts. See Figure 4.

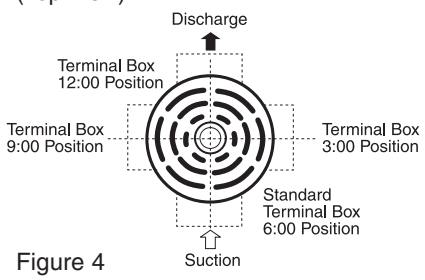


Figure 4

Field Wiring

Wire sizes should be based on the current carrying properties of a conductor as required by the latest edition of the National Electrical Code or local regulations. Direct on line (D.O.L.) starting is approved due to the extremely fast run-up time of the motor and the low moment of inertia of pump and motor. If D.O.L. starting is not acceptable and reduced starting current is required, an auto transformer, resistant starter or soft start should be used. It is suggested that a fused disconnect be used for each pump where service and standby pumps are installed.

Motor Protection

1. **Single-Phase Motors:**

   With the exception of 7 1/2 and 10 HP motors which require external protection, single-phase CR pumps are equipped with multi-voltage, squirrel-cage induction motors with built-in thermal protection.

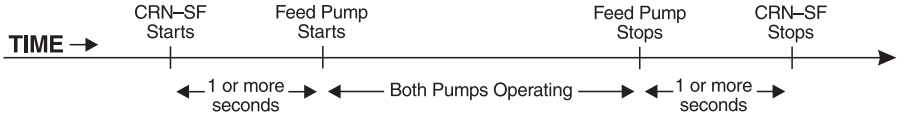
2. **Three-Phase Motors**

   CR pumps with three-phase motors must be used with the proper size and type of motor-starter to ensure the motor is protected against damage from low voltage, phase failure, current imbalance and overloads. A properly sized starter with manual reset and ambient-compensated extra quick trip in all three legs should be used. The overload should be sized and adjusted to the full-load current rating of the motor. Under no circumstances should the overloads be set to a higher value than the full load current shown on the motor nameplate. This will void the warranty. Overloads for auto transformers and resistant starters should be sized in accordance with the recommendations of the manufacturer. Three phase MLE motors (CRE-Pumps) require only fuses as a circuit breaker. They do not require a motor starter. Check for phase imbalance (worksheet is provided on page 15).

   NOTE: Standard allowable phase imbalance difference is 5%.

3. **CRN-SF**

   The CRN-SF is typically operated in series with a feed pump. Because the maximum allowable inlet pressure of the CRN-SF increases from 73 psi (when pump is off and during start-up) to 365 psi (during operation), a control device must be used to start the CRN-SF pump one second before the feed pump starts. Similarly, the CRN-SF must stop one second after the feed pump stops.



Starting the Pump the First Time

Figure 5a

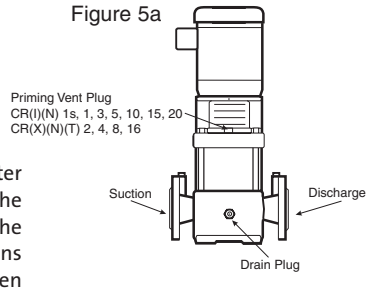
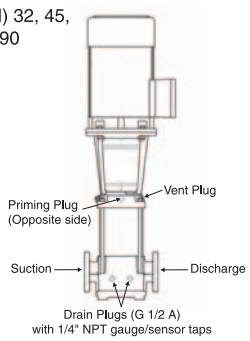


Figure 5b

CR(N) 32, 45, 64 & 90



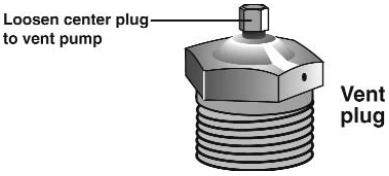
Priming

To prime the pump in a closed system or an open system where the water source is above the pump, close the pump isolation valve(s) and open the priming plug on the pump head. See Figures 5A and 5B. Gradually open the isolation valve in the suction line until a steady stream of airless water runs out the priming port. Close the plug and securely tighten. Completely open the isolation valves.

In open systems where the water level is below the pump inlet, the suction pipe and pump must be filled and vented of air before starting the pump. Close the discharge isolation valve and remove the priming plug. Pour water through the priming hole until the suction pipe and pump are completely filled with water. If the suction pipe does not slope downward from the pump toward the water level, the air must be purged while being filled. Replace the priming plug and securely tighten.

1. Switch power off.
2. Check to make sure the pump has been filled and vented.
3. Remove the coupling guard and rotate the pump shaft by hand to be certain it turns freely.
4. Verify that the electrical connections are in accordance with the wiring diagram on the motor.
5. Switch the power on and observe the direction of rotation. When viewed from the top, the pump should rotate counter-clockwise (clockwise for CRN-SF).
6. To reverse the direction of rotation, first switch OFF the supply power.
7. On three-phase motors, interchange any two power leads at the load side of the starter. On single-phase motors, see connection diagram on nameplate. Change wiring as required.
8. Switch on the power and again check for proper motor rotation. Once rotation has been verified, switch off power again. Do not attempt to reinstall the coupling guards with the motor energized. Replace the coupling guard if the rotation is correct. After guards are in place the power can be reapplied.

NOTE: Motors should not be run unloaded or uncoupled from the pump at any time; damage to the motor bearings will occur.



REMINDER: Do not start the pump before priming or venting the pump. Never operate the pump dry.

Operating Parameters

CR multi-stage centrifugal pumps installed in accordance with these instructions and sized for correct performance will operate efficiently and provide years of service. The pumps are water-lubricated and do not require any external lubrication or inspection. The motors will require periodic lubrication as noted in the following Maintenance Section.

Under no circumstances should the pump be operated for any prolonged periods of time without flow through the pump. This can result in motor and pump damage due to overheating. A properly sized relief valve should be installed to allow sufficient water to circulate through the pump to provide adequate cooling and lubricaton of the pump bearings and seals.

Pump cycling

Pump cycling should be checked to ensure the pump is not starting more than:

20 times per hour on 1/3 to 5 HP models
15 times per hour on 7 1/2 to 15 HP models
10 times per hour on 20 to 60 HP models

Rapid cycling is a major cause of premature motor failure due to increased heat build-up in the motor. If necessary, adjust controls to reduce the frequency of starts and stops.

Boiler-feed installations

If the pump is being used as a boiler-feed pump, make sure the pump is capable of supplying sufficient water throughout its entire evaporation and pressure ranges. Where modulating control valves are used, a bypass around the pump must be installed to ensure pump lubrication (see "Minimum Continuous Duty Flow Rates").

Freeze Protection

If the pump is installed in an area where freezing could occur, the pump and system should be drained during freezing temperatures to avoid damage. To drain the pump, close the isolation valves, remove the priming plug and drain plug at the base of the pump. Do not replace the plugs until the pump is to be used again. Always replace the drain plug with the original or exact replacement. **Do not** replace with a standard plug. Internal recirculation will occur, reducing the output pressure and flow.

Motor Inspection

Inspect the motor at regular intervals, approximately every 500 hours of operation or every three months, whichever occurs first. Keep the motor clean and the ventilation openings clear. The following steps should be performed at each inspection:

WARNING:

DO NOT TOUCH ELECTRICAL CONNECTIONS BEFORE YOU FIRST ENSURE THAT POWER HAS BEEN DISCONNECTED. ELECTRICAL SHOCK CAN CAUSE SERIOUS OR FATAL INJURY. ONLY QUALIFED PERSONNEL SHOULD ATTEMPT INSTALLATION, OPERATION, AND MAINTENANCE OF THIS EQUIPMENT.

1. Check that the motor is clean. Check that the interior and exterior of the motor is free of dirt, oil, grease, water, etc. Oily vapor, paper, pulp, textile lint, etc. can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.
2. Use an Ohmmeter ("Megger") periodically to ensure that the integrity of the winding insulation has been maintained. Record the Ohmmeter readings. Immediately investigate any significant drop in insulation resistance.
3. Check all electrical connectors to be sure that they are tight.

Motor Lubrication

Electric motors are pre-lubricated at the factory and do not require additional lubrication at start-up. Motors without external grease fittings have sealed bearings that cannot be re-lubricated. Motors with grease fittings should **only** be lubricated with approved types of grease. Do not **over-grease** the bearings. Over greasing will cause increased bearing heat and can result in bearing/motor failure. Do not mix petroleum grease and silicon grease in motor bearings.

Bearing grease will lose its lubricating ability over time, not suddenly. The lubricating ability of a grease (over time) depends primarily on the type of grease, the size of the bearings, the speed at which the bearings operate and the severity of the operating conditions. Good results can be obtained if the following recommendations are used in your maintenance program. It should also be noted that pumps with more stages, pumps running to the left of the performance curve, certain pump ranges may have higher thrust loads. Pumps with high thrust loads should be greased according to the next service interval level.

Severity of Service	Ambient Temperature (Maximum)	Environment	Approved Types of Grease
Standard	+104°F (+40°C)	Clean, little corrosion	See motor nameplate for grease type or compatible equivalent type of grease
Severe	+122°F (+50°C)	Moderate dirt, corrosion	
Extreme	>+122°F (+50°C) or Class H insulation	Severe dirt, abrasive dust, corrosion	

If pump is fitted with a bearing flange that requires grease, see the stickers on either the bearing flange or coupling guards for proper grease type and greasing schedule.

Motor Lubrication Schedule

NEMA/(IEC) Frame Size	Standard Service Interval	Severe Service Interval	Extreme Service Interval	Weight of Grease to Add Oz./(Grams)	Volume of Grease to Add In^3/(Teaspoons)
Up through 210 (132)	5500 hrs.	2750 hrs.	550 hrs.	0.30 (8.4)	0.6 (2)
Over 210 through 280 (180)	3600 hrs.	1800 hrs.	360 hrs.	0.61 (17.4)*	1.2 (3.9)*
Over 280 up through 360 (225)	2200 hrs.	1100 hrs.	220 hrs.	0.81 (23.1)*	1.5 (5.2)*
Over 360 (225)	2200 hrs.	1100 hrs.	220 hrs.	2.12 (60.0)*	4.1 (13.4)*

*The grease outlet plug **MUST** be removed before adding new grease.

Procedure

CAUTION:

TO AVOID DAMAGE TO MOTOR BEARINGS, GREASE MUST BE KEPT FREE OF DIRT. FOR AN EXTREMELY DIRTY ENVIRONMENT, CONTACT YOUR BALDOR DISTRIBUTOR OR AN AUTHORIZED BALDOR SERVICE CENTER FOR ADDITIONAL INFORMATION.

1. Clean all grease fittings. If the motor does not have grease fittings, the bearing is sealed and cannot be greased externally.
2. If the motor is equipped with a grease outlet plug, remove it. This will allow the old grease to be displaced by the new grease.
3. If the motor is stopped, add the recommended amount of grease. If the motor is to be greased while running, a slightly greater quantity of grease will have to be added.

   NOTE: If new grease does not appear at the shaft hole or grease outlet plug, the outlet passage may be blocked. At the next service interval the bearings must be repacked.

   Add grease SLOWLY until new grease appears at the shaft hole in the endplate or grease outlet plug. Never add more than 1-1/2 times the amount of grease shown in the lubrication schedule.
4. For motors equipped with a grease outlet plug, let the motor run for 20 minutes before replacing the plug.

Preventative Maintenance

At regular intervals depending on the conditions and time of operation, the following checks should be made:

1. Pump meets required performance and is operating smoothly and quietly.
2. There are no leaks, particularly at the shaft seal.
3. The motor is not overheating.
4. Remove and clean all strainers or filters in the system.
5. Verify the tripping of the motor overload protection.
6. Check the operation of all controls. Check unit control cycling twice and adjust, if necessary.
7. If the pump is not operated for unusually long periods, the unit should be maintained in accordance with these instructions. In addition, if the pump is not drained, the pump shaft should be manually rotated or run for short periods of time at monthly intervals.
8. To extend the pump life in severe duty applications, consider performing one of the following actions:
   - Drain the pump after each use.
   - Flush the pump , through system, with water or other fluid that is compatible with the pump materials and process liquid.
   - Disassemble the pump liquid components and thoroughly rinse or wash them with water or other fluid dthat is compatible with the pump materials and process liquid.

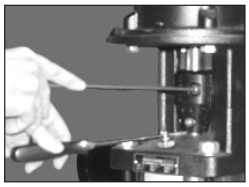
   If the pump fails to operate or there is a loss of performance, refer to the Troubleshooting Section on pages 13-14.

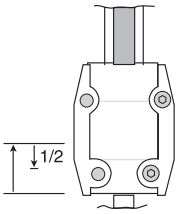
Motor Replacement

If the motor is damaged due to bearing failure, burning or electrical failure, the following instructions detail how to remove the motor for replacement. It must be emphasized that motors used on CR pumps are specifically selected to our rigid specifications. Replacement motors must be of the same frame size, should be equipped with the same or better bearings and have the same service factor. Failure to follow these recommendations may result in premature motor failure.

Figure 6

CR(X)(N)(T) 8, 16 & CRT 2, 4





- Note the clearance below the coupling
- Raise the coupling higher, as far as it will go.
- Lower it halfway back down (1/2 the distance you just raised it).
- Tighten screws (see torque specifications below)

Disassembly

1. Turn off and lock out power supply. The power supply wiring can not be safely disconnected from the motor wires.
2. Remove the coupling guards.
3. Using the proper metric Allen wrench, loosen the four cap screws in the coupling. Completely remove coupling halves. On CR1s-CR20, the shaft pin can be left in the pump shaft. CR(N)32, 45, 64 and 90 do not have a shaft pin.

   CR 1s, 1, 3, 5, 10, 15, and 20: do not loosen the three shaft seal securing allen screws.
4. With the correct size wrench, loosen and remove the four bolts which hold the motor to the pump end.
5. Lift the motor straight up until the shaft has cleared the motor stool.

Assembly

1. Remove key from motor shaft, if present, and discard.
2. Thoroughly clean the surfaces of the motor and pump end mounting flange. The motor and shaft must be clean of all oil/grease and other contaminants where the coupling attaches. Set the motor on the pump end.
3. Place the terminal box in the desired position by rotating the motor.
4. Insert the mounting bolts, then diagonally and evenly tighten. For 3/8" bolts, torque to 17 ft.-lbs., for 1/2" bolts torque to 30 ft.-lbs., and for 5/8" bolts torque to 59 ft.-lbs.
5. **CR 1s, 1, 3, and 5:**
   Insert shaft pin into shaft hole. Reinstall the coupling halves onto shaft and shaft pin. Reinstall the coupling screws and leave loose. Check that the gaps on either side of the coupling are even, and that the motor shaft keyway is centered in the coupling half, as shown in Figure 6a, page 11. Tighten the screws to the correct torque.

   CR 10, 15 and 20:

   Insert shaft pin into shaft hole. Insert plastic shaft seal spacer beneath shaft seal collar. Reinstall the coupling halves onto shaft and shaft pin. Reinstall the coupling screws and leave loose. Check that the gaps on either side of the coupling are even and that the motor shaft key way is centered in the coupling half, as shown in Figure 6a, page 11. Tighten the screws to the correct torque. Remove plastic shaft seal spacer and hang it on inside of coupling guard.

   CR 2, 4, 8 and 16:

   Reinstall coupling halves. Make sure the shaft pin is located in the pump shaft. Put the cap screws loosely back into the coupling halves. Using a large screwdriver, raise the pump shaft by placing the tip of the screwdriver under the coupling and carefully elevating the coupling to its highest point (see Figure 6). Note: the shaft can only be raised approximately 0.20 inches (5mm). Now lower the shaft halfway back down the distance you just raised it and tighten the coupling screws (finger tight) while keeping the coupling separation equal on both sides. When the screws are tight enough to keep the couplings in place, then torque the screws evenly in a criss-cross pattern.

CR(N) 32, 45, 64 & CR90:

Place the plastic adjustment fork under the cartridge seal collar (see Figure 7).

Fit the coupling on the shaft so that the top of the pump shaft is flush with the bottom of the clearance chamber in the coupling (see Figure 8).

Lubricate the coupling screws with an anti-seize and lubricating compound. Tighten the coupling screws (finger tight) while keeping the coupling separation equal on both sides and the motor shaft keyway centered in the coupling half as shown in Figure 6a. When the screws are tight enough to keep the couplings in place, then torque the screws evenly in a crisscross pattern.

Torque coupling screws to 62 ft.-lbs. Remove the adjustment fork from under the cartridge seal collar and replace it to the storage location (see Figure 9).

6. Check to see that the gaps between the coupling halves are equal. Loosen and readjust, if necessary.
7. Be certain the pump shaft can be rotated by hand. If the shaft cannot be rotated or it binds, disassemble and check for misalignment.
8. Prime the pump.
9. Follow the wiring diagram on the motor label for the correct motor wiring combination which matches your supply voltage. Once this has been confirmed, reconnect the power supply wiring to the motor.
10. Check the direction of rotation, by bump-starting the motor. Rotation must be left to right (counter-clockwise) when looking directly at the coupling.
11. Shut off the power, then re-install the coupling guards. After the coupling guards have been installed the power can be turned back on.

Torque Specifications
CR(I)(N) 1s, 1, 3, 5, 10, 15, and 20
CR(N)(X)(T) 2, 4, 8, and 16

Coupling Bolt Size	Min. Torque Specifications
M6	10 ft-lbs.
M8	23 ft-lbs.
M10	46 ft-lbs.

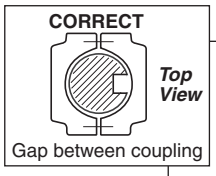


Figure 6a
All CR(I)(N)(X)(T)

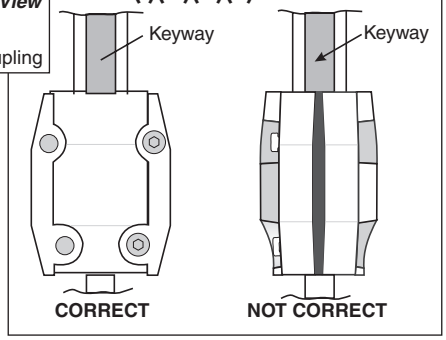


Figure 7
CR(N) 32, 45, 64, 90

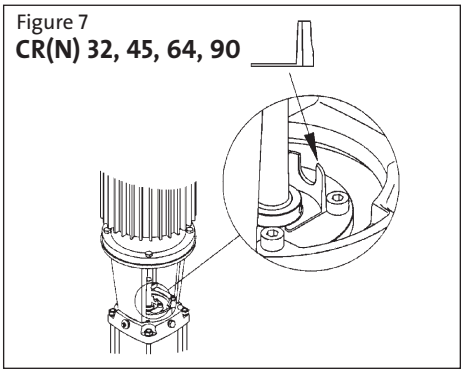
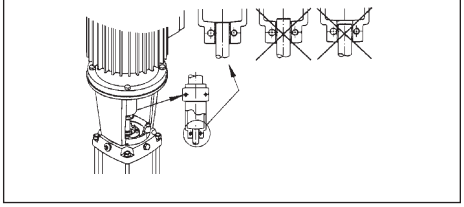
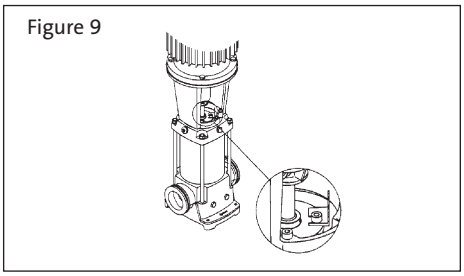


Figure 8



NOTE: To avoid damaging the coupling halves, ensure that no portion of the keyway on the motor shaft lies within the gap between the two coupling halves.

Figure 9



Parts List

For each CR pump model Grundfos offers an extensive **Parts List** and diagram of part used in that pump and is recommended to have on hand for future maintenance. In addition, the listings also provide information about prepackaged **Service Kits** for those pump components most likely to exhibit wear over time, as well as the complete Impeller Stack needed to replace the "guts" of each model. These Parts Lists are available separately from the Grundfos literature warehouse or as a set with extensive service instructions in the Grundfos CR **Service Manuals** (for a small charge).

Left, prepackaged impeller stacks ready for immediate installation; right, prepackaged flange kits.

Spare Parts

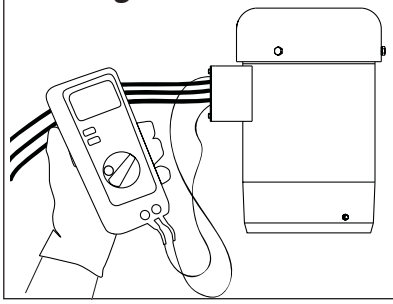
Grundfos offers an extensive list of spare parts. For a current list of these parts, refer to: "All Product Spare Parts/Service Kits" Price List, Form # L-SK-SL-002.

WARNING:

WHEN WORKING WITH ELECTRICAL CIRCUITS, USE CAUTION TO AVOID ELECTRICAL SHOCK. IT IS RECOMMENDED THAT RUBBER GLOVES AND BOOTS BE WORN, AND METAL TERMINAL BOXES AND MOTORS ARE GROUNDED BEFORE ANY WORK IS DONE. FOR YOUR PROTECTION, ALWAYS DISCONNECT THE PUMP FROM ITS POWER BEFORE HANDLING.

Preliminary tests

Supply voltage



How to measure

Use a voltmeter, (set to the proper scale) measure the voltage at the pump terminal box or starter.

On single-phase units, measure between power leads L1 and L2 (or L1 and N for 115 volt units). On three-phase units, measure between:

- Power leads L1 and L2
- Power leads L2 and L3
- Power leads L3 and L1

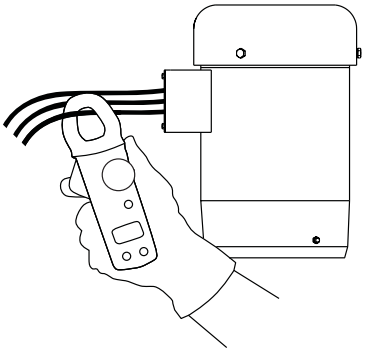
What it means

When the motor is under load, the voltage should be within ±10% of the nameplate voltage. Larger voltage variation may cause winding damage.

Large variations in the voltage indicate a poor electrical supply and the pump should not be operated until these variations have been corrected.

If the voltage constantly remains high or low, the motor should be changed to the correct supply voltage.

Current measurement



How to Measure

Use an ammeter, (set on the proper scale) to measure the current on each power lead at the terminal box or starter. See the motor nameplate for amp draw information.

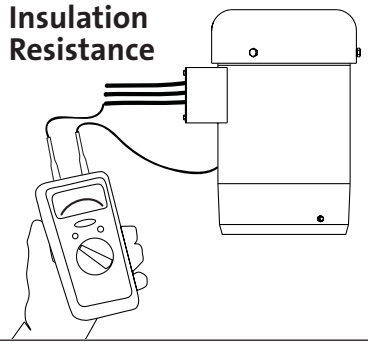
Current should be measured when the pump is operating at constant discharge pressure.

What it Means

If the amp draw exceeds the listed service factor amps (SFA) or if the current imbalance is greater than 5% between each leg on three-phase units, check the following:

1. Burned contacts on motor starter.
2. Loose terminals in starter or terminal box or possible wire defect.
3. Too high or too low supply voltage.
4. Motor windings are shorted or grounded. Check winding and insulation resistances.
5. Pump is damaged causing a motor overload.

Insulation Resistance



How to Measure

Turn off power and disconnect the supply power leads in the pump terminal box. Using an ohm or mega ohm meter, set the scale selector to Rx 100K and zero adjust the meter.

Measure and record the resistance between each of the terminals and ground.

What it Means

Motors of all HP, voltage, phase and cycle duties have the same value of insulation resistance. Resistance values for new motors must exceed 1,000,000 ohms. If they do not, motor should be repaired or replaced.

Diagnosing specific problems

Problem	Possible cause	Remedy
The pump does not run	1. No power at motor.	Check for voltage at motor teminal box. If no voltage at motor, check feeder panel for tripped circuits and reset circuit.
	2. Fuses are blown or circuit breakers are tripped.	Turn off power and remove fuses. Check for continuity with ohmmeter. Replace blown fuses or reset circuit breaker. If new fuses blow or circuit breaker trips, the electrical installation, motor and wires must be checked.
	3. Motor starter overloads are burned or have tripped out.	Check for voltage on line and load side of starter. Replace burned heaters or reset. Inspect starter for other damage. If heater trips again, check the supply voltage and starter holding coil.
	4. Starter does not energize.	Energize control circuit and check for voltage at the holding coil. If no voltage, check control circuit fuses. If voltage, check holding coil for shorts. Replace bad coil.
	5. Defective controls.	Check all safety and pressure switches for operation. Inspect contacts in control devices. Replace worn or defective parts or controls.
	6. Motor is defective.	Turn off power and disconnect wiring. Measure the lead to lead resistances with ohmmeter (RX-1). Measure lead to ground values with ohmmeter (RX-100K). Record measured values. If an open or grounded winding is found, remove motor and repair or replace.
	7. Defective capacitor. (Single-phase motors)	Turn off power and discharge capacitor. Check with ohmmeter (RX-100K). When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity (∞). Replace if defective.
	8. Pump is bound.	Turn off power and manually rotate pump shaft. If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair.
The pump runs but at reduced capacity or does not deliver water	1. Wrong rotation	Check wiring for proper connections. Correct wiring.
	2. Pump is not primed or is airbound.	Turn pump off, close isolation valve(s), remove priming plug. Check fluid level. Refill the pump, replace plug and start the pump. Long suction lines must be filled before starting the pump.
	3. Strainers, check or foot valves are clogged.	Remove strainer, screen or valve and inspect. Clean and replace. Reprime pump.
	4. Suction lift too large.	Install compound pressure gauge at the suction side of the pump. Start pump and compare reading to performance data. Reduce suction lift by lowering pump, increase suction line size or removing high friction loss devices.
	5. Suction and/or discharge piping leaks.	Pump runs backwards when turned off. Air in suction pipe. Suction pipe, valves and fittings must be airtight. Repair any leaks and retighten all loose fittings.
	6. Pump worn.	Install pressure gauge, start pump, gradually close the discharge valve and read pressure at shutoff. Convert measured pressure (in PSI) to head (in feet): (Measured PSI x 2.31 ft./PSI = _____ ft.). Refer to the specific pump curve for shutoff head for that pump model. If head is close to curve, pump is probably OK. If not, remove pump and inspect.
	7. Pump impeller or guide vane is clogged.	Disassemble and inspect pump passageways. Remove any foreign materials found.

Diagnosing specific problems

Problem	Possible cause	Remedy
The pump runs but at reduced capacity or does not deliver water (continued)	8. Incorrect drain plug installed.	If the proper drain plug is replaced with a standard plug, water will recirculate internally. Replace with proper plug.
	9. Improper coupling setting.	Check/reset the coupling, see page 10.
Pump cycles too much	1. Pressure switch is not properly adjusted or is defective.	Check pressure setting on switch and operation. Check voltage across closed contacts. Readjust switch or replace if defective.
	2. Level control is not properly set or is defective.	Check setting and operation. Readjust setting (refer to level control manufacturer's data). Replace if defective.
	3. Insufficient air charging or leaking tank or piping.	Pump air into tank or diaphragm chamber. Check diaphragm for leak. Check tank and piping for leaks with soap and water solution. Check air to water volume. Repair as necessary.
	4. Tank is too small.	Check tank size and air volume in tank. Tank volume should be approximately 10 gallons for each gpm of pump capacity. The normal air volume is 2/3 of the total tank volume at the pump cut-in pressure. Replace tank with one of correct size.
	5. Pump is oversized.	Install pressure gauges on or near pump suction and discharge ports. Start and run pump under normal conditions, record gauge readings. Convert PSI to feet (Measured PSI x 2.31 ft./PSI = _____ ft.) Refer to the specific pump curve for that model, ensure that total head is sufficient to limit pump delivery within its design flow range. Throttle pump discharge flow if necessary.
Fuses blow or circuit breakers or overload relays trip	1. Low voltage.	Check voltage at starter panel and motor. If voltage varies more than ±10%, contact power company. Check wire sizing.
	2. Motor overloads are set too low.	Cycle pump and measure amperage. Increase heater size or adjust trip setting to a maximum of motor nameplate (full load) current.
	3. Three-phase current is imbalanced.	Check current draw on each lead to the motor. Must be within ±5%. If not, check motor and wiring. Rotating all leads may eliminate this problem.
	4. Motor is shorted or grounded.	Turn off power and disconnect wiring. Measure the lead-to-lead resistance with an ohmmeter (RX-1). Measure lead-to-ground values with an ohmmeter (RX-100K) or a megaohm meter. Record values. If an open or grounded winding is found, remove the motor, repair and/or replace.
	5. Wiring or connections are faulty.	Check proper wiring and loose terminals. Tighten loose terminals. Replace damaged wire.
	6. Pump is bound.	Turn off power and manually rotate pump shaft. If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair.
	7. Defective capacitor (single-phase motors).	Turn off power and discharge capacitor. Check with ohmmeter (RX-100K). When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity (∞). Replace if defective.
	8. Motor overloads at higher ambient temperature than motor.	Use a thermometer to check the ambient temperature near the overloads and motor. Record these values. If ambient temperature at motor is lower than at overloads, especially where temperature at overloads is above +104°F (+40°C), ambient-compensated heaters should replace standard heaters.

Three Phase Motors

Below is a worksheet for calculating current unbalance on a three-phase hookup and selecting the proper wiring. Use the calculations in the left-hand column as a guide.

EXPLANATION & EXAMPLES	
Here is an example of current readings at maximum pump loads on each leg of a three-wire hookup. You must make calculations for all three hookups. To begin, add up all three readings for hookup number 1, 2, and 3.	**Hookup 1** T1 = 51 Amps T2 = 46 Amps T3 = 53 Amps TOTAL = 150 Amps
Divide the total by three to obtain the average.	**Hookup 1** 50 Amps 3|150 Amps
Calculate the greatest current difference from the average.	**Hookup 1** 50 Amps – 46 Amps 4 Amps
Divide this difference by the average to obtain the percentage of unbalance. In this case, the current unblanace for hookup number 1 is 8%.	**Hookup 1** .08 or 8% 50| 4.00 Amps

FIGURE HERE		
Hookup 1 L_1 to T_1 = ____ Amps L_2 to T_2 = ____ Amps L_3 to T_3 = ____ Amps TOTAL = ____ Amps	**Hookup 2** L_1 to T_3 = ____ Amps L_2 to T_1 = ____ Amps L_3 to T_2 = ____ Amps TOTAL = ____ Amps	**Hookup 3** L_1 to T_2 = ____ Amps L_2 to T_3 = ____ Amps L_3 to T_1 = ____ Amps TOTAL = ____ Amps
Hookup 1 _____ Amps 3| _____ Amps	**Hookup 2** _____ Amps 3| _____ Amps	**Hookup 3** _____ Amps 3| _____ Amps
Hookup 1 ____ Amps – ____ Amps ____ Amps	**Hookup 2** ____ Amps – ____ Amps ____ Amps	**Hookup 3** ____ Amps – ____ Amps ____ Amps
Hookup 1 ____ or ____% ____|____ Amps	**Hookup 2** ____ or ____% ____|____ Amps	**Hookup 3** ____ or ____% ____|____ Amps

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