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AC-Series Ozone Generators User Manual




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1 Safety

1.1 General Precautions

	<p>WARNING!</p> <p>Use this product ONLY as detailed in this manual.</p> <p>This product is not intended or recommended by Teledyne API (TAPI) for use in (a) medical therapy or physical therapy of any kind whether as a direct or adjunct part of such therapy, including, without limitation, life support (i.e., critical medical) applications or (b) any nuclear facility applications. TAPI will not knowingly sell this product for use in such applications. Use of the TAPI product in connection with medical or like treatment cannot be reasonably expected to produce accurate monitorings of therapy or treatment and may cause failure of the life support device or significantly affect its safety or effectiveness. Use by any direct purchaser or after-market purchaser in such applications whether or not known to TAPI shall absolve TAPI of any responsibility or liability to such purchaser (s) or to any person (s) subjected to or affected by such use knowingly or unknowingly.</p>
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 	<p>WARNING!</p> <p>Ozone (O₃) is a toxic gas. High concentrations of Ozone are dangerous and harmful to humans. Take reasonable steps to avoid exposure. The current maximum 8-hour exposure limit for Ozone is 0.1 ppm (according to U.S. OSHA).</p> <p>Install appropriate safety monitoring equipment wherever high concentrations of Ozone are used. TAPI manufactures several Ozone monitors for workplace safety applications.</p> <p>Materials in contact with high concentrations of Ozone should be suitable for such use. 316L Stainless, Teflon®, Chemraz® and Kynar® are recommended.</p> <p>Use only stainless steel gaskets for VCR® gas connections</p> <p>Ozone must be destroyed before it can be released to exhaust. TAPI manufactures a complete line of Ozone destruction equipment. Please consult with us for your Ozone destruction requirements.</p> <p>Never attempt to open Ozone catalyst canisters (if supplied). The content of the canisters can be hazardous if not handled properly.</p> <p>Use only TAPI-recommended spare parts. Substitution parts could result in damage to the equipment, may create hazardous conditions and will void the warranty.</p>
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WARNING!

Electrical Hazard. DO NOT OPEN COVERS to access electrical equipment with the power on, unless you are certified to perform specific troubleshooting/repair tasks.

When performing any maintenance to the unit, make sure all AC power is disconnected from the unit.



WARNING!

LOX FIRE HAZARD!

When liquid Oxygen (LOX) is used as a source for gaseous Oxygen, care must be taken to maintain the evaporating equipment so that liquid Oxygen does not enter the Ozone Generator. LOX is highly inflammable when exposed to flammable materials. For further information, refer to an appropriate MSDS



WARNING!

Certain components may be hot to the touch. Please allow proper cooling time before working with these components.



CAUTION!

Read the operating manual before operating the unit.

Do not subject the unit to extreme physical or thermal shock.

Use care in handling the unit and any of its components.



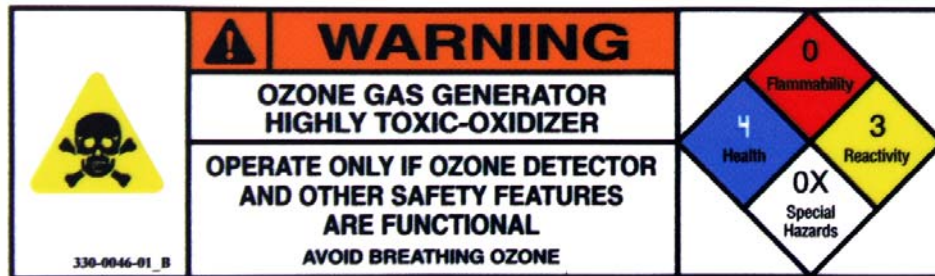
DO NOT use this equipment in any manner not specified by the manufacturer. If the equipment is used in a manner other than as specified in this document, the safety protections may be impaired.



1.2 Safety Labels

1.2.1 Ozone Safety

The Ozone safety-warning label is intended to warn users about the toxicity and danger of Ozone gas. Prior to operating the generator, ensure that your system/facility's Ozone detector is attached to the generator and is functional. Ensure that all other safety-monitoring features are functional.



1.2.2 Hazardous Voltage

One or more hazardous voltage labels may be affixed to the device to warn of possible electrical shock or burn hazards. Follow all safety directions.



GENERAL NOTES

- All trademarks, registered trademarks, brand names or product names appearing in this document are the property of their respective owners and are used herein for identification purposes only.
 - Teledyne API (TAPI) reserves the right to make changes to the product covered in this manual to improve performance, reliability or manufacturability. Make sure that this Manual is used with the original Product with which it was shipped.
 - Although every effort has been made to ensure accuracy of the information contained in this manual, TAPI assumes no responsibility for inadvertent errors. Contents of the manual are subject to change without notice.
 - TAPI assumes no responsibility for the use of any measuring schemes described herein.
 - This product should only be used as specified by this manual. Any use other than as specified may impair the safety features of the system.
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2 AC Series Description

2.1 System Overview

The AC series Ozone generators are designed to produce high purity Ozone gas from Oxygen sources, including Oxygen concentrators. The AC generators are available in standard rack-mount (or desktop application), as well as well as a wall-mount configuration.



Figure 1: AC Series Ozone Generators – Front Views

2.2 Principle of Operation

Teledyne API's IN USA-brand Ozone Generator uses high voltage electricity in a proprietary system to efficiently convert Oxygen to high purity Ozone. Oxygen flows at a controlled rate through the generator where it encounters a programmed electrical energy. The percentage of Ozone in the outlet stream is primarily dependent on the applied voltage. Other factors affecting Ozone concentration include:

- Oxygen inlet pressure
- Oxygen flow rate
- Generator back pressure
- Ambient temperature
- Oxygen concentration
- Oxygen impurities
- Generator cooling and cell conditions


2.3 Specifications

Specification	Rack-Mount System	Wall-Mount System
Dimensions (approximate) (W x H x D):	19" x 6.97" x 19.63" (483 mm x 177 mm x 499 mm)	30.14" x 20" x 11" (766 mm x 508 mm x 279 mm)
Oxygen flow:	0.05 to 20 slm	
Ozone outlet pressure:	20 to 35 psig (Typically set to 23 psig)	
Proof pressure:	120 psig	
Storage temperature:	5 – 35 °C (<40% relative humidity)	
AC power:	115 to 240VAC, 1 ϕ /2 ϕ , 50/60HZ, 1 kVA	
Heat Load	IKW approximately	
Cooling requirement:	<p>Air Cooled 18 °C \pm 3 °C Proper air cooling of the components is essential to proper operation.</p> <p>Never block the air vents. Never place any high-heat operating equipment or exhausts near the system.</p> <p>Do not mount in enclosed cabinets. Thermal shutdown can result in the case of inadequate cooling.</p>	
	<p>Two cooling fans, on the left side, draw air into the housing, exhausting it on the right side.</p> <p>Provide adequate venting on both sides of the generator – this may require having large holes in both sides of a cabinet.</p>	<p>Four cooling fans are provided in the generator housing. Two fans on the right side (as faced from the front) draw air into the housing, while two fans on the left side exhaust air out of the housing.</p>
Approximate weight:	25 Lbs. (11.3 kg)	82 Lbs. (37 kg)

3 Installation and Connections

3.1 Facility Requirements

Requirement	Rack-Mount System	Wall-Mount System
Oxygen supply:	Oxygen, with at least 0.5% content Nitrogen, and less than 10 PPM water (Dew Point of -60° C or lower) or Output of Oxygen Concentrator (>90% by Vol), less than 10 PPM water (Dew Point of -60° C or lower)	
Gas connection:	Gas Inlet: ¼" male VCR or compression (stainless steel) Gas Outlet: ¼" male VCR or compression (stainless steel)	Gas Inlet: ¼" male compression (stainless steel) Gas Outlet: ¼" male compression (stainless steel)
Power:	Input: 115 to 240 VAC Phases: 1 or 2 Frequency: 50/60 Hz Full Load: 1 kVA Input Breaker: 10 A Largest Load Amp Rating: 10 A	
Cooling Air:	18°C ±3°C, unobstructed to, from and through the generator	
Ozone leak detectors:	Install in desired protection areas. TAPI offers a wide range of Ozone Leak detectors – please consult with your TAPI representative for recommendations.	

	<p>WARNING!</p> <p>LOX FIRE HAZARD!</p> <p>When liquid Oxygen (LOX) is used as a source for gaseous Oxygen, care must be taken to maintain the evaporating equipment so that liquid Oxygen does not enter the Ozone Generator. LOX is highly inflammable when exposed to flammable materials. For further information, refer to an appropriate SDS</p>
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3.2 Water Isolation Valve

If the Ozone gas downstream (“TO PROCESS”) is dissolved into water, a manual 2-way valve, MV1, should be spliced in-line with the Ozone gas pipe to provide isolation and protect the generator from accidental flooding. This valve should be closed when the generator is not in use.

An additional method of protection is the use of a water trap which automatically dumps water into a drain. Such drain must be capable of handling Ozonated water.


3.3 Mounting

Refer to the System Dimensions section of this manual for mounting requirements. The system should be installed as close as possible to the point of use.

Do not subject the generator to direct adverse conditions, including water, dust, humidity, chemical environments, static and/or electromagnetic generation, transformers, blowers, or other equipment or hazards. The system must be installed in a cool location. See specifications.

The Rack-Mount design can also be Bench Mounted on integral feet.

Required Clearance	Rack-Mount System	Wall-Mount System
Front of system:	minimum of 24” (60 cm)	minimum of 40” (100 cm) door opens to 16” (40 cm)
Rear of system:	minimum of 24” (60 cm)	Mounted on a wall
Bottom of system:	Leave standard rack clearance as a minimum. Do not mount heat generating equipment below the AC Series Ozone Generator.	minimum of 12” (30 cm) typical depth required for Installation Kit Allow about three feet of unobstructed air flow below the generator Do not mount heat generating equipment below the AC Series Ozone Generator.
Sides of System :	Depending on application; Must provide cooling air through the generator.	Not expected to be an issue

	<p>IMPORTANT!</p> <p>Allow the minimum clearance specified around the enclosure to ensure unobstructed flow of cooling air. Refer to the system specifications and dimensional drawings. Clearance space can be shared with other equipment.</p>
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3.3.1 Dimensions – Wall-Mount Systems

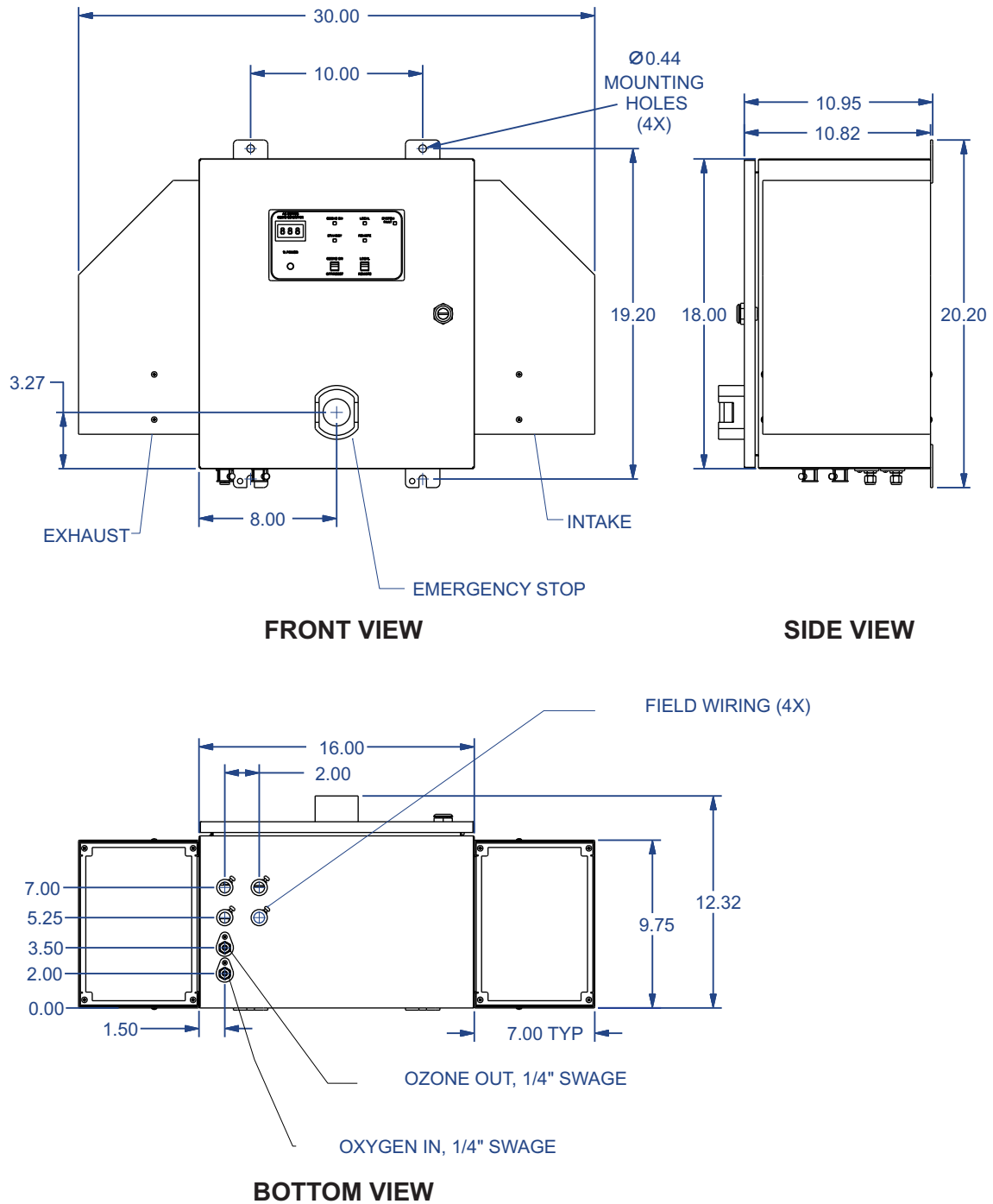


Figure 2: Wall-Mount Dimensions (in inches)

3.3.2 Dimensions – Rack-Mount Systems

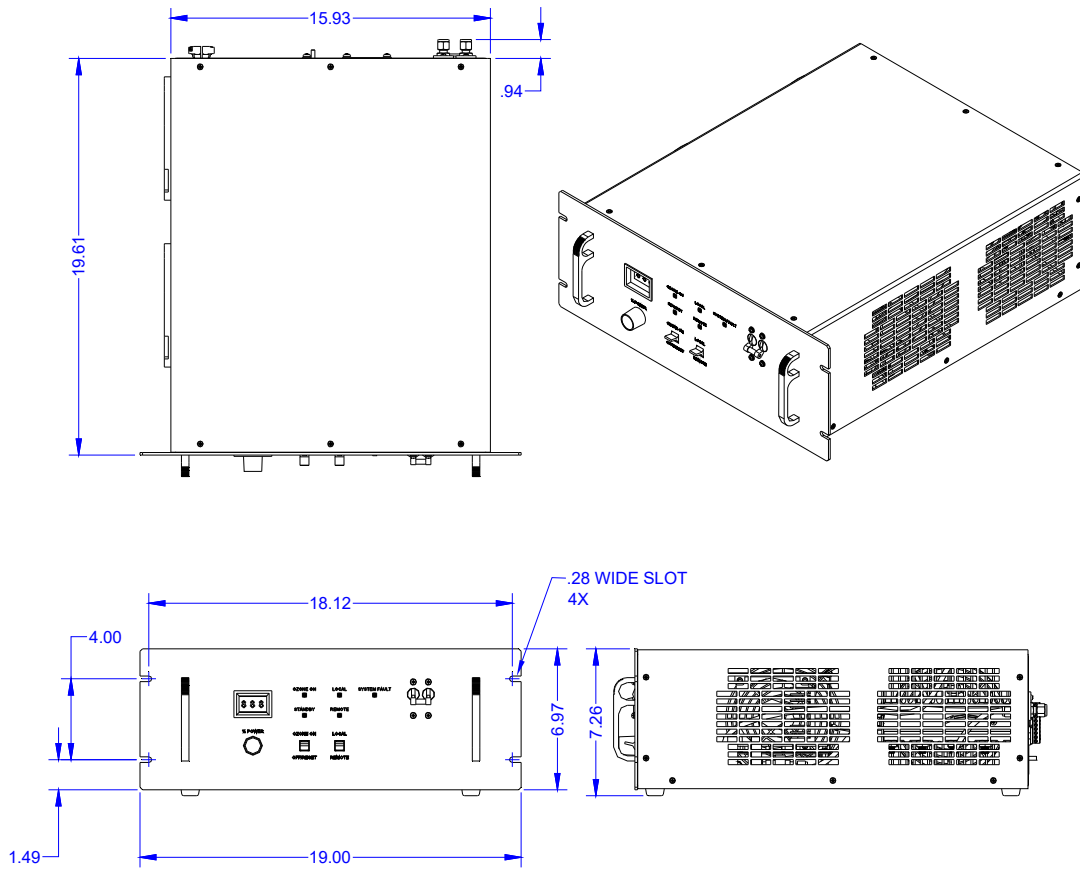


Figure 3: Rack-Mount Front, Side and Top Dimensions

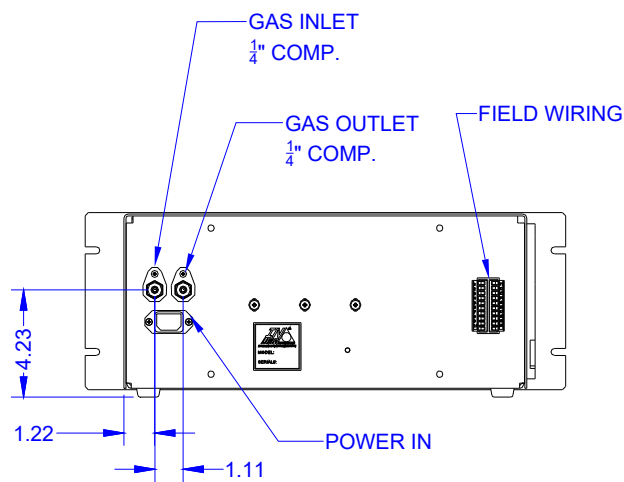


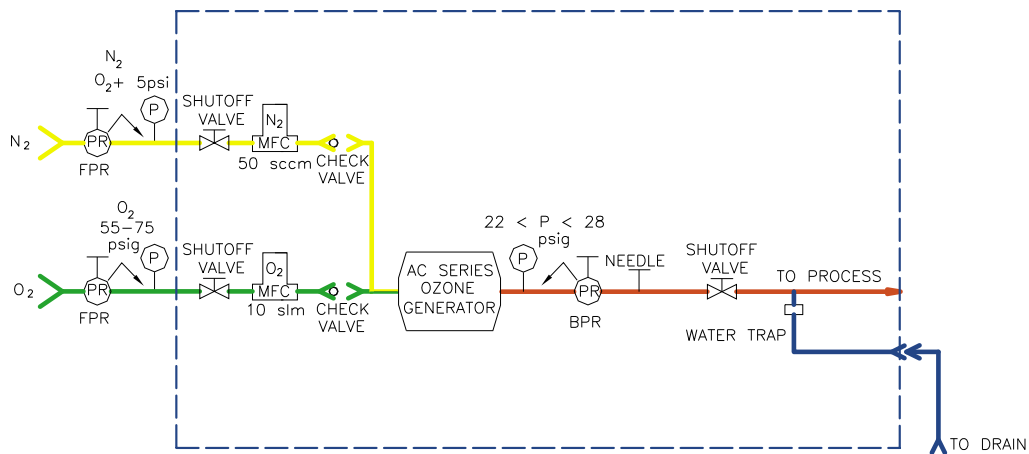
Figure 4: Rack-Mount Rear Dimensions

3.4 Recommended Pneumatic Diagrams

Use the following recommended pneumatic diagrams to configure an Ozone generation system. Each option is provided with comments to help you evaluate and weigh the performance, repeatability, and cost benefits and considerations for your application. Consult INUSA with any questions.

3.4.1 Option A: Using MFCs and BPR

The use of MFCs for flow control provides the best performance and highest repeatability.

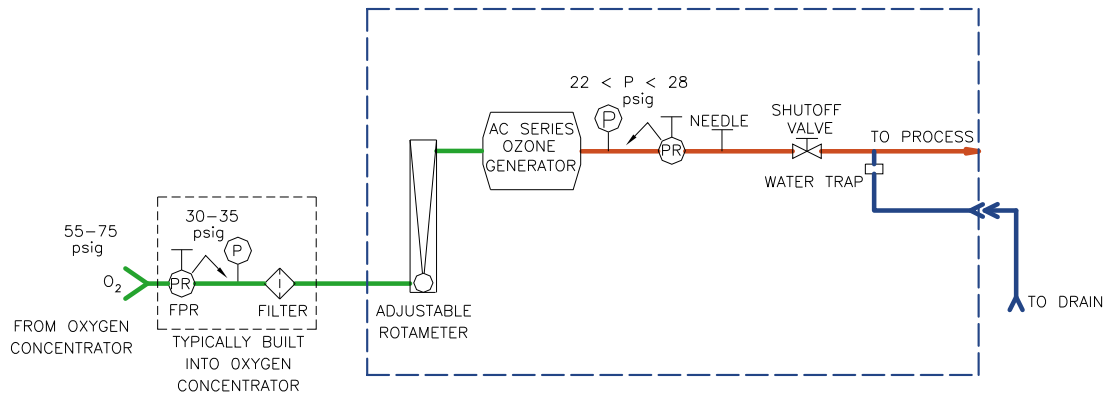


1. Set N2 inlet pressure 5 psi higher than O2 inlet pressure.
2. Set O2 flow to desired rate (slm: standard liters per minute).
3. Set N2 flow to 0.5% by volume of O2 flow (by selecting MFCs with ratio of 200, they can be controlled together).
4. Set BPR (back pressure regulator) so that P reads between 22 and 28 psig.
5. If PROCESS is at negative pressure (vacuum relative to atmosphere), adjust needle valve so BPR is regulating.
6. Use drain trap to prevent back flow of liquid into Ozone generator
7. 10 slm and 50 sccm (standard cubic centimeters per minute) are used as examples of MFCs

Comments:

- The generation of Ozone is enhanced by the addition of N₂ to the stream of O₂.
- Check valves prevent cross-contamination of the inlet gases.
- The Back Pressure Regulator (BPR) provides the optimum pressure at the outlet of the Ozone generating cell.
- The BPR operates best when the outlet pressure is close to one atmosphere.
- The needle valve is used to provide a pressure drop between the outlet of the BPR and process outlet – assumed to be less than atmospheric pressure because of venturi action of the liquid as it passes by the process outlet.
- The proper outlet pressure of the BPR is inferred by the proper operation of the BPR – if it is regulating, the pressure requirements are being met.
- The water trap prevents liquids from back-flowing into the generator.

3.4.2 Option B: Using Adjustable Rotameter and BPR

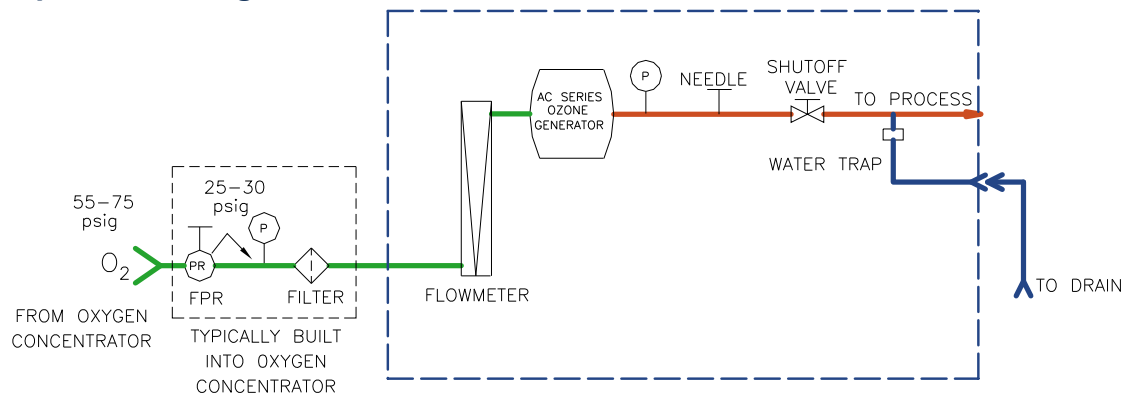


1. Adjust Rotameter to desired flow
2. Set BPR (Back Pressure Regulator) so that P is between 22 and 28 psig
3. If process is at negative pressure (vacuum relative to atmosphere), adjust needle valve so BPR is regulating.
4. Use drain trap to prevent back flow of liquid into O3 generator

Comments:

- An Oxygen concentrator is an economic method of deriving an acceptable source of Oxygen with about 4% of Nitrogen and other gases. They are commercially available from a variety of sources and typically include the pressure controls and filters shown in the diagram.
- For best performance from this type of setup, input pressure control is highly desired.
- The adjustable rotameter is an inexpensive alternate to the MFC (shown in previous section), but the readout of the gauge in the rotameter is subject to pressure variations.
- The Back Pressure Regulator (BPR) provides the optimum pressure at the outlet of the Ozone generating cell.
- The BPR operates best when its outlet pressure is close to one atmosphere.
- The needle valve is used to provide a pressure drop between the outlet of the BPR and process outlet – assumed to be less than atmospheric pressure because of *venturi* action of the liquid as it passes by the process outlet.
- The proper outlet pressure of the BPR is inferred by the proper operation of the BPR – if it is regulating, the pressure requirements are being met.
- The water trap prevents liquids from back-flowing into the generator.

3.4.3 Option C: Using a Flowmeter and Needle Valve



1. Adjust pressure at input to flowmeter to 25 – 30 psig.
2. Adjust needle valve for desired flow.
3. Use drain trap to prevent back flow of liquid into O3 generator

Comments:

- An Oxygen Concentrator is an economic method of deriving an acceptable source of Oxygen with about 4% of Nitrogen and other gases. They are commercially available from a variety of sources. They typically include the pressure controls and filters shown in the diagram.
- This is the simplest setup, using only inlet pressure and outlet constriction (needle valve), to optimize the generation of Ozone. This setup requires iterative adjustments (fiddling) of inlet pressure and outlet constriction.
- The flowmeter readout accuracy is subject to pressure variations, making iterative adjustments more problematical.
- The requirements of the Ozone generating cell are same as in the previous setups, but the method of achieving them is different.
- The needle valve and pressure control are used simultaneously to establish the flow of gases through the generator and to establish the pressure at the outlet of the generator.
- The water trap prevents liquids from back-flowing into the generator.

3.5 Wall Mount, Bottom Connection Locations



Figure 5: Wall-Mount shown with standard conduit entry ways – Bottom View

See section on optional bulkhead connectors for details



Figure 6: Wall-Mount shown with optional bulkhead connectors – Bottom View

3.6 Rack Mount, Rear Connection Locations

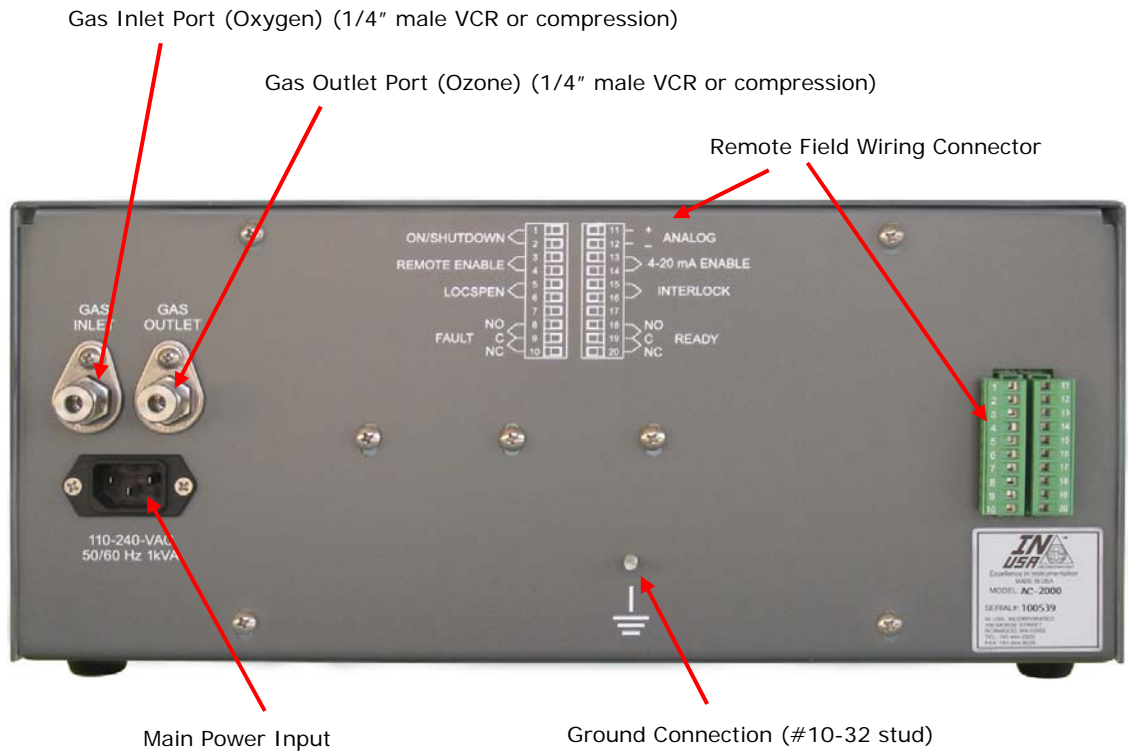


Figure 7: Rack Mount – Rear View

3.7 Power Connections

The AC-Series operate from 115 to 240VAC, 1 ϕ or 2 ϕ , 50/60 Hz. The internal power supply is Power Factor Corrected (Unity Factor). Refer to system specifications for power requirement details.


Connection	Rack-Mount System	Wall-Mount System
Power connection type:	Supplied with a standard 6 ft US power cord, to be connected to a 15 Ampere, grounded outlet, in compliance with the local electrical code. The power cord consists of 3 (three) 18AWG wires (line1, line2 and earth).	Input connections: Line 1, Line 2, Earth Ground Auxiliary Output AC connection (unfused): rated for 250VAC/5A Line 1, Line 2, Earth Ground (live when AC Gen is turned ON). Can be used to power an Oxygen Concentrator or other peripheral.

3.8 Chassis Ground Connection

The AC-Series features an external threaded stud for earth ground connections. In the Rack-Mount version, the user is expected to connect this stud to local earth ground. Use a 14AWG or greater wire for this connection.

In the Wall-Mount version, the user is expected to connect earth ground to the cabinet by wiring to the internal connections in the DIN rail connectors. The connector for earth is colored Green/Yellow and is connected by the DIN rail to chassis ground. There is an additional wire that runs from this connection to the threaded stud internal to the cabinet.

Connection	Rack-Mount System	Wall-Mount System
Ground connection type:	#10-32 stud, located on rear panel	¼-20 Stud, Located inside cabinet Connect to DIN rail connector strip

	<p>WARNING!</p> <p>Electrical Hazard. DO NOT OPEN COVERS to access electrical equipment with the power on, unless you are certified to perform specific troubleshooting/repair tasks.</p> <p>High voltages that can cause injury or death to operators are present in the AC Series Generators.</p> <p>The AC Series Generators must be properly grounded before operation.</p>
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3.8.1 Wall-Mount System Internal Wiring Locations

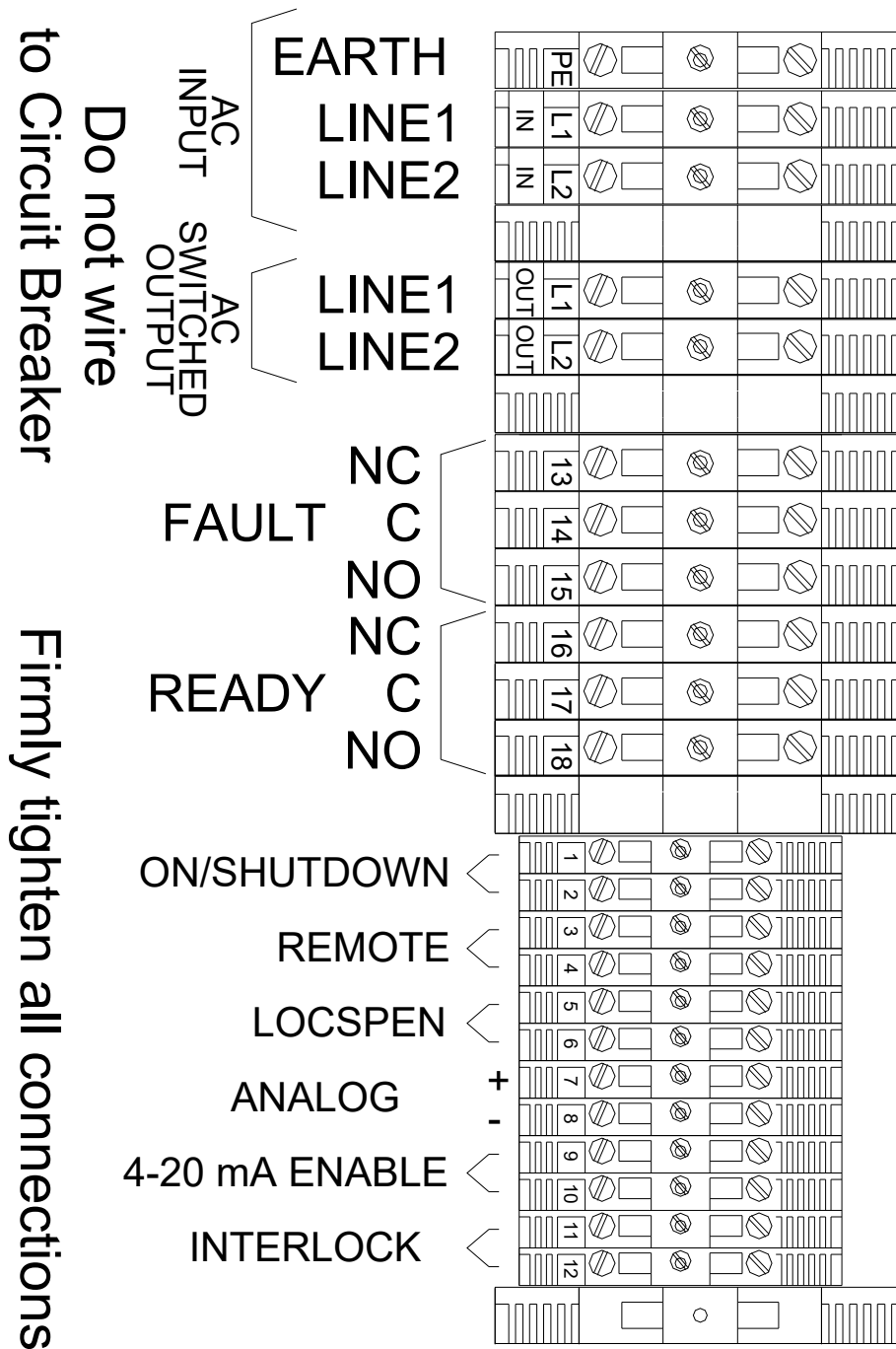
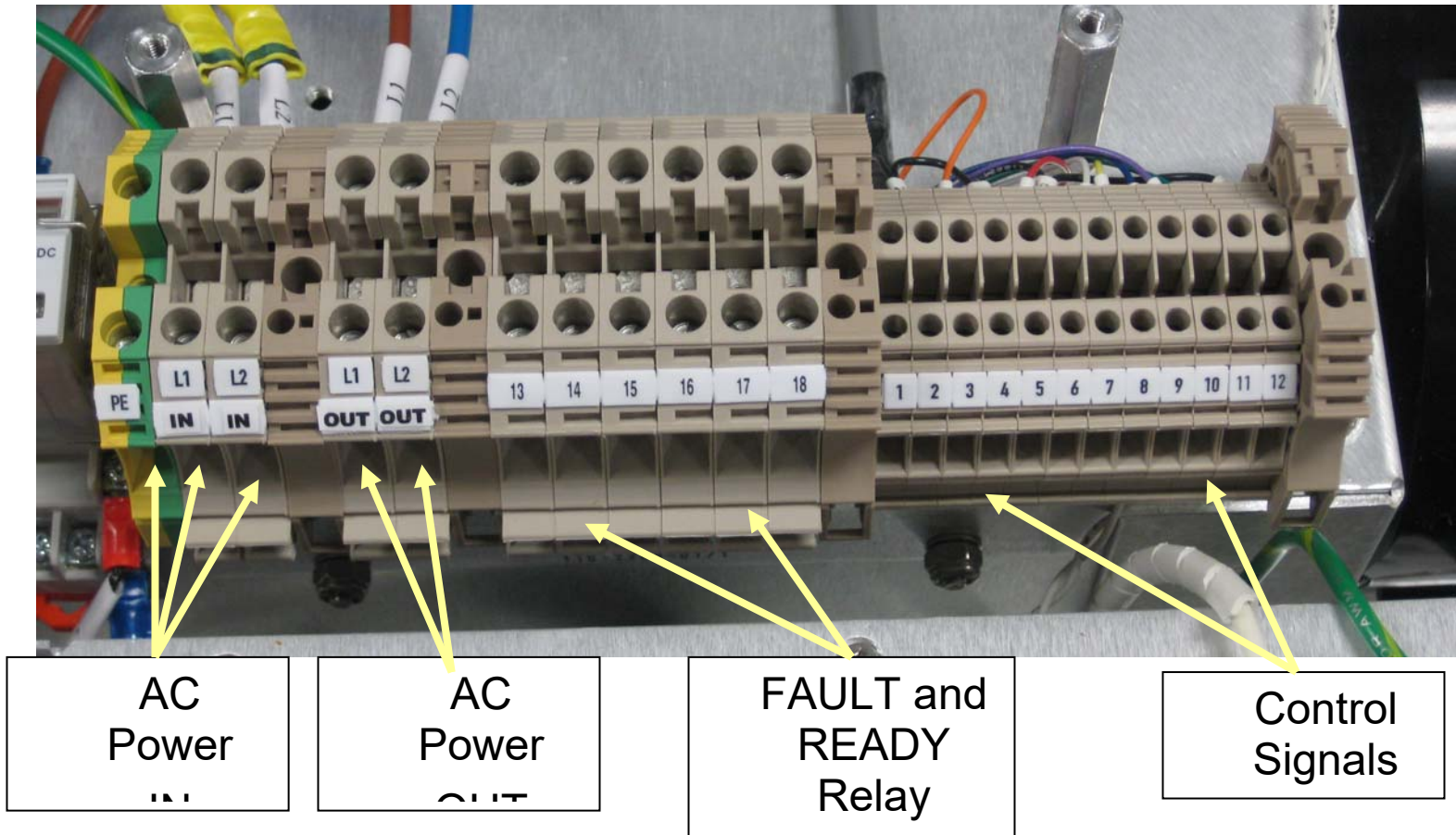


Figure 8: Wall-Mount Wiring Locations

3.8.2 Wall-Mount Field Wiring Pictorial



3.8.3

Rack Mount Remote Interface Connector (Rear Panel)

Pin #	Signal	Description	Comment
1	ON/SHUTDOWN	When in Remote Mode: Connect Pins 1 & 2 to turn the Generator ON Disconnect to shutdown.	Equivalent to Front Panel ON switch.
2			
3	REMOTE ENABLE ¹	Connect pins 3 & 4 to enable remote control.	Equivalent to Front Panel Remote switch.
4			
5	LOCAL SETPOINT ENABLE ²	When in Remote Mode: Connect Pins 5 & 6 to enable the front panel setpoint control (knob)	Can be useful when setting up the AC Generator under partial tool control.
6			
7			
8	FAULT, Normally Open	Normally OPEN contacts close on FAULT Contacts are rated for 250VAC at 5A	Fault occurs when: External Interlock is missing Cell overtemperature Internal generator fault Power is turned on in ON condition
9	FAULT Common		
10	FAULT Normally Closed		
11	+ Analog	External Setpoint, 0 to 10 Volts or 4 to 20 mA	Isolated input: 500 ohms impedance (1%).
12	- Analog		
13	4-20 MA Enable ³	When in Remote Mode: Connect Pins 13 & 14 for 4 to 20mA input	When not connected, the analog input is interpreted as 0-10V
14			
15	External Interlock	When in Remote Mode: Connect Pins 15 & 16.	This is a safety feature. The Interlock feature is inoperative in Local Mode. In Remote Mode, not connecting these pins will cause a Fault.
16			
17	Not connected		
18	READY Normally Open	Normally OPEN contacts close when Generator is ON Contacts are rated for 250VAC at 5A	
19	READY Common		
20	READY Normally Closed		
Notes:	¹ Connecting 3 & 4 forces Remote Mode, effectively locking out the front panel controls		
	² In Remote Mode, connecting 5 & 6 sets the %Power Level by the front panel knob.		
	³ The analog input is interpreted as 0-10V unless 13 & 14 are connected. In that case, the input is interpreted as 4-20mA.		

3.8.4

Wall-Mount Remote Interface Command Connections (Field Wiring)

Pin #	Signal	Description	Comment
1	ON/SHUTDOWN	When in Remote Mode: Connect Pins 1 & 2 to turn the Generator ON Disconnect to shutdown.	Equivalent to Front Panel ON switch.
2			
3	REMOTE ENABLE ¹	Connect pins 3 & 4 to enable remote control.	Equivalent to Front Panel Remote switch.
4			
5	LOCAL SETPOINT ENABLE ²	When in Remote Mode: Connect Pins 5 & 6 to enable the front panel setpoint control (knob)	Can be useful when setting up the AC Generator under partial tool control.
6			
7	+ Analog	External Setpoint, 0 to 10 Volts or 4 to 20 mA	Isolated input: 500 ohms impedance (1%).
8	- Analog		
9	4-20 MA Enable ³	When in Remote Mode: Connect Pins 9 & 10 for 4 to 20mA input	When not connected, the analog input is interpreted as 0-10V
10			
11	External Interlock	When in Remote Mode: Connect Pins 11 & 12.	This is a safety feature. The Interlock feature is inoperative in Local Mode. In Remote Mode, not connecting these pins will cause a Fault.
12			
Notes:			
	¹ Connecting 3 & 4 forces Remote Mode, effectively locking out the front panel controls		
	² In Remote Mode, connecting 5 & 6 sets the %Power Level by the front panel knob.		
	³ The analog input is interpreted as 0-10V unless 9 & 10 are connected. In that case, the input is interpreted as 4-20mA.		

3.8.5 Wall-Mount Remote Interface Relay Outputs (Field Wiring)

Pin #	Signal	Description	Comment
13	FAULT, Normally Closed	Normally OPEN contacts close on FAULT Contacts are rated for 250VAC at 5A	Fault occurs when: External Interlock is missing Cell overtemperature Internal generator fault Power is turned on in ON condition
14	FAULT Common		
15	FAULT Normally Open		
16	READY Normally Closed	Normally OPEN contacts close when Generator is ON Contacts are rated for 250VAC at 5A	
17	READY Common		
18	READY Normally Open		

3.9 Gas Connections

Connection	Rack-Mount System	Wall-Mount System
Gas connection type:	Gas Inlet and Outlet: ¼" male VCR or ¼" compression (stainless steel)	Gas Inlet and Outlet: ¼" compression (stainless steel)
Oxygen supply:	<p>Oxygen, with at least 0.5% content Nitrogen, and less than 10 PPM water (Dew Point of -60° C or lower)</p> <p>or</p> <p>Output of Oxygen Concentrator (>90% by Vol), less than 10 PPM water (Dew Point of -60° C or lower)</p> <p>IMPORTANT: The AC-Series require an Oxygen gas supply to operate. Some content of Nitrogen, at least 0.5%, is needed to maintain Ozone production specifications; this may be accomplished by deliberate mixing of dry air or Nitrogen into the Oxygen feed, or by the residual Nitrogen content of an Oxygen Concentrator.</p>	
Oxygen inlet pressure:	<p>70 PSIG max</p> <p>refer to recommended pneumatic diagrams</p>	
Ozone Back Pressure:	<p>23-25 psig typical</p> <p>refer to recommended pneumatic diagrams</p>	
Oxygen flow rate:	<p>0.1 to 20 slm</p>	

3.9.1 Particulate In-Line Filters.

Ozone-compatible in-line filters are available as a separate line item. Contact TAPI for more information.



WARNING!

LOX FIRE HAZARD!

When liquid Oxygen (LOX) is used as a source for gaseous Oxygen, care must be taken to maintain the evaporating equipment so that liquid Oxygen does not enter the Ozone Generator. LOX is highly inflammable when exposed to flammable materials. For further information, refer to an appropriate MSDS

4 Operation

The AC-Series can be operated locally, via the controls located in the Front Panel; or remotely, via the Remote Interface.

4.1 Wall Mount Front Panel



Figure 9: Wall-Mount Front Panel

4.2 Rack Mount Front Panel



Figure 10: Rack-Mount Front Panel

4.3 Control Panel Controls/Indicators

Table 1: Controls and Indicators, Front Panel

Identifier	Position	Description
POWER BREAKER SWITCH	UP	This breaker is used to connect the AC power to the unit. When the breaker handle is in the UP position, the main AC power is applied to the unit. In the Wall-Mount, it is located inside the enclosure.
	DOWN	When the breaker handle is in the DOWN position, AC power is disconnected.
OZONE ON – OFF/RESET SWITCH	ON	This turns on the Generator when in LOCAL mode, making Ozone according to the Power Setting on the Front Panel by adjusting the knob below the display.
	OFF/RESET	This turns off the Generator when in LOCAL Mode. In LOCAL Mode this also RESETS the internal fault alarm. Note that the RESET function is not available while the AC Generator is in Remote Mode.
LOCAL – REMOTE SWITCH	LOCAL	This position activates the ON switch and the front panel knob for power setting. Note that LOCAL mode is overridden when REMOTE Mode is commanded from the Remote Interface.
	REMOTE	This position activates the rear panel Remote ON command from the Remote Interface and the rear panel analog signal for power setting.
% POWER		This rotary encoder controls the amount of power delivered to the generating cells in LOCAL mode (and ultimately the amount of Ozone being generated). By depressing the knob, a switch is closed that results in displaying the cell temperature in degrees F in the front panel display.
OZONE ON LED		This indicator is ON (Green) when power is applied to the generating cells.
STANDBY LED		This indicator is ON (Green) when the generator is ready to make Ozone.
LOCAL LED		This indicator is ON (Green) when the Local Mode has been selected.
REMOTE LED		This indicator is ON (Green) when Remote Mode has been selected.
FAULT LED		This indicator is ON (Red) when the controller has detected one or more abnormal conditions and automatically shuts off the Generator. A fault can occur when <ol style="list-style-type: none"> 1) there is an internal fault in the generator itself; or 2) the Remote Interface External Interlock is not set in Remote Mode; or 3) there is an over-temperature condition in the generating cell – depress the %power knob to see the temperature of the cell. 4) the unit was turned on in the ON condition – this is illegal. <p>The unit will remain in the FAULT state until the fault is cleared, the front panel switches are in ON and LOCAL and the Remote Mode is not selected in the Remote Interface.</p>

4.4 RESET Switch on the Wall-Mount

In typical applications, the Wall-Mount version will be installed in an environment that is hazardous to open cabinets. For this reason there is a RESET Switch mounted on the front of the cabinet on the door. This switch can be depressed at any time and will result in resetting the Ozone Generator. Refer to the section on Faults for more information about recovering from a fault.

4.5 Reset Condition

The Front Panel Switches are in OFF/RESET and LOCAL; and the Remote Interface is not in Remote Mode. Refer to the section on Faults for more information about recovering from a fault.

4.6 Typical System Operation from a PLC

There are two modes of operation: Local and Remote. Local mode allows control of Ozone process from the front panel of the AC-Series generator. Remote mode uses analog and digital inputs from a separate controller, via the REMOTE INTERFACE connection.

Remote Interface Pin Assignments – connect together for remote command:

Command	Wall-Mount	Rack-Mount
REMOTE Command – forces Remote Mode – disconnect to enable LOCAL mode and RESET	Positions 1 & 2	Positions 1 & 2
Remote ON – available only when front panel switch is in REMOTE or when REMOTE Command is active	Positions 3 & 4	Positions 3 & 4
Local Setpoint Enable – in Remote Mode, connecting these two pins will enable the front panel %Power Setpoint.	Positions 5 & 6	Positions 5 & 6

In Remote Mode, the External Interlock signal must be provided.

In Local Mode, the Remote Interface is not required. Note that if the AC Generator is used in a stand-alone situation (not connected to a remote controller), switching the front panel switch from LOCAL to REMOTE will result in a FAULT condition. To clear the Fault condition, put the front panel switches in the OFF and LOCAL positions.

4.7 How to select a Mode of Operation

Desired Mode of Operation	Front Panel Switch Setting	Remote Interface
LOCAL Mode – responds to ON/OFF/RESET Switch	LOCAL	Not in Remote Mode
REMOTE Mode – responds to REMOTE ON	REMOTE	Not in Remote Mode
	LOCAL or REMOTE	Remote Mode

Notes:

In Remote Mode, the External Interlock must be set. In servo control applications, this is a safety feature. In Local Mode, the External Interlock is not required.

4.8 Local Mode

4.8.1 Local Mode Operation

In this mode, the Front Panel is used to control the operation of the generator.

IMPORTANT!!!: Feed Gas flow should be established before attempting to generate Ozone.

Typically, the Ozone Generator is installed as part of an “Ozone System” containing supporting plumbing, valves, and safety equipment. Please review the previous sections of this manual for details.

First Time Powering ON. The following is a list of pre-operation requirements that need to take place before Local Operation can start the first time.

Local Mode after the first time. Start with step 3 for an established configuration (power on, feed gases and Ozone process/destruct outputs are connected).

Step	Action
1.	Verify that the Power Breaker is in the OFF (Down) Position.
2.	Verify that the Oxygen gas feed is connected to the Oxygen Inlet.
3.	If an Isolation Manual Valve (MV1) is in used, make sure that the valve is in the OPEN Position.
4.	Turn on the flow of Oxygen feed.
5.	Adjust the generator’s Back Pressure to 20-25 PSIG. To accomplish this, use a needle valve and pressure gauge. Note that the adjustments of supply pressure and needle valve constriction is iterative – they might require adjustments as you vary the Ozone flow rate.
6.	If the Remote Interface is used, make sure Remote Command is not selected.
7.	% POWER” defaults to 00 on power on. No action is required on power on.
8.	Set the “LOCAL/REMOTE” toggle switch to the “LOCAL” position.
9.	Set the “OZONE ON/OFF-RESET” toggle switch to the “OFF-RESET” position.
10.	Set the Power Breaker to the “ON” position.
11.	Verify that the internal cooling fans are operating. The “LOCAL” LED Indicator should light. The “STANDBY” indicator should light.
12.	Set the “OZONE ON/OFF-RESET toggle switch to the “OZONE ON” position. The “OZONE ON” indicator should light. The “STANDBY” indicator should be off. The “% POWER” digital readout should read 00.
13.	Rotate the “% POWER” knob clockwise. This will apply an increasingly larger voltage across the generating cells, creating an electrical discharge and generating Ozone.



4.8.2 Reading the Cell Temperature

Depress the %POWER knob. The cell temperature is displayed in degrees C.



4.9 Remote Mode

The Ozone generator can be operated from a remote control device (a PLC, for example). In this mode, using the Remote electrical connector, digital inputs provide OZONE ON/OFF toggling, and an external Analog Signal, 0 to 10 VDC or 4 to 20 mA, controls the power delivered to the Ozone generating cells (ultimately controlling the amount of Ozone produced). 10 VDC or 20 mA corresponds to 100% power.

Set up the generator in Local Mode first. Then switch over to Remote Mode.

Step	Action	Remote Interface	
		Wall-Mount	Rack-Mount
14.	Start by running in Local Mode.	Positions 3 & 4 not connected	
15.	Setup the remote controller (PLC, for example): not in Remote Mode; deselect Remote ON; Analog Signal at 'zero' (0 V or 4 mA); Select "External Interlock"; If analog signal is current, select "4 to 20 mA Enable".	Positions 3 & 4 not connected Positions 1 & 2 not connected Positions 7 & 8 analog input Positions 11 & 12 connected Positions 9 & 10 connected for 4 to 20 mA input	Positions 3 & 4 not connected Positions 1 & 2 not connected Positions 11 & 12 analog input Positions 15 & 16 connected Positions 13 & 14 connected for 4 to 20 mA input
16.	Put the remote controller in Remote Mode	Positions 3 & 4 connected	
17.	Turn on the Generator in Remote Mode	Positions 1 & 2 connected	
18.	Select the desired power level by applying the appropriate voltage or current.	Positions 7 & 8 analog input	Positions 11 & 12 analog input

5 System Shutdown

Step	Action
1.	Select LOCAL Mode by deselecting Remote Interface Remote Mode and putting the front panel switches in LOCAL and OFF/RESET
2.	Switch off the Power Breaker.
3.	Unplug the system from the power source if required.
4.	To purge the generator of Ozone, let the Oxygen flow for about ten minutes. Then turn off the flow of Oxygen.
5.	Close the manual Valve, MV1, off (optional, supplied by installer) to protect unit from accidental flooding.

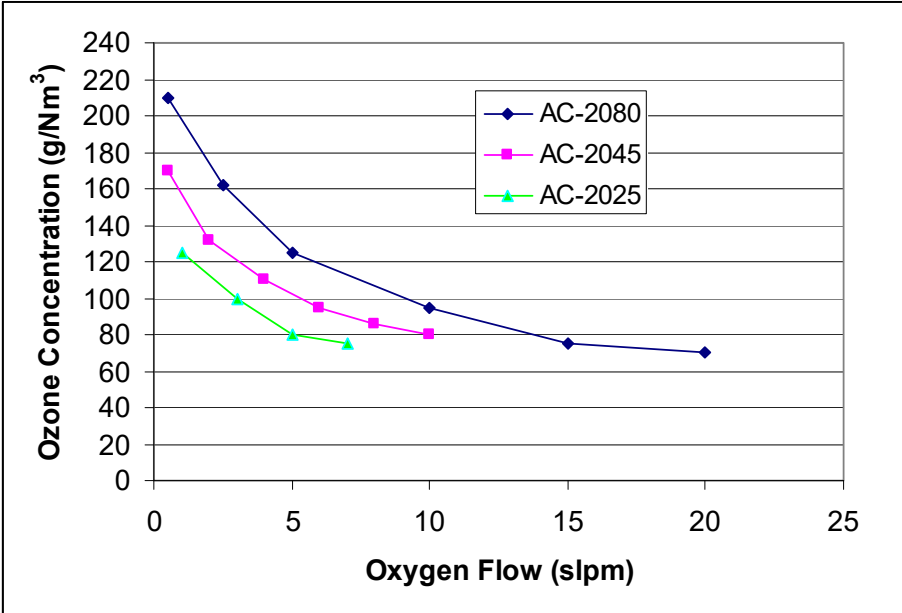
6 Standard Operating Procedures

NOTE: To assure a long, trouble-free service life of an AC-Series Ozone Generator, provide the following operating conditions:

- Make sure that the Oxygen concentrator (if one is used) is maintained properly and is producing Oxygen at greater than 89% purity and less than -60°C dew point. Check sieve conditions and replace it as often as recommended by manufacturer
- Make sure to maintain working pressure across Ozone cell as specified 18-22PSIG for the generator protection and most efficient Ozone production.
- When injecting Ozone into water make sure to protect the generator from flooding by installing a device capable in case of water backup to automatically drain it and to prevent water from entering the Ozone cell.
- Protect internal components of the Ozone generator from water, dust and humidity; make sure that there is a sufficient amount of clean air is available for the unit cooling and air inlet and outlet are not obstructed by other equipment or elements.
- Leave plenty of room around the generator for access to cooling air.
- Check that electrical power fluctuations are within normal and install power-conditioning devices if necessary.

7 Performance Data

This graph shows the relative performance of three ranges of Ozone Generator.



8 Maintenance

The AC-Series Ozone Generators have no required consumable or user serviceable parts with the exception of the inlet fan filter on the wall-mount units. If a problem occurs, please contact TAPI Technical Support.

8.1 Preventative Maintenance Schedule

Generally the AC-Series is maintenance-free although it is useful to check the Ozone generator for proper operation and clean items as noted below:

Item	Action	Interval			
		As Needed	Monthly	6 Months	12 Months
Operation	Make sure the green indicator light is lit during operation Make sure the red indicator light is off during operation	YES	YES	YES	YES
Oxygen Concentrator	Make sure that all system equipment (Oxygen concentrator, air compressor, etc.) is maintained according to manufacturer recommendations.	YES	YES	YES	YES
Regulators/Filters	Evaluate external fluid regulators and filters as required by manufacturers, if installed.	YES	YES	YES	YES
Cabinet Cleaning	Perform general cleaning of cabinet exterior prior to disconnecting the equipment from electrical source.	YES	-	YES	YES
Clean Interior	Using clean/dry compressed air, blow out the interior of cabinet, taking special care around small components and wiring.	YES	-	YES	YES
Clean Inlet Filter	Replace the inlet filter on the right bottom of the wall-mount unit. The used filter can be washed and thoroughly dried to re-use. Check the outlet grill and clean if necessary.	YES	YES	YES	YES

8.2 Wall-Mount Cooling Air Filter Replacement Kit

The flow of cooling air into the AC Generator is critical for optimal generation of Ozone. High Temperatures inside the generator limit the ability of the generator to produce economic quantities of Ozone.

The Filter is designed to prevent small particles from entering the generator while permitting cooling air to pass.

The Filter will not prevent large obstructions from blocking the flow of cooling air (for example, a sheet of paper).

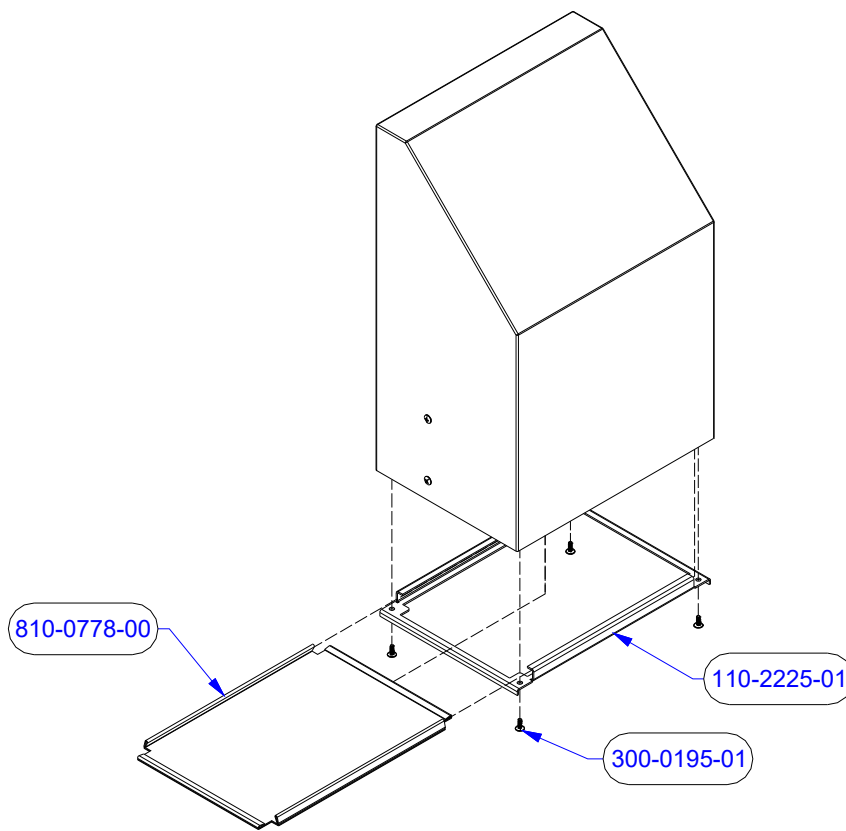
The Filter is installed only on the intake side of the Generator – on the right when facing the generator.

The Filter also prevents adventurous and curious fingers from being harmed by the fan blades.



CAUTION. When changing the Filter, turn off the power to the AC Generator. If this is not possible, extra care is needed to prevent hands, sheets of paper (like this one) and other objects from entering the intake side of the Rain Guard.

1. Refer to the picture and diagram for additional information.
2. Turn off the power to the AC Generator.
3. Remove four screws from the retaining ring.
4. Carefully lower the filter assembly.
5. Slide out the old filter.
6. Slide in the new filter.
7. Reattach the filter assembly, in reverse order. Additional screws are supplied, if needed.
8. Responsibly dispose of the old filter.
9. Return the AC Generator to service.



Filter Kit 870-0101-01, Consisting of four replacement Filters
Replacement Filter 810-0778-01 Mounting Screws (4) 300-0195-01

9 Troubleshooting

9.1 General Troubleshooting

The Series AC Ozone Generator has internal diagnostic sensors that continuously check for fault conditions:

Fault Indicator	Possible Cause	Recommended Solution	Displayed Error Code
Fault LED on front panel Fault Relay closure in Field Wiring Connector Flashing Error Code on Front Panel	Excessive temperature in the unit	Check system cooling fans for cleanliness and operation.	E01
	Over Current fault and/or Over Voltage fault	Over Current fault indicates that there is an electrical problem associated with the High Voltage Power Supply (HVPS) across the generator gap. This may arise from conditions such as not enough or excessive gas pressure, particle contamination, water vapor, etc.	E02 Or E04 Or E06
	External interlock open	Check interlock and reset the generator.	E08
	Generator was turned on in an ON condition – this is illegal	Reset Error Code by going into LOCAL and OFF/RESET	E00
	There was a fault but it has been cleared	Reset Error Code by going into LOCAL and OFF/RESET	E00
	The watchdog timer in the control board timed out – self recovery	Reset Error Code by going into LOCAL and OFF/RESET	E99

9.2 What to do when the Ozone Generator is not performing as expected




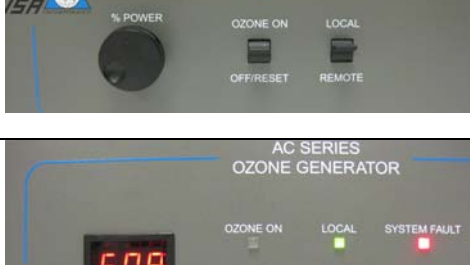
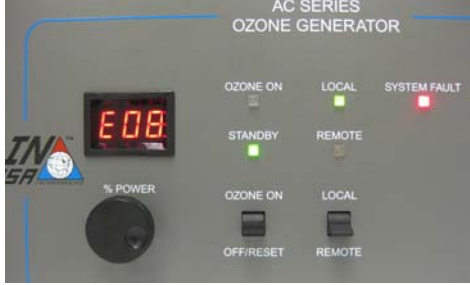
There are several variables that can affect the performance of the Ozone Generator.

It is recommended that each application be characterized by recording some or all of these parameters. Then when troubleshooting, these parameters can be compared to those that were established in the early days of performance.

Back Pressure at the outlet port	Forward Pressure at the inlet port	Water in the outlet port Do you need a water trap?
Air temperature of the immediate environment	Quality of the Oxygen from the Concentrator or Cryogenic System	Electrical Power Is there a 'brown out'?

9.3 Fault Indications and Codes

Whenever the Fault LED is illuminated, there is/was a fault. The Display indicates the Fault by flashing 'E' followed by a two digit number between 0 and 15 inclusive. Although this is unlikely, there can be multiple faults. The displayed fault number is the sum of the fault codes listed below.

Fault Code	Cause	Pictorial
0	1. Unit turned on in ON condition 2. There was a fault but it has been cleared	
1	Cell Overtemperature	
2	HVPS over voltage	
4	HVPS over current	
8	No External Interlock	

9.4 How the Fault conditions are detected, cleared and displayed

The faults described above cause an internal controller flag to be set. This flag also causes the Fault LED to be illuminated and the display to flash 'E' followed by a two digit code (see below why two digits are displayed).

The Fault flag is not reset until the RESET condition is detected (the front panel switches are in OFF and LOCAL; and the Remote Interface is not in Remote Mode; or the RESET button is pushed). If a fault persists, the fault flag will not be reset.

The Fault conditions described above are of necessity temporary: the cell will cool down, the HVPS current and voltage will disperse, the External Interlock will be activated. For this reason, the fault codes will change from the fault codes described above (1, 2, 4, 8 or combinatory sums of them) to 'E00'. When all the fault conditions have been corrected, either by waiting for a cell to cool down or by activating the External Interlock, the displayed Fault Code will be 'E00'.

When the display is 'E00', this means the internal flag is still set but the faults have gone away. Just go into the RESET condition to clear the Fault flag. For the Wall-Mount, do that or press the RESET button.

9.5 Recovering from RESET

Recovering from RESET is different for each mode and whether there was a fault before the RESET.

Reset by one of two methods:

1. Put the ON/OFF switch in OFF position
Put the LOCAL/REMOTE switch in LOCAL position

Deselect the Remote Mode in the Remote Interface (Pins 3 & 4)
2. Press the RESET button on the Wall-Mount

Mode	No Fault before	With Fault before
LOCAL	Put the ON/OFF switch in the ON position. The power setting will be unchanged.	Put the ON/OFF switch in the ON position. The power setting will be '00'.
REMOTE	Connect pins 3 & 4 in the Remote Interface. The power setting will be set by the Analog Signal.	Connect pins 3 & 4 in the Remote Interface. The power setting will be set by the Analog Signal.
REMOTE with Local Setpoint Enable	Connect pins 3 & 4 in the Remote Interface. The power setting will be unchanged.	Connect pins 3 & 4 in the Remote Interface. The power setting will be '00'.

9.6 Dialing '00.0' while in STANDBY

The operation of the AC Generator while in LOCAL and STANDBY mode is described as follows:

Setting the ON switch to ON makes the previous value of Setpoint come up in the display.

To set the power to zero, while in STANDBY, the user simply turns the knob (fingerwheel) one turn CCW (counter-clockwise). Then when the ON switch is set to ON, the setpoint will be '00.0'.

There is no similar operation in Remote Mode. To select zero from Remote, the external setpoint has to be set to 'zero' (0 volts or 4 mA).

9.7 Reading the Fault Code Display

The summing of the codes for display is possible because the codes are binary-weighted. The table below will help users to read the displayed fault codes.

Display	Indicated Fault
0	Power turned on in ON condition
1	Cell Overtemperature
2	HVPS Over Voltage
3	HVPS Over Voltage and Cell Overtemperature
4	HVPS Over Current
5	HVPS Over Current and Cell Overtemperature
6	HVPS Over Current and HVPS Over Voltage
7	HVPS Over Current, Voltage and Cell Overtemperature
8	External Interlock
9	External Interlock and Cell Overtemperature
10	External Interlock and HVPS Over Voltage
11	External Interlock, HVPS Over Voltage and Cell Overtemperature
12	External Interlock and HVPS Over Current
13	External Interlock, HVPS Over Current and Cell Overtemperature
14	External Interlock, HVPS Over Current and Voltage
15	External Interlock, HVPS Over Current, Voltage and Cell Overtemperature

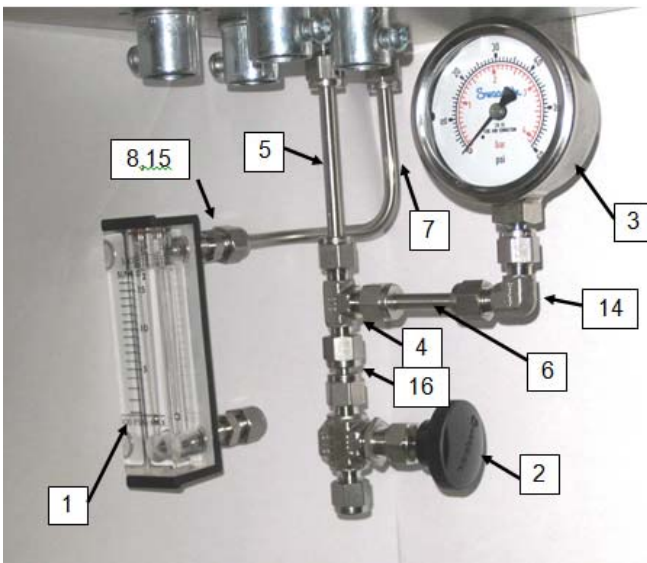
IMPORTANT!!:

After a fault, before restarting the unit, wait at least 15 seconds.

Knowledge of electrical applications is required for troubleshooting. Contact a certified electrician if you are unsure of your ability to service the equipment. If any condition persists, contact TAPI Technical Support.

10 Installation Kit

The Installation shown below is intended for Wall-Mount applications. Every Wall-Mount is shipped with this installation kit. The picture shows the replacement parts for maintenance purposes. These fittings are 1/4" compression. The Installation Kit contains the pneumatic components needed to complete an installation with an Oxygen concentrator. Other kits are available. Contact TAPI for details.



10.1 Spare Parts for Installation Kit

Item	Part Number	Description
1	316-0009-01	Flowmeter, 16 slm, non-valved
2	315-0001-01	Needle Valve
3	390-0375-01	Pressure Gage, 0-60 psig
4	310024	Union Tee
5	810-0801-02	Straight Pipe, 3-1/4"
6	810-0801-01	Straight Pipe, 2-1/2"
7	810-0802-01	Pipe, Double Bend
8	310013-1	Fitting, Straight, 1/8MNPT x ¼ tube
9	320-0038-01	Tubing PFE Teflon
14	310023	Union Elbow
15	610012	Teflon tape
16	310025	Port Connector

10.2 Adjustment of Pressure Gauges and Flowmeter

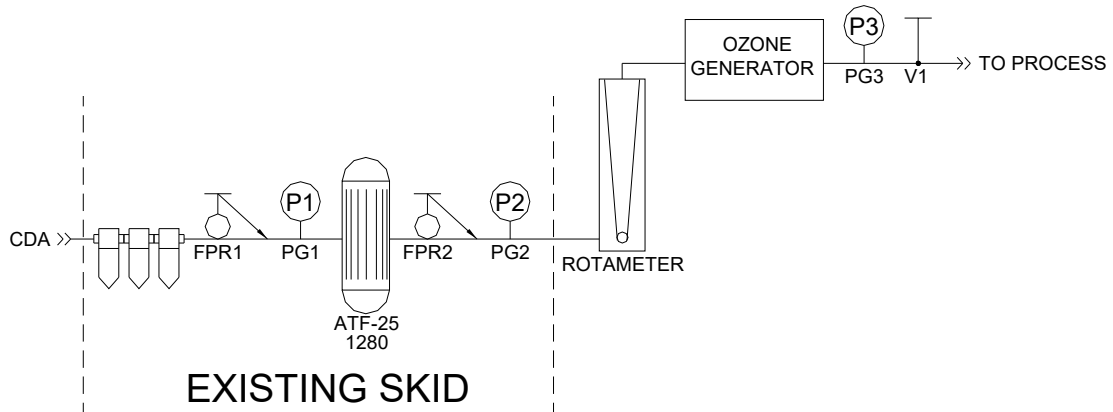


Diagram for Adjustment of Oxygen and Ozone with Flow Rate and Pressure

For systems equipped with flowmeter and gauges, as shown above, adjust settings as follows:

1. Initial setting of Needle Valve. Set the needle valve to achieve a flow of about 6 lpm. This will provide enough constriction for the pressure regulators.
2. Inlet CDA Pressure. Using the forward pressure regulator FPR1 and pressure gauge PG1, located at the inlet to the Oxygen Concentrator (SeQual ATF-25 Model 1280, adjust the supply pressure of CDA (Compressed Dry Air) to 35 psig (relative to ambient air pressure).
3. Inlet Ozone Generator Pressure. Using the forward pressure regulator FPR2 and pressure gauge PG2, located at the outlet of the Oxygen Concentrator, adjust the delivery pressure of Oxygen to the Ozone Generator to 20 psig.
4. Outlet Flow. Using the needle valve V1 located at the outlet of the Ozone Generator, and monitoring the flowmeter at the inlet to the Ozone Generator, adjust the flow of Oxygen into the generator to 6.5 lpm (liters per minute).
5. Verify that the delivery pressure P2 (adjusted in step 2) is stable at 20 psig. If it is not, increase the CDA feed pressure by 1 to 2 psig.
6. Using the pressure gauge PG3 located downstream of the Ozone Generator and upstream of the Needle Valve V1, verify that the back pressure P3 on the generator is stable and its value is larger than 15 psig. If the pressure is not greater than 15 psig, check the connections along the flow path from the CDA to the needle valve.

11 Optional Bulkhead Connectors

This option is available for Wall-Mount generators. This option provides for quick disconnect of the generator from the system, for maintenance purposes. Contact TAPI for details.

The picture below shows bulkhead connectors mounted on the bottom of the cabinet.



11.1.1 Wall Mount AC Power Inlet Connector (Bulkhead Connector Option)



This is the inside view of the mating connector. The terminals accept wire sizes up to 16AWG. Solder three wires as shown in the table below. Use heatshrink to protect against accidental shorts on the lines.

Note that the AC Generator operates on standard voltages and frequencies, from 90 to 240 VAC, 50/60 Hz, single phase or two phase. Use heatshrink to protect against accidental shorts on the AC power lines. Use wire types and colors that are approved for use in your area. TAPI recommends 600V insulated wire. All voltages in the table are nominal.

Type of Power	Phases	Input Voltage	A	B	C
American 3-Phase	2	208VAC	L1/L2/L3	L2/L3/L1	Earth
American 3-Phase	1	120VAC	L1/L2/L3	N	Earth
European 3-Phase	1	220VAC	L1/L2/L3	N	Earth

For two-Phase power, use any two phases, L1-L2, L1-L3, L2-L3.

For single-phase power, use any phase plus neutral, L1-N, L2-N, L3-N.

Note: this is a convenience AC outlet. It has been provided so customers can power an Oxygen Concentrator automatically when the AC Generator is turned ON. The contacts of the internal relay are rated for 250VAC 5A.

11.1.2 Wall Mount AC Power Output Connector (Bulkhead Connector Option)



This is the inside view of the mating connector. The terminals accept wire sizes up to 16AWG. Solder three wires as shown in the table below. Use heatshrink to protect against accidental shorts on the lines.

Note that voltages available are identical to the voltage input in the AC Power Inlet Connector. Use wire types and colors that are approved for use in your area. TAPI recommends 600V insulated wire.

Type of Power	Phases	Input Voltage	A	B	C
American 3-Phase	2	208VAC	L1/L2/L3	L2/L3/L1	Earth
American 3-Phase	1	120VAC	L1/L2/L3	N	Earth
European 3-Phase	1	220VAC	L1/L2/L3	N	Earth

11.1.3 Wall Mount Relay Output Connector (Bulkhead Connector Option)



The Fault and Ready relay contacts are wired internally to the bulkhead mate to this connector. The relay contacts are rated for 250VAC at 5A. Use heatshrink to protect against accidental shorts on the lines.

Use wire types that are approved for use in your area. TAPI recommends 600V insulated wire for this application.

Function	Pin
Fault Normally Open (NO)	A
Fault Common (C)	B
Fault Normally Closed (NC)	C
Ready Normally Open (NO)	D
Ready Common (C)	E
Ready Normally Closed (NC)	F

11.1.4 Wall Mount Control Input Connector (Bulkhead Connector Option)



The control inputs are wired in pairs. Except for the Analog Input, each pair is activated by connecting them together, with a relay contact from a PLC, for example. The contacts are rated for 22AWG wire, low voltage (24V). Use heatshrink to protect against accidental shorts on the wires.

The Analog Input pair accepts either a 0-10V signal or a 4-20mA signal. One pair of inputs is used to tell the Ozone Generator which input type is being used (4-20mA Enable).

Refer to the manual for a detailed explanation of the functions of the control inputs.

Function	Pins
Ozone ON	Connect A & B
Forced Remote	Connect C & D
Local Setpoint Enable	Connect E & F
Analog Input	G (+) & H (-)
External Interlock	Connect J & K
4-20 mA Enable	Connect L & M

Note: 4-20mA Enable and External Interlock may be connected on the internal DIN Rail.