evoqua
WATER TECHNOLOGIES

PACIFIC OZONE™
an evoqua brand

ADVANCED DISINFECTION

Introducing our Portable Ozone Disinfection Solutions

PC Mobile Ozone System

Complete Systems

O_2	O_3	MT	CN

- Industrial Mobile Design w/High Concentration
- 2-4 ppm Capacity
- Ozone Generator 18 or 30 g/hr alternatives
- Oxygen Concentrator (medical grade)
- Air Compressor (Oil-Free)
- Booster-Injection Pump
- Complete injection-System (gas-to-liquid mass transfer)
- Off-gas management w/O3 Destruct System
- Security water backflow prevention
- Full Instrumentation & Control Panel
- Accessories such as hose w/nozzle available
- Completely assembled, configured, QC tested, and ready for installation

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Technical Specifications

Model/ Part Number	Max. Ozone Production	Max. Ozone Concentration	Max. Reactor Pressure	Feed Gas Flow Range	Water Inlet & Outlet Fittings	Power Consumption	Air Cooling	Dimensions (HxWxD)	Weight
	lbs./day (grams/hour)	% weight	psig (bar)	scfh (lpm)	inches (mm)	watts	scfm (lpm)	inches (mm)	lbs (kg)
PC16/ R-PC161 (115V 60Hz) R-PC162 (230V 60Hz) R-PC163 (115V 50Hz) R-PC164 (230V 50Hz)	0.8 (16)	6%	12 (0.8)	7-15 (3.3-7.1)	1.5" (38.1) Sanitary Fitting	1750	240 (6796)	46.4x22.1x55.0 (1179x561x1397)	210 (95)
PC25/ R-PC251(115V 60Hz) R-PC252 (230V 60Hz) R-PC253(115V 50Hz) R-PC254 (230V 50Hz)	1.3 (25)	6%	12 (0.8)	7-15 (3.3-7.1)	1.5" (38.1) Sanitary Fitting	1820	240 (6796)	46.4x22.1x55.0 (1179x561x1397)	215 (98)

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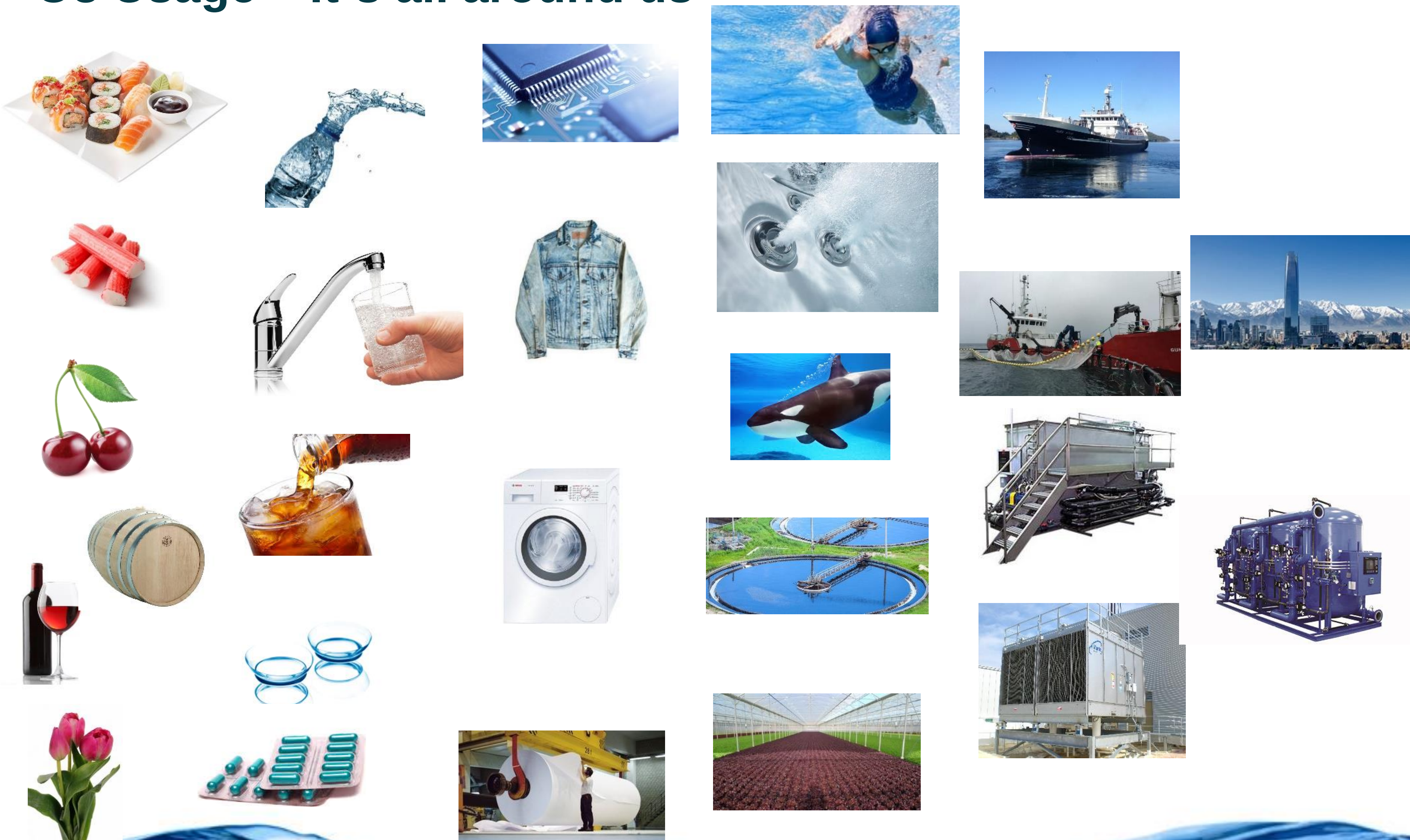
FCB-5
FCB-5

O3 Usage – It´s all around us



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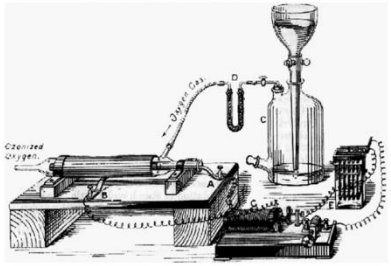
O3-History



THE WALLACE & TIERNAN STORY
By M. F. Tiernan

The association between C. F. Wallace and myself began in New York about the middle of 1909. Wallace, an electrical engineer with practical experience - which started with digging post holes for telephone lines - got a job with the Gerard Ozone Process Co., a manufacturer of machinery for producing ozone. I came to New York about two weeks before Wallace's arrival, from Pittsburgh, where I did laboratory work for the Pittsburgh Typhoid Fever Commission. The Gerard Co. hired me as a chemist. I had graduated from the University of Rochester in 1906 and my first job was at the Rochester Water Works on a reservoir job. Wallace and I lived together in New York and this was the beginning of an association which is now of nearly 40 years duration.

Discovery Phase

1932 Used as a disinfectant

1909 Used to preserve food

1896 Nicola Testla designs & patents O3-Generator

1893 Used to treat drinking water

1857 Werner von Siemens built the first superior induction tube

1840 Schonbein names ozone

1785 Martinus van Marum "discovers" Ozone

Development Phase

1986 Pacific Ozone gets established

1986 Adoption by EPA of CT Values

1982 FDA approval O3 in Bottled Water

1979 IOA formed

1970 Used in Bottled Water

Commercialization Phase

2018 – Evoqua acquires Pacific Ozone

2007 – Accelerated adoption ongoing

2001 – FDA approval food contact

1997 – Declared GRAS

1996 – USDA approval as disinfectant

1989 – Companies enter market

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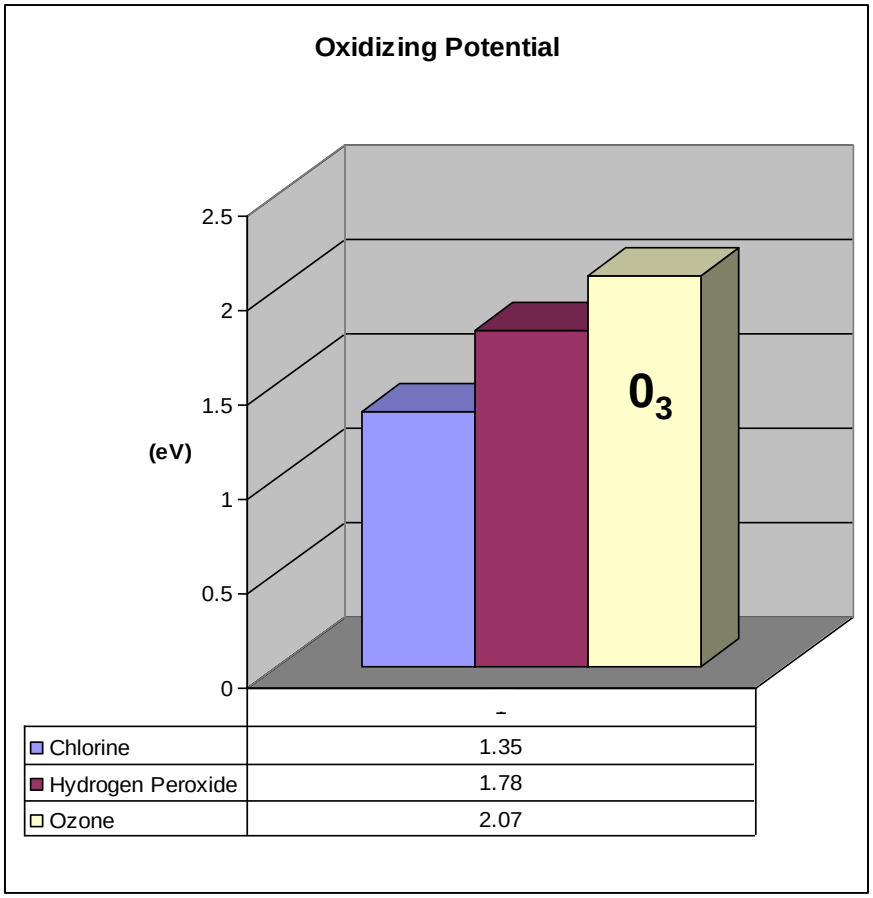
What is Ozone?

- Ozone (O_3) is tri-atomic oxygen
- The highly reactive product of energy (electricity or UV) disrupting O_2 molecules
- Most powerful commercially available oxidant



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Why Ozone is the Most Powerful Advanced Disinfection Technology?

Three Simultaneous Reactions

- **Oxidation**
  - Breaks cell walls
  - Precipitates suspended molecules
- **Disinfection**
  - Kills bacteria, viruses, molds, cysts, parasites
  - Effective against all common food borne pathogens
- **Decomposition**
  - Decomposes to oxygen

Ozone lysis of *Giardia*

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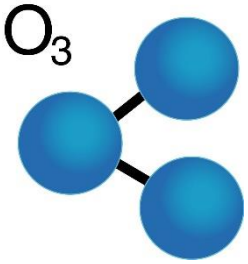
Ozone Explained…



- It is 12,5 times more soluble in water than O2
- It leaves no residuals or byproducts except O2 and a minimal amount of carbon dioxide and water
- O3 quickly oxidizes and removes colors in water
- O3 removes odors by reacting and destroying the offensive smelling particulates, molecules and bacteria
- **O3 acts both a coagulant and Flocculant**

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Benefits of Ozone
Superior Disinfection Results
More Process Uptime
Requires Less Maintenance
Less Expensive Than Hot Water Sanitization
More Cost Effective Than Chemical Sanitization
Ozone Generated On-Site (No Storage)
Rapidly Reaches All Wetted Part of Water System
Quick and Seamless Integration

SIMPLE. PROVEN.
OZONE TECHNOLOGY.

evoqua WATER TECHNOLOGIES

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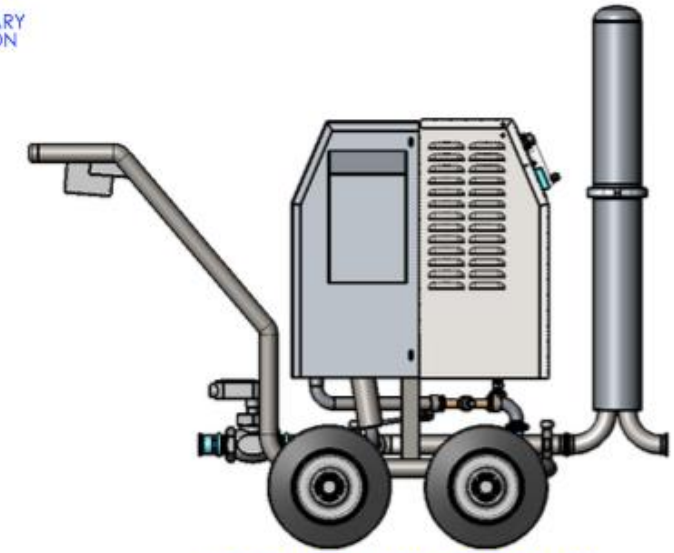
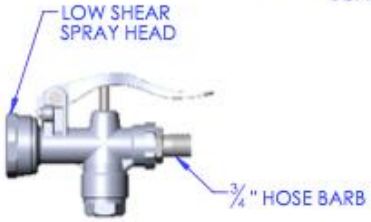
Integrated Contact Systems

IPA470 - 25' HOSE WITH SPRAY NOZZLE KIT

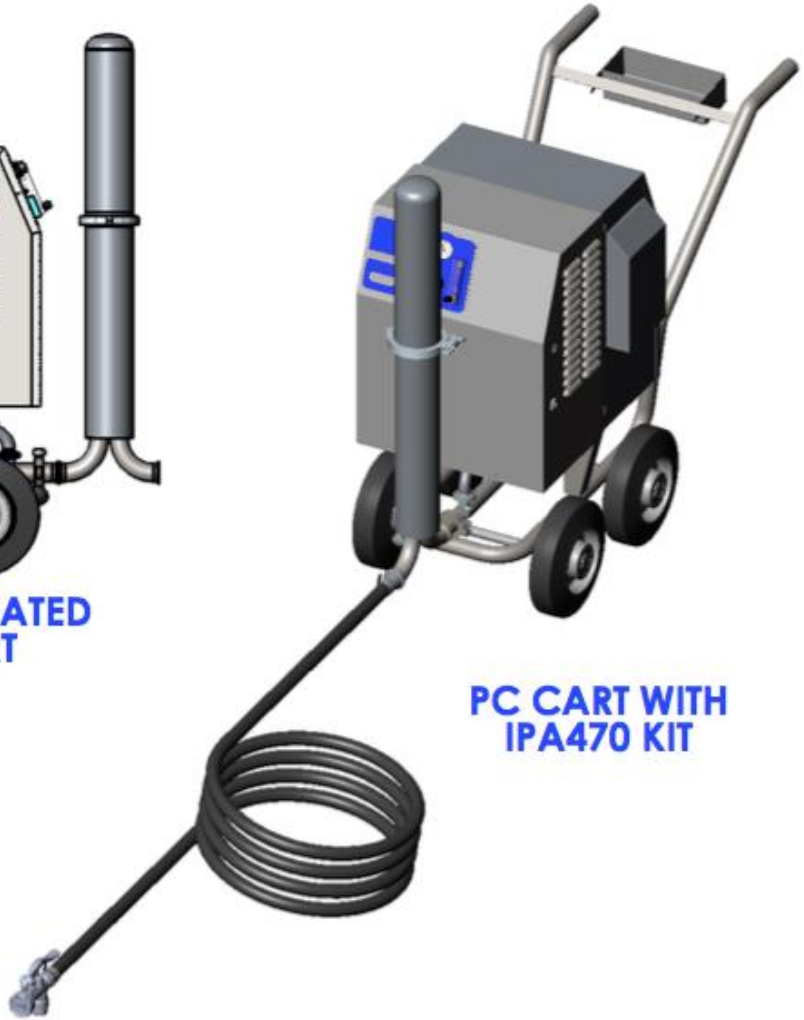


PC16/25 INTEGRATED OZONE CART
SCALE 1:10

IPA452- 25' x 1-1/2" HOSE WITH SANITARY FITTINGS



ASR165 NOZZLE ONLY
SCALE 1:4



PC CART WITH IPA470 KIT

PROPRIETARY AND CONFIDENTIAL THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF PACIFIC OZONE TECHNOLOGY. ANY REPRODUCTION IN PART OR WHOLE WITHOUT WRITTEN PERMISSION IS PROHIBITED.	DRAWN BY: Ken Blanchard APPROVED BY: ~	DATE: 6/4/09 DATE: ~	DESCRIPTION: **PC CART INTEGRATED OZONE SYSTEM** SCALE: 1:10 DWG. NUMBER: L-1292 REV: 001 SHEET 1 OF 1	PACIFIC OZONE™ 6160 EGRET COURT BENICIA, CA 94510 USA (707) 747-9600

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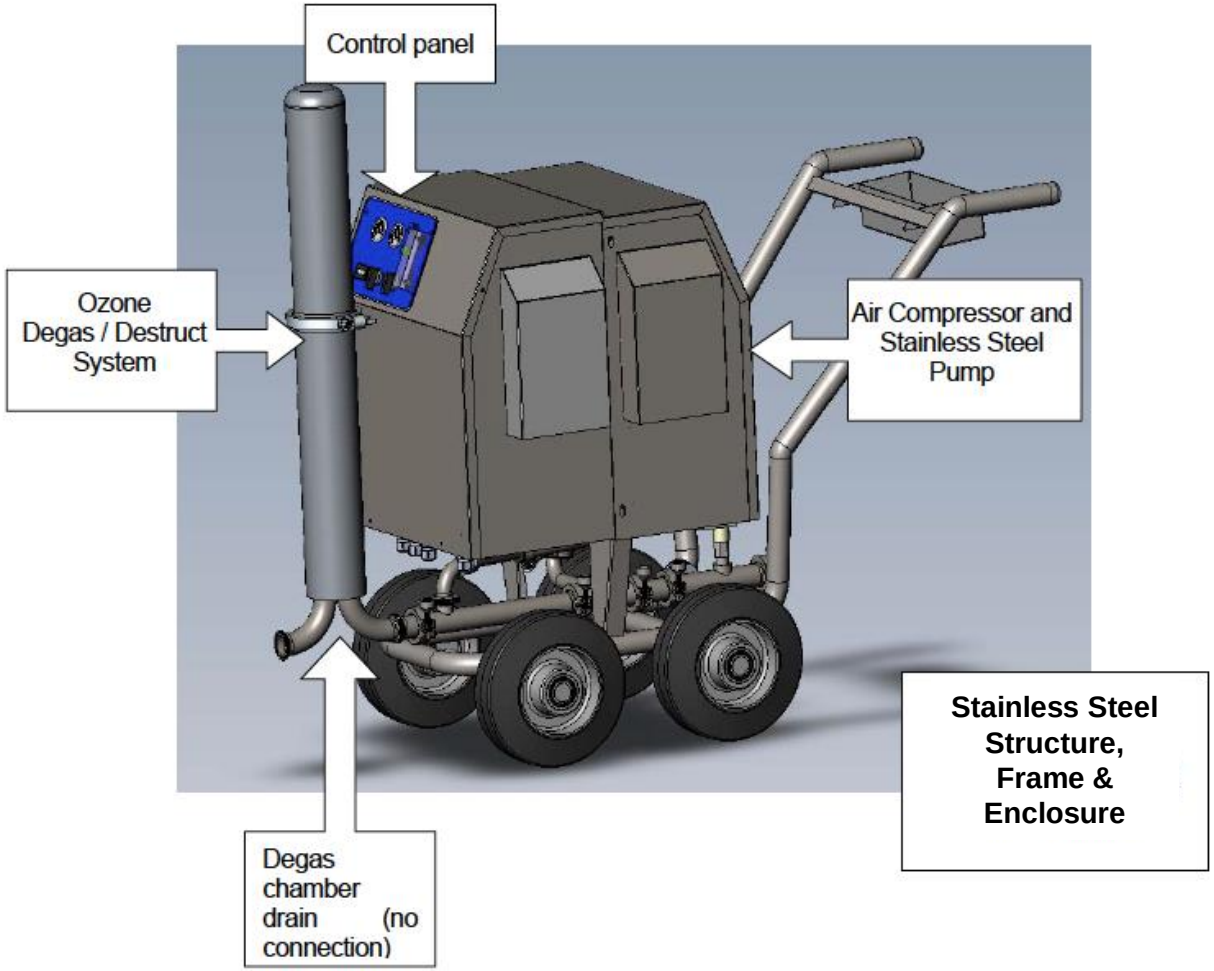
PC Mobile Ozone System

External Layout



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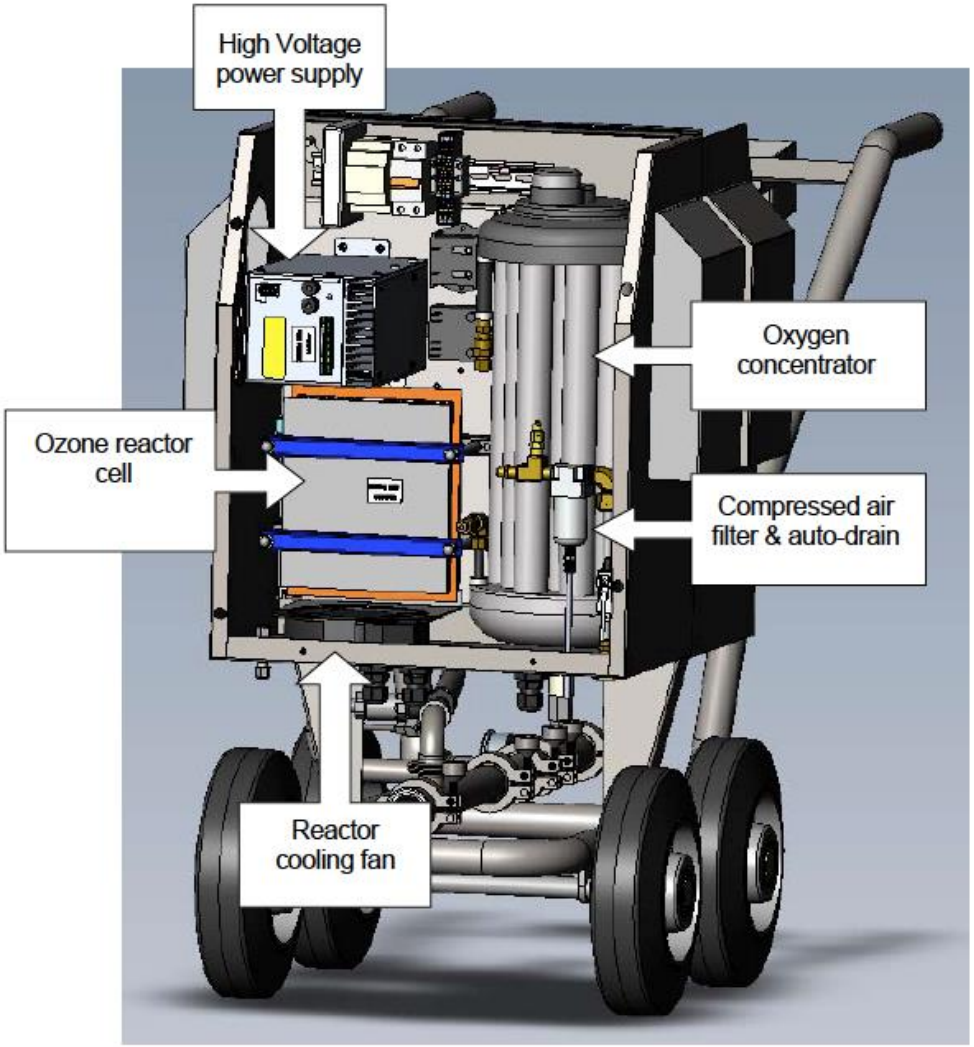
PC Mobile Ozone System

Internal Layout 1



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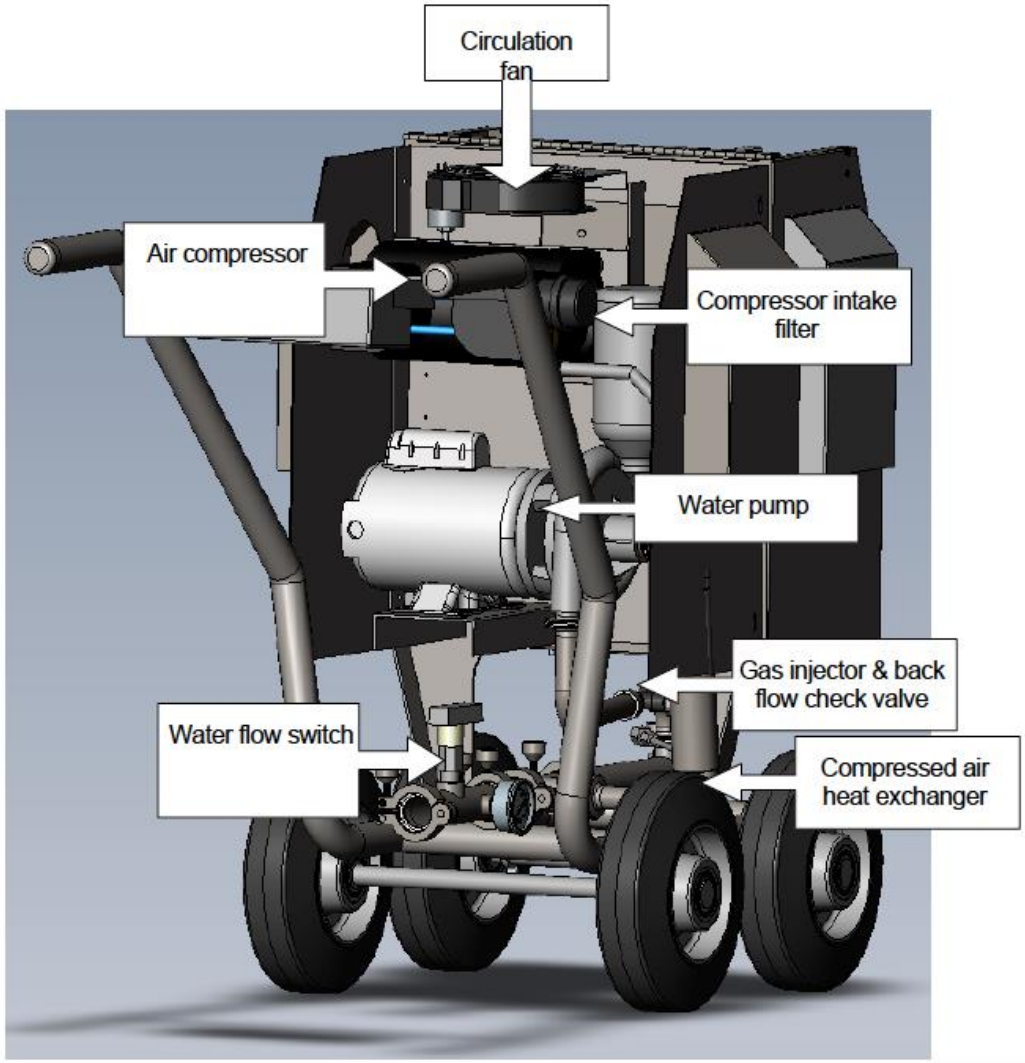
PC Mobile Ozone System

Internal Layout 2



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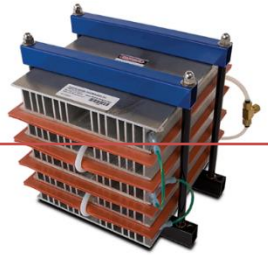
Fundamentals of Ozone

Commercialized Corona Discharge Ozone System

Components required in all ozone applications

O_2	O_3	MT	CN
			
Feed Gas / Air Prep	Ozone Generator / Reactor	Gas / Process Management	Control / Safety

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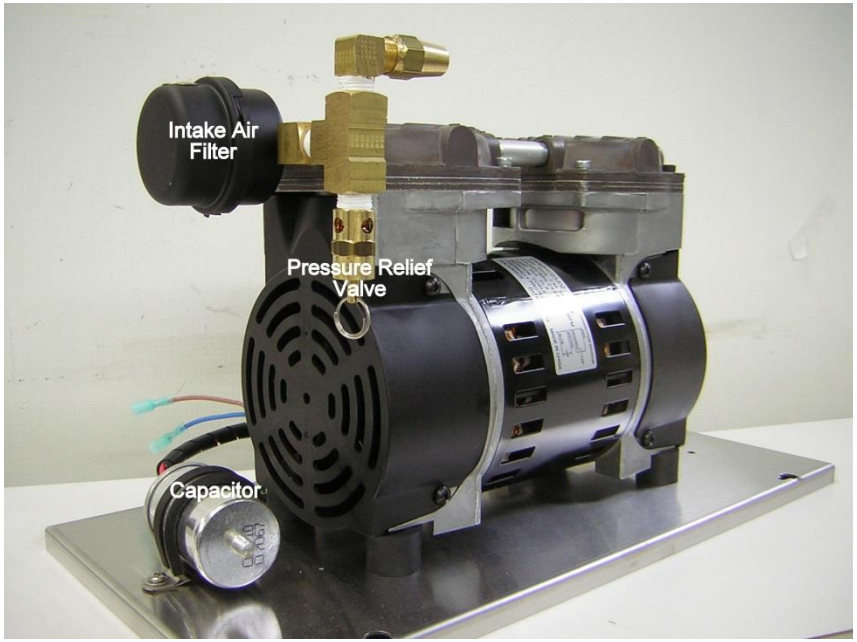
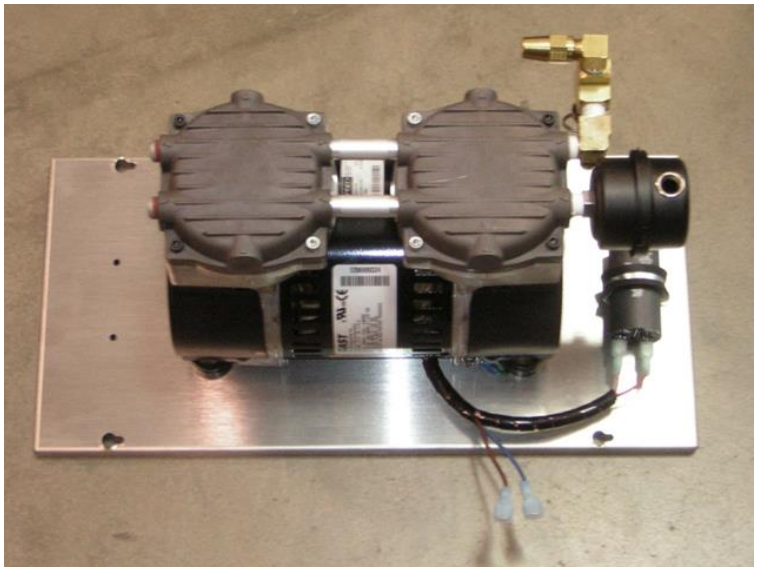
The Air Compressor





- 100 psi / 7 bar capacity
- 3 cfm / 85 lpm
- 0.25 kW
- 230 50Hz / 115v 60Hz
- Oil Free Operation
- 10,000 – 12,000 hrs. before service
- Rebuild Kits are available
- Can be rebuilt in 30 minutes or less
- Relief Valve @ 30 psi

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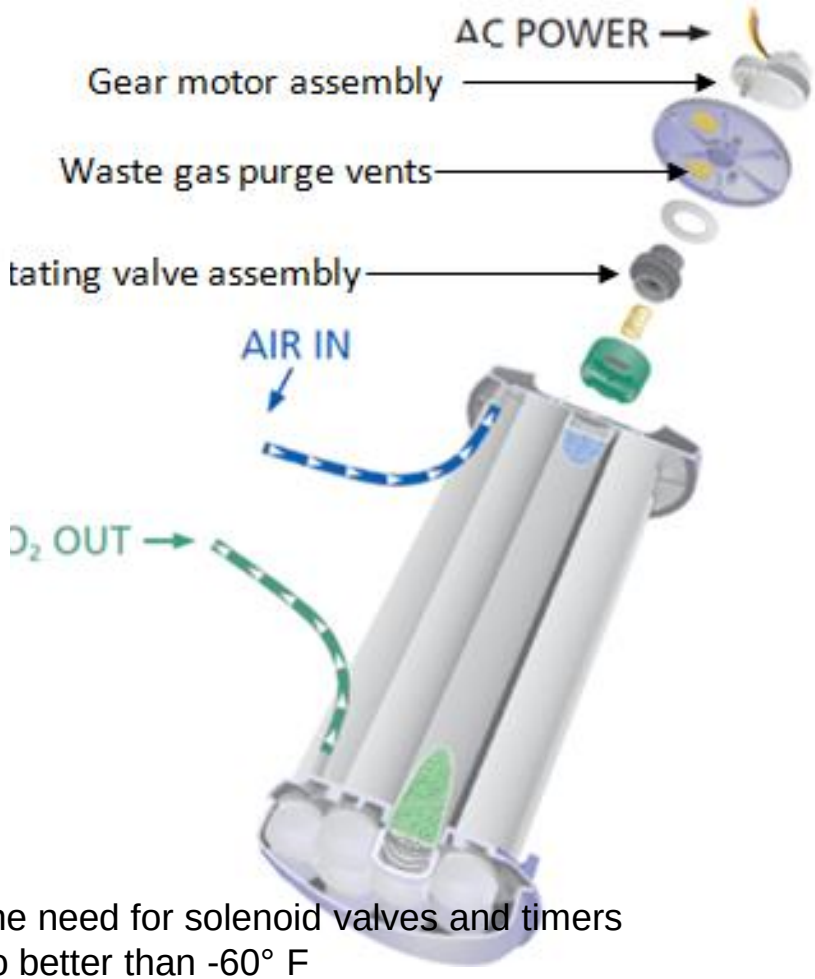
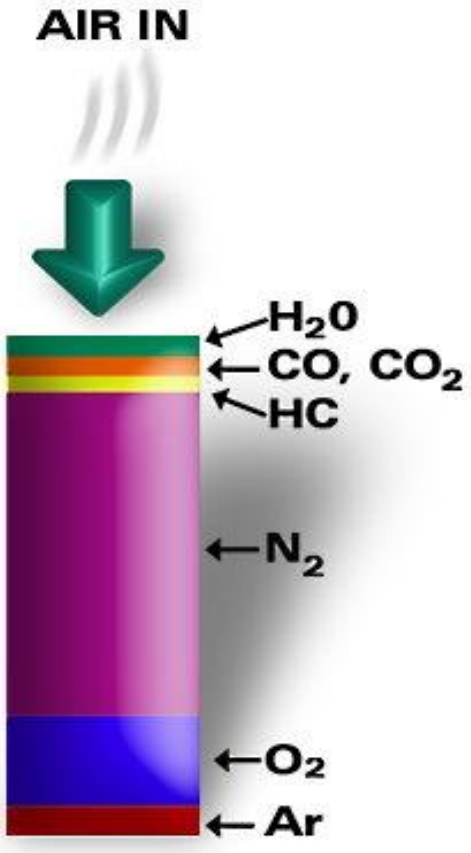
The Oxygen Concentrator





- Patented Technology
- Rotary valve eliminates the need for solenoid valves and timers
- Reduces gas dew point to better than -60° F
- Leaves high purity oxygen (>90%)
- Factory exchange program

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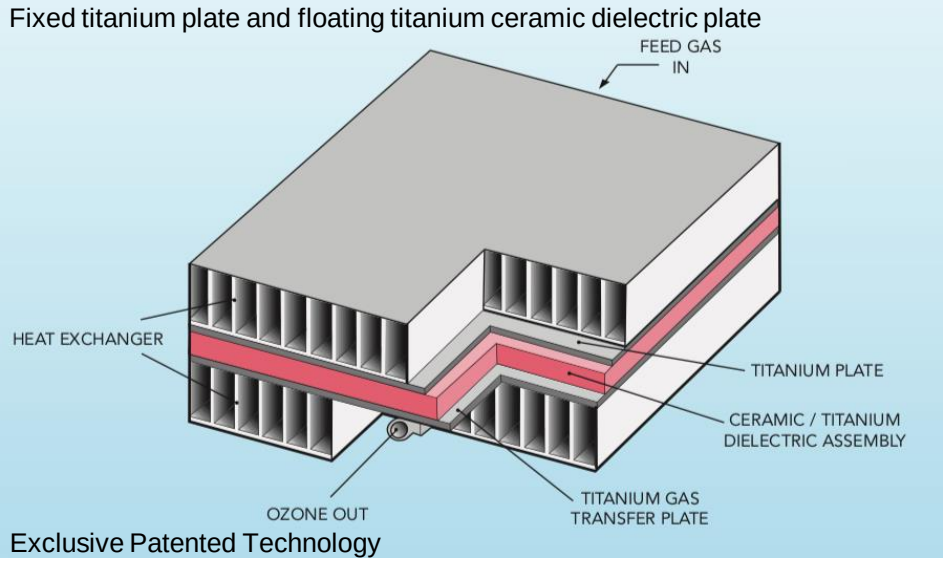
The Pacific Ozone Reactor Cell

THE HEART OF PACIFIC OZONE SYSTEMS IS OUR PATENTED FLOATING PLATE TECHNOLOGYTM (FPTTM) IN THE OZONE REACTION CELLS.

Floating Plate Technology™



In the FPT reactor cell, an electric field is created across an ultra-narrow gap between a fixed titanium plate and a floating titanium- ceramic dielectric plate.
The ultra-narrow gap of our patented FPT reactor cells increases the efficiency of the ozone generation module.
The smaller the gap between the plates, the less energy required to generate ozone
Ultra-narrow gap means Lower voltage, power consumption, and heat generation
Virtually impervious to the stresses of heat, pressure, and vacuum of corona discharge ozone generation
Air cooling: Simplifies installation and operation, Lowers complexity and cost, Increases reliability
Non-rigid electrode connection

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Gas-To-Liquid Mass Transfer (Pump-Injector) Basic Setup

- Dissolves ozone gas into water using a venturi and pressure differential
- Pressure differential of approximately 30 PSIG is required to produce suction
- Injector-Pump provides pressure drop across injector
- Use pressure gauges before and after injector to verify pressure differential
- Use **check valves** to prevent water from backing into ozone generator

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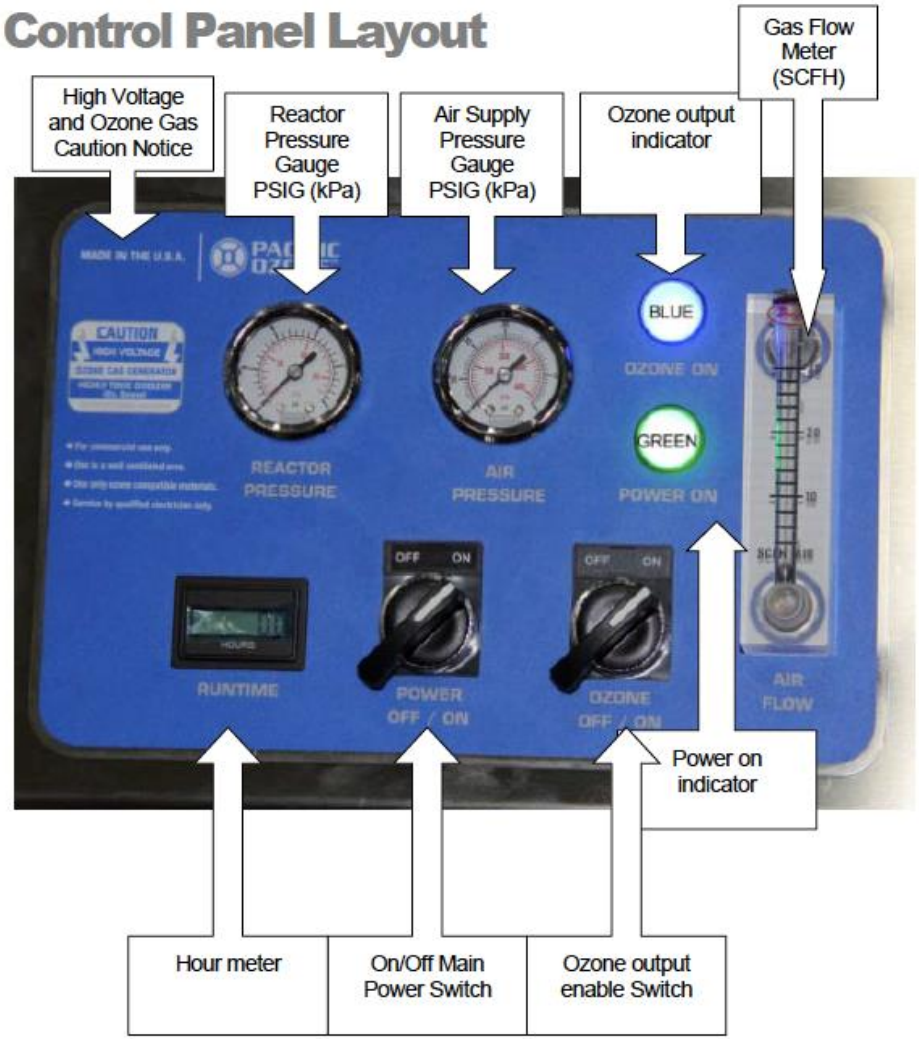
PC Mobile Ozone System



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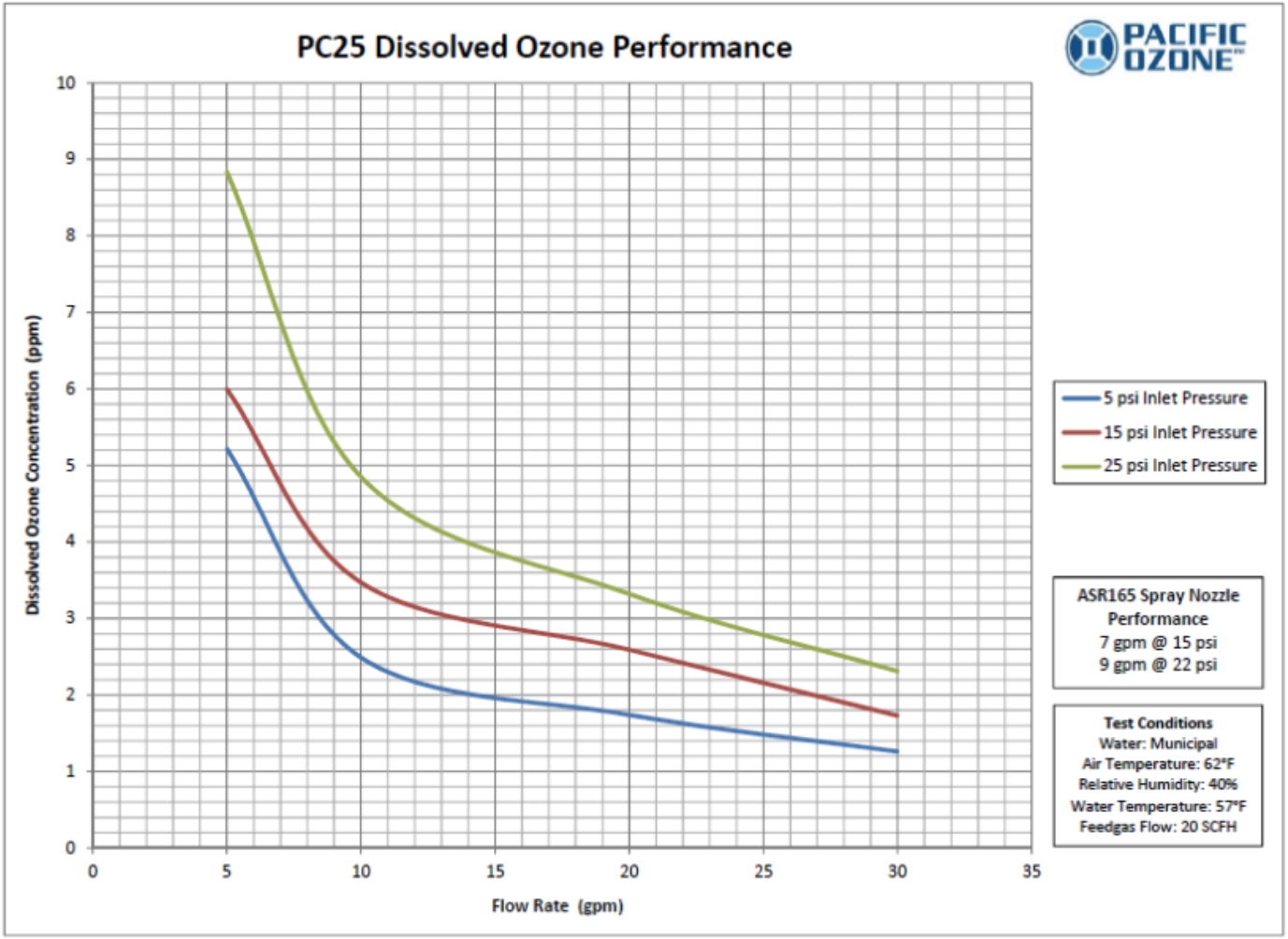
Performance – PC25

PC Mobile Ozone System



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PC Mobile Ozone System

Maintenance Item	Weekly	Monthly	Quarterly	Annually
Reset destruct catalyst bag in degas separator (PC series only) Reset as needed				
Inspect external filter elements	●			
Inspect internal filter elements	●			
Clean water traps and/or auto drains	●			
Zero and calibrate dissolved ozone sensor(s)	●			
Replace external filter elements		●		
Replace Internal filter elements		●		
Clean machine interior surfaces		●		
Clean cabinet fan screen		●		
Replace membranes and electrolyte on dissolved ozone sensor(s). For concentrations <0.5 ppm sensor should be rebuilt every 4-6 months. For concentrations >0.5 ppm sensor should be rebuild more frequently			●	
Inspect and clean ozone reactor cell exterior			●	
Clean power supply heat transfer surfaces			●	
Inspect and clean power supply cooling fan			●	
Inspect and clean ozone reactor cell cooling fan			●	
Test ambient ozone sensor for o3 detection			●	

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PC Mobile Ozone System

Maintenance Item	Weekly	Monthly	Quarterly	Annually
Inspect and clean (or replace) back-flow check valves				●
Inspect all wire termination points				●
Calibrate sensor on ambient ozone gas detector				●
Test or replace pressure relief valve				●
Test oxygen concentrator purity				●
Replace power supply cooling fan*				
Replace ozone reactor cell cooling fan*				
Rebuild internal oil-less compressor, including mounting feet replacement[t]				
Maintain PSA air dryer[y]				
Replace oxygen concentrator (when purity drops below 80%)				
Replace auto-drain float in polishing filter (every 2-4 years depending on water load)				
Replace dissolved ozone sensor (Every 2 years for concentrations >2 ppm and every 4 years for concentrations <1 ppm)				
Rebuild ozone reactor cell (every 45,000 to 50,000 hours)				
Replace sensor on ambient ozone gas detector (every 3-5 years, as required)				

**Estimated MTBF (mean time between failure) is 20,000 hours; suggest changing at 15-18,000 hours*
[t] Recommend rebuild every 10,000 to 12,000 hours
[y] Recommend rebuild/replacement every 3-5 years if filters are properly maintained

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Markets and Applications

Beverage

Applications:

- Clear & Near Clear (BW)
- Product water process
- Clean-in-place (O3-CIP)
- Tank, equipment sanitization
- Bottle and cap sanitizing
- Source water treatment
- Equipment and surface sanitization

Summit Series

PC Series

High Purity Water

Applications:

- Storage & distribution system sanitization
- High-purity water production
- Surface and equipment sanitization
- Clean-in-place (O3-CIP)

Horizon Series

PC Series

Food

Applications:

- Equipment and surface sanitization
- Fresh produce & fruit sanitizing
- Meat & Seafood sanitization
- Continuous loop process

Tank Platform

PC Series

Aquaculture

Applications:

- Bio-security
- Incoming water treatment
- Wastewater management and disinfection
- System sanitization
- Product Processing
- Marine and on-board

M Generator Series

PC Series

Industrial Water

Applications:

- Cooling and boiler water treatment
- Industrial water production
- Textile manufacturing
- Industrial laundry

SGA Gen/Sys Series

PC Series

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Beverage and Bottled Water SUMMIT-SERIES

90% of Bottled Water worldwide is disinfected with ozone

- **Improve taste, odor & color while disinfecting product water**
- **Disinfection of bottles prior to filling**
- **Disinfection of bottling equipment**
- **Disinfection of bottle & cap**
- **Disinfection against airborne microorganisms in the air gap**

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Fruit & Vegetable Washing

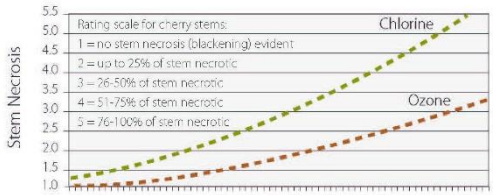
Rinsing with Ozonated (Flume) Water to reduce improve quality, shelf life and reduce chlorine usage

Typical Dose rate 0,2 – 1,2 ppm

Summit series

CONTROL OF CROSS-CONTAMINATION	Limited due to required long exposure times	Effective control via short exposure times
RESISTANCE ISSUES	An ongoing problem	None
RESIDUE ON PRODUCE	May adhere to surface or be absorbed into cut ends of product. Leaves stems brown	Ozone reverts to pure oxygen leaving no residue. Preserve green stems
SENSORY ASPECTS OF PRODUCE	Salts may burn treated product. Absorption may effect taste and appearance	Ozone maintains fruits taste, texture and smell characteristics, greener stems, higher fruit pressures
WORK ENVIRONMENT	Strong/irritating odors can permeate the work space	Proper system design mitigates any odors
REGULATORY OVERHEAD	Increased water discharge costs and scrutiny	None
CORROSIVENESS	Can corrode equipment	No issue with a properly designed solution

BRIGHT GREEN STEMS



Ozone preserves bright-green cherry stems.

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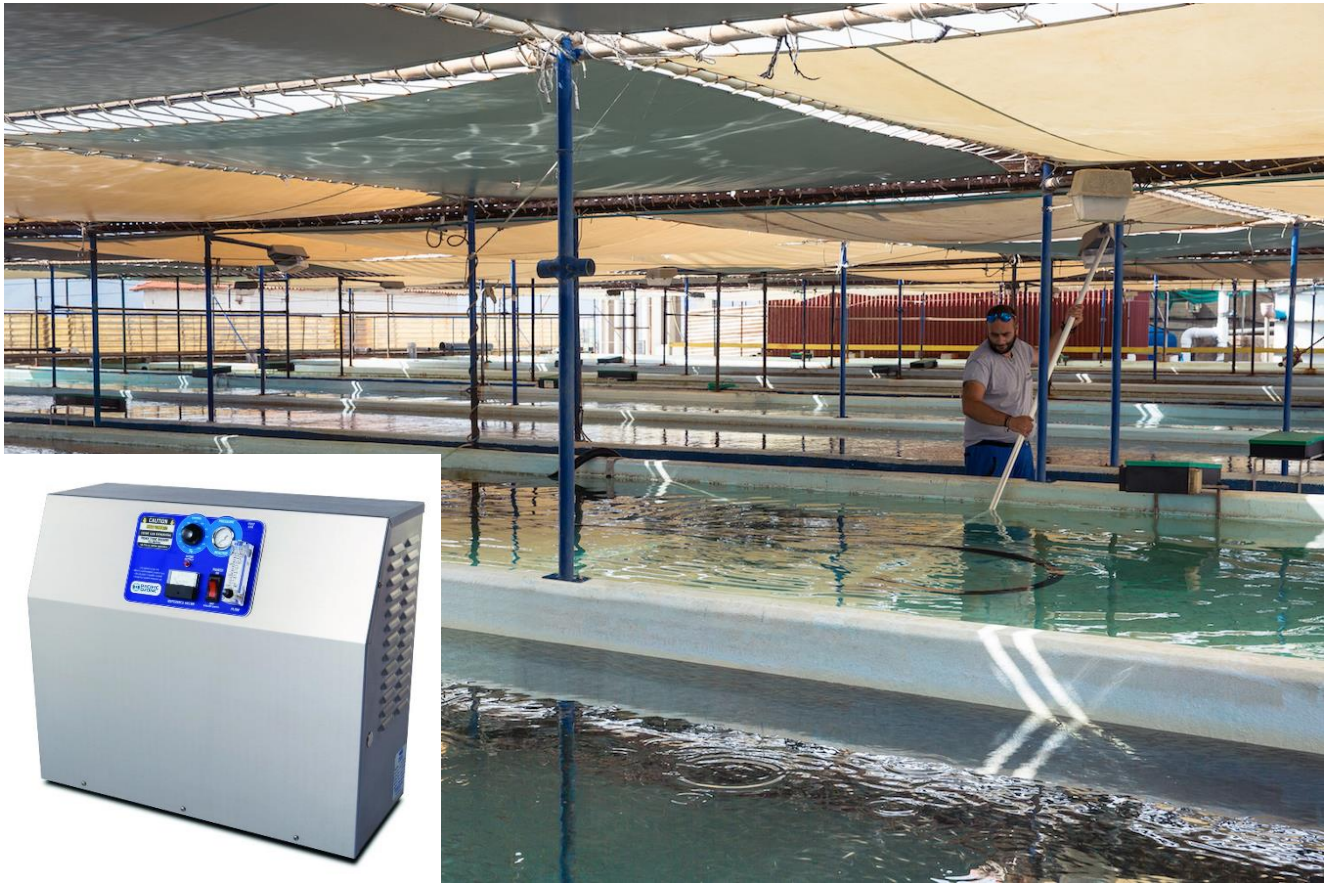
Aquaculture - Fish Farming



NIREUS AQUACULTURE

CERMAQ

Grieg Seafood®

MOWI

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Industrial Water Treatment

Personal Products
Aveda
Hair and body care products make-up water.

Consumer Products
Procter and Gamble
Process water treatment for Swiffer®

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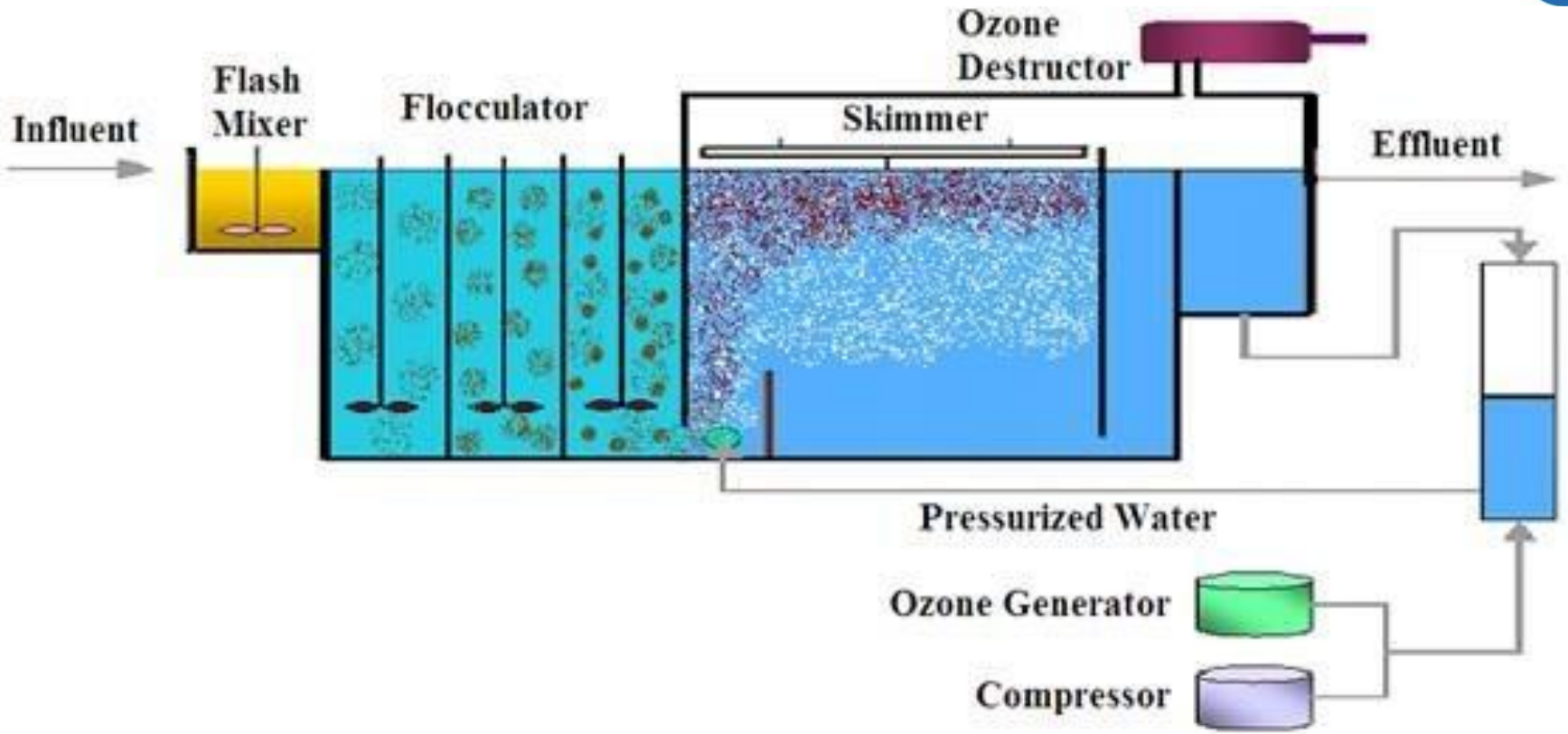
Wastewater Treatment by Dissolved Ozone Flotation / DOF



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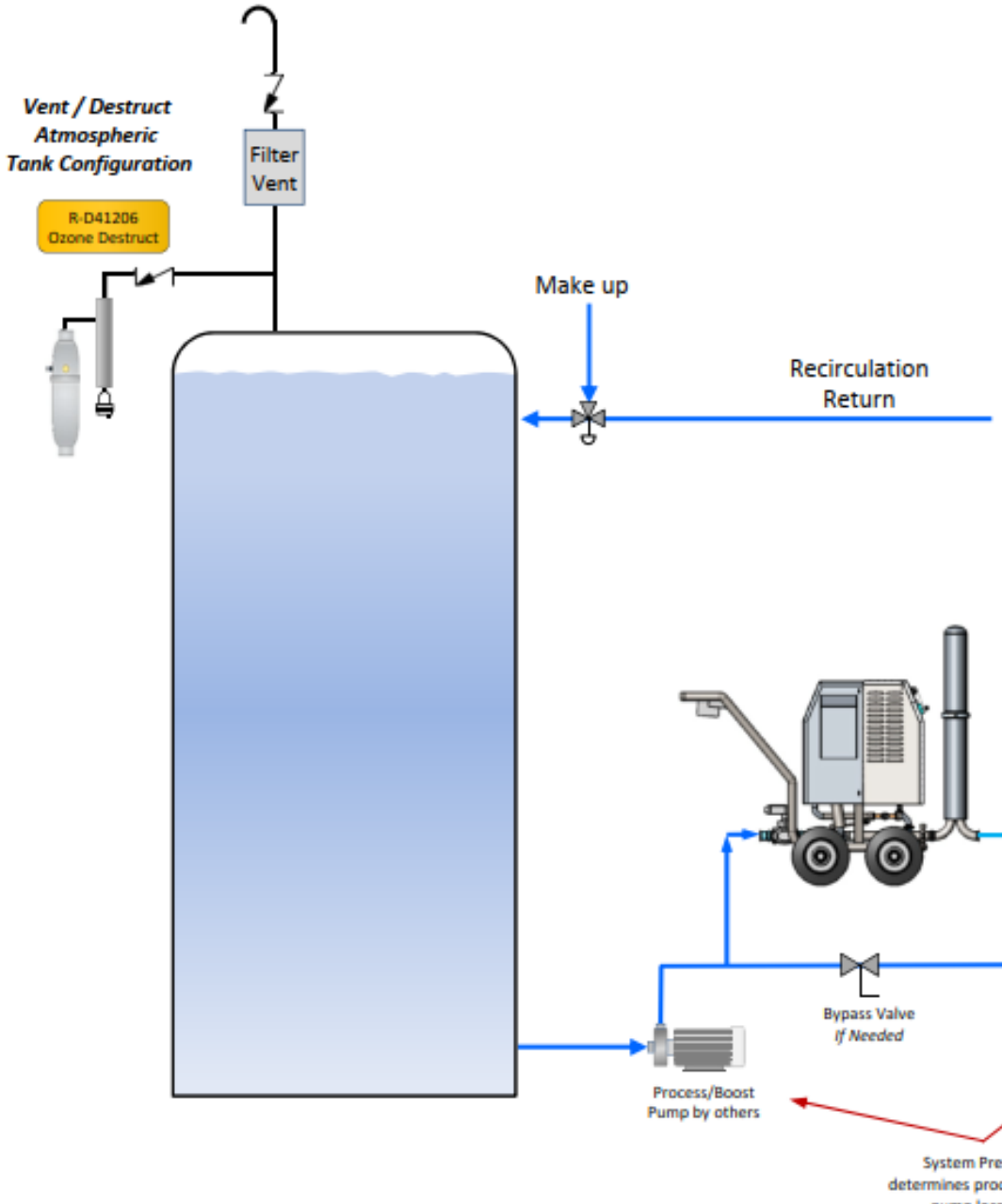
Sanitizing/Disinfection

w/ Portable Cart

Process Loop Bypass Arrangement

Vent / Destruct Atmospheric Tank Configuration



Application information needed:

- Tank pressure _____
- Tank Dimension _____
- Operating Fill Level _____
- Process pump GPM _____
- Line pressure _____
- Line size _____
- Line length _____

Standard Cart details:

- 1.5" Sanitary inlets
- Recirculate up to 30gpm
- Water feed pressure 20 to 30 psi.
- No Dissolved ozone controls
- No Ambient ozone controls
- Power requirements 230 or 115v 1Ø

PORTABLE OZONE

PC2510203

Recirculation Set Up Shown w/ Accessories

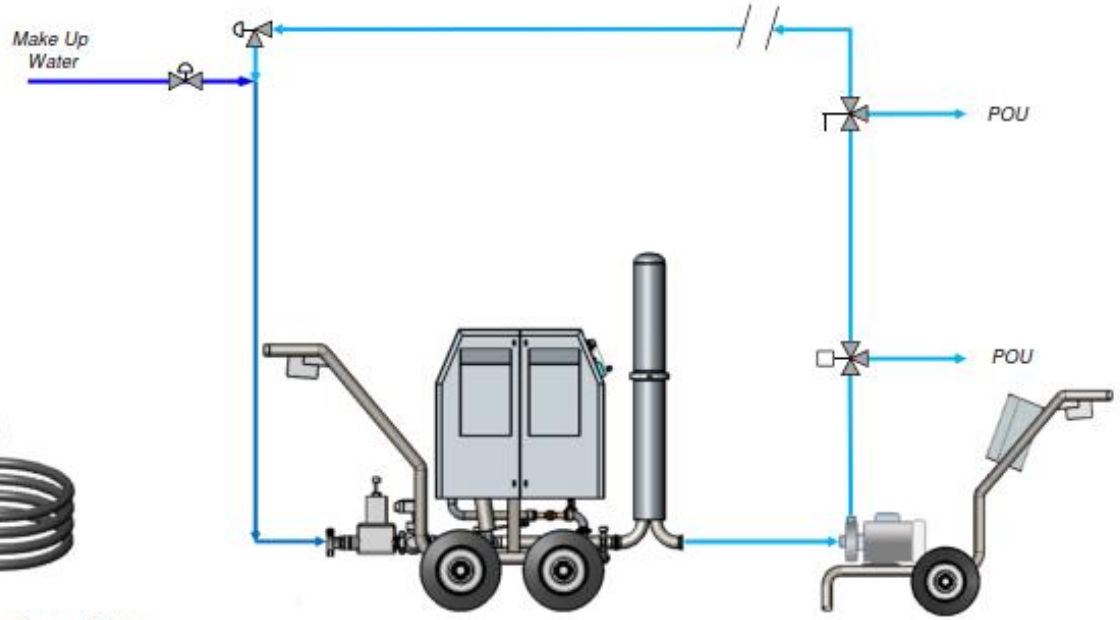
Process or Pressu
Boost Pump
by others

Note:
System balance and pressure to be constant
Balance Valve, POU Valves and Recirculation Pump by others
Contact Pacific Ozone Engineering for system max flow
Water pressures from 10 to 30 PSI

25' Hose w/ 1.5" tri clamp adapter and Spray Nozzle
IPA 470

10' Hose w/ 1.5" tri clamp adapter and Spray Nozzle
IPA 192

Nozzle Only
ASR 165



Note: no measurable pressure drop passing through the Portable Ozone Cart

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VISTA OZONE DISINFECTION SYSTEM

Portable Compact and Complete O3 System

Bypass Arrangement Shown

Trade Organizations, Affiliations & Regulatory Approvals

International Ozone Association

Pan American Group (PAG)

Your Worldwide Ozone Resource

We're only beginning to discover ozone's potential. As a powerful disinfectant with a positive environmental footprint, ozone is used worldwide to improve how we live.

Learn more

The International Ozone Association is a nonprofit educational and scientific organization dedicated to the collection and dissemination of information on, and to promote research in, any and all aspects of ozone and related oxygen species technologies. As a member, you'll gain access to the most cutting edge information on ozone technology.

- Ozone: Science & Engineering
- Ozone News
- Conferences

OZONE NEWS

The Newsletter of the International Ozone Association

EUO3TA.org European Ozone Trade Association

- FDA Direct Food Contact
- USDA Disinfectant
- EPA Sustainable Technology Platform
- USDA Organic Guidelines
- Approved for Halal Processing

Int. Society for Pharmaceutical Engineering (ISPE)
Typical ISPE Good Practice Guide Ozone Sanitization of Pharmaceutical Water Systems

- 20~200ppb continuous normal dissolved ozone concentration in storage tank
- ≥ 50ppb periodic/loop sanitization up (250ppb typical)
- 200~2000ppb biofilm removal (time dependent)

European Agency for Evaluation of Medical Products:

- "routine sanitization using ozone…essential to prove that the agent has been removed…ozone effectively removed using UV."

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Technical Support

Prompt Factory Technical Support + Factory Trained Partner Technicians

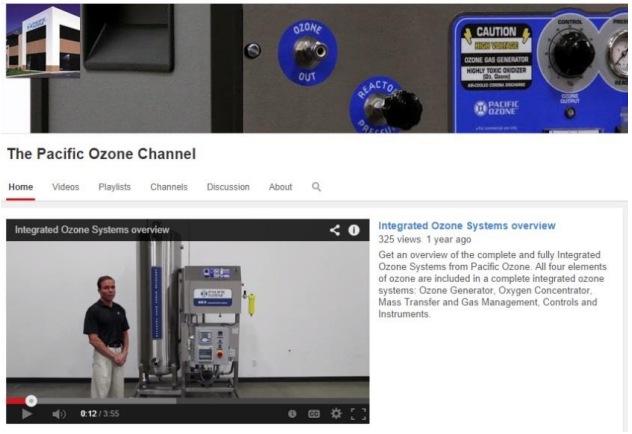
Technical support is available by telephone directly from Pacific Ozone at **(707) 747-9600**. When calling, please be prepared to provide the following information:

- Model number
- Serial number
- Brief description of equipment issue
- Line voltage
- Inlet air quality and flow
- Water source, quality and incoming pressure and flow rate
- Location ventilation
- Number of hours per day the machine is used & length of time t

Requests for parts or service may also be faxed to **(707) 747-9209** or sen

Response Now Service

Technical Service Videos



Online Technical Support

Technical Online Support is available through the Pacific Ozone web site at www.pacificozone.com/support Registered users will have access to:

- Basic start up procedures
- Troubleshooting guides
- Product specifications
- Service bulletins

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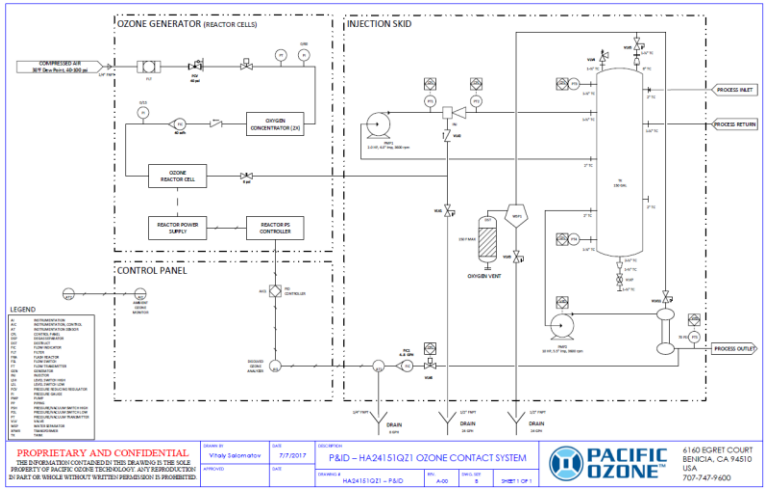
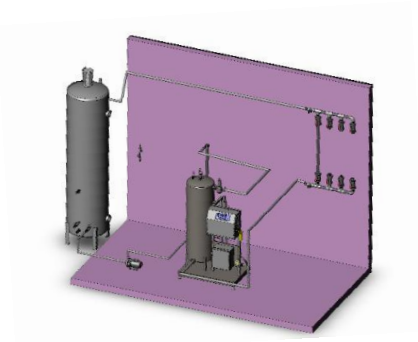
Commissioning & Qualification

Complete wet test facilities* with full suite of ozone analysis instrumentation and test equipment.





** FAT's, training and customer qualification*

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BUSINESS

Ozone Generation Market is Set to Experience Revolutionary Growth by 2026

Global Ozone Generation Market was valued US$ $830.54 in 2017 and is expected to reach US$ $1600.26Mn by 2026, at a CAGR of 8.55 % during a forecast period

…Asia Pacific region is projected to lead the global ozone generators market

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PC Portable Ozone Generator Systems for Surface Disinfection

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Thank you!

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