OZONE GENERATORS

Standard Equipment:

- Models available for Ozone production rates of 65 & 130 grams per hour.
- Medium frequency, ***Cold Cathode*** Corona Discharge
- Self-fusing glass tube dielectric
- Water cooled, stainless steel, vertical "tube in shell" generator module
- Integral Oxygen Concentrator/Compressor Subsystem
- Computer controlled with LCD interface panel
- 4-20mA Control
- Variable output
- Complete Ozone isolation during shutdown
- Auto feed-gas flow control to maintain vacuum
- Ammeter for ozone module power
- White powder-coated steel enclosure built to NEMA-12 specs
- Emergency power shutdown
- Contacts for remote:
  - Ambient ozone monitor shutdown
  - User interlock
- Fault protection from:
  - Water backflow
  - Door open
  - Loss of cooling water flow
  - Feed-gas pressure failure
  - Loss of vacuum or over vacuum
  - Overheating on generator & power supply
  - High Ambient temperature

Accessories and Optional Equipment:

- Ambient Ozone monitor / controller
- Dissolved Ozone monitor / controller
- Mixing / Degassing tower
- Contact / Degas tanks
- Degas valves
- Catalytic Ozone destruct units
- Dry Tap™ Sensor Port
- Mazzei® Injectors
- Injector Assemblies
- Flow Splitters
- Closed-loop cooling
- Flow switches
- Booster pumps

Specification:

I. Ozone System

A. General Description

1. The ozone system shall consist of a modular package incorporating an ozone generator, oxygen concentrator, injector, mixing/reaction/degassing tank, off-gas destruction, and ambient ozone monitor.

2. The ozone generator shall be of the corona discharge type. No ultraviolet ozone generation systems will be allowed.

3. For safety purposes, ozone generation and conveyance to the water stream will be kept under vacuum at all times (except on pressure models).

4. Ozone will be generated using oxygen feed gas as supplied by an integrated oxygen concentrator. The oxygen concentrator shall be capable of delivering the rated flow rate of 85% (min.) pure oxygen and maintaining at all times a dewpoint of minus 70°C or lower.

5. The Ozone generator system shall be **DEL Ozone** Corona Discharge, model _____ with an ozone output of _____ grams per hour at a minimum concentration of 5.5% by weight at a flow rate of _____ scfh (see Table 1 or shop drawings.)

B. Listings

1. Ozone generator and all components shall be UL/CUL classified for electrical safety and output standards. *
2. Ozone generator, reaction tanks, mixing towers, and injectors shall be NSF listed, Standard 50.

II. Ozone Generator

A. Design Standards

1. Ozone shall be produced at high concentrations (greater than 5.5% by weight) to provide enhanced mass transfer to the process water.
2. The generator shall be capable of continuous operation for one (1) year with no major cleaning and disassembly (when installed and operated in accordance with the manufacturer's instructions.)
3. The ozone generator shall utilize cold-cathode electrodes operating at medium frequency for reliability and ease of maintenance.
4. Generator module to be all 304/316 stainless steel, glass, and ceramic construction. No generators utilizing combustible materials shall be allowed.
5. Ozone shall be generated and maintained under vacuum until the point of injection into the process water. Partial loss of vacuum shall be compensated for by automatic feed-gas flow reduction. Critical vacuum loss in the generator module shall cause a system fault and initiate shutdown (Pressure models excepted).
6. All valves and fittings for ozone conveyance shall be type 316 stainless steel.
7. Each generator shall permit variable production within a range of 0% to 100% of rated output as controlled by a PLC controller.
8. Power requirements of ozone generator (including oxygen concentrator and compressor) combined shall not exceed 60.0 Watts per gram of ozone produced per hour.
9. Each ozone generator module shall be water cooled, utilizing a vertical tube in shell cooling design.
10. The system shall provide for complete ozone isolation during shutdown.

B. High Voltage

1. High voltage shall not exceed 8 KV (peak) in order to prevent glass dielectric failure due to high voltage.
2. Each ozone generator shall incorporate a high voltage transformer rated at least 5% above the maximum anticipated KVA.
3. High Voltage transformer shall be hermetically sealed and oil encapsulated ensuring corona free operation.
4. High Voltage transformer shall be UL recognized.

C. Oxygen Concentrator

1. Ozone generator systems shall utilize an oxygen concentrator to supply low pressure (0-20 psig) oxygen rich feed gas enabling increased ozone production at high concentrations and low flow rates.
2. Oxygen concentrators shall be capable of supplying oxygen at the rated flow rate of the ozone generator (see Table 1 or shop drawings) at a minimum of 85% purity.
3. Feed gas from the oxygen concentrator shall be dry to less than minus 70°C dewpoint.
4. Oxygen concentrator(s) shall be SeQual ATF™ units sized to supply the necessary oxygen flow to the system.

*HECD-65 & HECD-130 are U.L. classified. Other models, if not U.L. classified, shall be built to the same standards.

D. Air Compressors

1. Systems (DEL Model CD-65 & CD-130) shall incorporate small oil free compressor(s) housed in the cabinet to supply each modular oxygen concentrator.

E. Electrodes

1. Electrodes shall be gas-filled glass tubes providing individual fusing for power supply protection.
2. Electrodes shall have sealed ceramic endcap housing emitter connections for electrical insulation and protection against contamination.

F. Controls

1. The ozone generator system shall use a Programmable Logic Controller (PLC) incorporating ladder logic programming to automatically control start-up, shut-down, failure detection, fault protection, ORP control, and oxygen concentrator feed gas operation.
2. Each ozone generator shall be furnished as a package which shall include the following controls fully interlocked through the PLC and displayed via a LCD user interface panel:
   a. Door safety switch.
   b. Water backflow detection.
   c. Feedgas fault.
   d. Vacuum under and over range.
   e. Thermal protection on high ambient air, voltage transformer(s) and generator module(s).
   f. Coolant water flow fault sensor.
   g. Standby mode control.
   h. ORP sensor input for control (shutdown) function.
3. Each ozone generator shall be furnished with the following control and monitoring circuitry interfaced through the PLC:
   a. External input for shutdown mode control.
   b. Standby mode on/off.
   c. Normal system operation indication.
   d. System fault alarm conditions.
4. Optional controls shall include:
   a. Dissolved ozone monitor/controller.
   b. ORP controllers for ozone output and/or control of solenoid valves.
   c. Ambient ozone monitor(s)/controller(s).
6. The PLC shall provide and use 24 volt DC circuitry for all sensor inputs.
7. The PLC shall store historic information on the following fault events: low vacuum, water back flow, and high transformer temperature.
8. The PLC shall store ozone generator accumulated run time in non volatile memory.
9. Diagnostic LCD user interface panel controlled by the PLC to indicate the cause of fault of any of the protective devices such as: Water Backflow, Door open, Overheating, Low feed gas pressure, Low vacuum, etc.
10. Each ozone generator shall be provided with circuitry to permit deactivation from either the local control panel or from a remote location.
11. Each ozone generator shall provide circuitry for connections of remote alarm/monitoring equipment to indicate normal operation and abnormal system fault conditions.

G. Testing

1. Each ozone generator shall be tested at its maximum rated output for 24-36 hours prior to shipment.
2. Each ozone generator shall be tested for ozone output and rated flow and validated against unit specification.

III. Support Equipment

A. Reaction / Degas Vessels

1. Vessel must be NSF listed, standard 50.
2. Vessel must be rated for 50 psi working pressure.
3. Vessel material: Fiberglass with epoxy based vinyl ester resin coat inside for ozone resistance.
4. Vessel shall be vertically mounted.
5. Internal baffles shall be incorporated to eliminate short circuit flow through the vessel and enhance degassing.
6. Plumbing connections: Inlet and outlet fittings shall be sized as shown on drawings or to limit flow velocity to less than 3 ft/sec. (1 m/sec.)
7. Air relief fitting shall be 3/4" NPT for connection to automatic level control valve.
8. Vessel shall incorporate a front mounted manhole for access to internal piping.
9. Vessel drain fitting 1 ½" minimum.

B. Automatic Level Control (Degassing) Valve

1. Quantity required: 1 per contact vessel.
2. Materials shall be suitable for ozone gas and salt water exposure: Teflon®, PVDF, Kalrez®, glass, ceramic, titanium, etc.
3. Fitting sizes: 3/4" NPT input, 1/2" NPT output.
4. Auto level control valve shall release air from the reaction tank but shall not pass liquid water.

C. Catalytic Ozone Destruct Unit

1. The ozone destruct unit shall incorporate a preheated dry bed catalyst to remove greater than 99.5% of the ozone content from off-gas.
2. Low power heater preheats saturated off-gas above its dewpoint to prevent condensation and protect the metal oxide catalyst bed.
3. The unit shall be constructed of 304 stainless steel with 1/2" NPT input and output fittings.
4. Unit sized to handle full ozone production capability of system.
5. Destruct unit shall incorporate minor demisting capability and automatic drain valve for condensate build-up.
6. Wall or uni-strut mountable.

D. Ozone Injectors

1. Injectors shall be Mazzei® Injector Corp. (MIC) model number _____ (as required.)
2. Injector shall be sized according to MIC recommendations to maximize ozone mass transfer efficiency and to provide the necessary suction for ozone generator operation.

E. Ozone Flow Splitter

1. An ozone flow splitter DEL Model # FS-____ shall manifold and control flow from ozone generator(s) to multiple points of injection.
2. Each input line shall be provided with a manual shut-off valve to isolate that individual ozone generator for maintenance purposes.
3. Each flow splitter shall incorporate a ball valve, flow meter and check valve on each line constructed from ozone resistant materials, i.e. stainless steel, glass and Kalrez®.
4. ORP controllers and stainless steel solenoid valves shall be incorporated into lines where automatic independent control of ozone delivery is necessary. A 4-20 mA output signal shall be available to interface to a building automation system.
5. Each controlled line shall have an 'auto' mode for external control of solenoid valve action (i.e. pump controller). It shall also include provision for manual override of solenoid valve operation.

F. Ambient Ozone Monitor

1. Monitor shall measure the level of ozone present in the room housing ozone equipment, and shall shut down the ozone generator when the ozone level exceeds a warning level of 0.1 ppm.
2. An additional high alarm of 0.3 ppm shall also be available for control of ventilation and/or signals.
3. The monitor shall include both visible and audible alarms and provide contacts for use in activation of exhaust fans and shut down of the ozone generator. Contacts must be rated 5 A @ 240 VAC minimum.
4. The monitor shall have a range of 0-10 ppm/volume with accuracy within 3% of actual.
5. The monitor shall employ an electrochemical gas diffusion sensor requiring no expendable reagents.

G. Closed Loop Cooling System

1. Closed loop cooling system shall provide for heat dissipation from the ozone generator module cooling fluid. The cooling capacity shall be rated at least 50% over the expected heat generated.

H. Dry Tap™ Sensor Port

1. Dry Tap™ sensor ports shall provide flow sampling and mounting of ORP sensors in the process water piping.
2. Dry Tap™ shall include an isolation valve to enable removal and cleaning of the ORP probe without interruption of water circulation system operation.

IV. Manufacturer Support

A. Warranty

1. A two year warranty shall be provided.

B. Commissioning and Service

1. Manufacturer shall provide commissioning and on-site training for customer or customers' maintenance personnel with each system sold (not included in purchase price).
2. Manufacturer shall offer a service agreement to provide regularly scheduled maintenance for the ozone generation equipment provided by the manufacturer.
3. Warranties on systems not commissioned by an authorized DEL Industries representative shall be deemed null and void. DEL Industries reserves all rights to determine and authorized DEL representatives.

Table 1: Specifications Chart.

MODEL NUMBER		HECD-65	HECD-65-50	HECD-130	HECD-130-03
STD. NOMINAL VOLTAGE		230VAC,60Hz, 1Ø	230VAC,50Hz, 1Ø	230VAC,60Hz, 1Ø	230VAC,50Hz, 1Ø
ELECTRICAL LOAD	Amps	15	15	23	23
CAPACITY[1]	lbs/day	3.5	3.5	7	7
	grams/hour	65	65	130	130
OXYGEN FEED-GAS FLOW	scfh	30 (max)	30 (max)	60 (max)	60 (max)
	lpm	14	14	28	28
COOLING WATER REQUIRED	GPM	1 (nominal)	1 (nominal)	1.5 (nominal)	1.5 (nominal)
	lpm	4	4	6	6
[1]Capacities listed at 5.75% wt. concentration and 60ºF(16ºC) cooling water					

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