ClorDiSys

US-EPA Registered Sterilant

Microbial Decontamination

Chlorine Dioxide Gas Equipment & Services

- Safest Fumigant Method
- Replaces EtO, Formaldehyde, and VPHP
- No Residues
- Complete Decontamination of all Surfaces and Crevices
- Fastest Cycle Times
- Effective Against all Viruses, Bacteria, Fungi, Spores, and Pinworm Eggs
- True Gas at Room Temperature
- Guaranteed Dosage with Concentration Monitoring
- Safe on Materials
- No Cycle Development
- Decontamination of Isolators to Entire Buildings
- Stress Free Validation

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WHAT IS CHLORINE DIOXIDE?

Chlorine dioxide (CD) is a greenish-yellow gas with a chlorine-like odor recognized since the beginning of the 20th century for its disinfecting properties. It is widely used as an antimicrobial pesticide and an oxidizing agent in drinking water as well as to whiten paper for the pulp and paper industry.

Chemical Formula:	ClO_2
Molecular Weight:	67.45 g/mole
Melting Point:	-59°C
Boiling Point:	-40°C
Density:	2.4 times that of air

ClorDiSys uses chlorine dioxide gas for its broad efficacy against microorganisms. It is applied in a number of different applications and industries to provide a 6-log (99.9999%) sterilization level decontamination. The rapid sterilizing activity of CD is present at ambient temperature and a wide range of gas concentrations, from 0.3 to 20 mg/L.

True Gas at Room Temperature

Chlorine dioxide is a true gas at room temperatures which enables it to fill the space it is contained within evenly and completely, just like oxygen in air. This property is essential when trying to eradicate pathogens from an area, as the gas will get everywhere and not allow anything to "hide" from it.

Measured and Controlled

Due to its yellow-green color, chlorine dioxide gas can be measured using a photometer. A photometer measures the darkness of the gas (darker color = higher concentrations) which allows for a highly accurate and reliable measurement to ensure tight process control.

Different from Chlorine

While "chlorine" is in its name, chlorine dioxide gas is **VERY** different. Chlorine dioxide's method of kill is oxidation, where chlorine kills through chlorination. Therefore, unlike chlorine, chlorine dioxide does not produce environmentally undesirable organic compounds and is safer on materials.

HOW DOES CHLORINE DIOXIDE WORK?

Chlorine dioxide (ClO_2) acts as an oxidizing agent, which kills organisms by "stealing" electrons from cells, which breaks their molecular bonds. The method and potency of chlorine dioxide gas prevents cells from mutating to a resistant form. This eliminates the need to rotate decontamination methods to prevent overuse and resistance. Additionally, because of the lower reactivity of chlorine dioxide, its antimicrobial action is retained longer in the presence of organic matter making it more effective than most other decontamination methods at killing within dust, dirt, and other organics.

IS CHLORINE DIOXIDE ENVIRONMENTALLY FRIENDLY?

Chlorine dioxide's properties make it an ideal choice to meet the challenges of today's environmentally conscious society. Chlorine dioxide gas is non-carcinogenic, leaves no residues or waste to treat or clean up, and does not deplete the ozone layer. It can be safely vented into the atmosphere in all parts of the world. It is used to treat drinking water and approved for organic crops on the USDA's National List of Allowed and Prohibited Substances. (7 CFR §205.601)

HOW DOES CHLORINE DIOXIDE REACT WITH WATER?

While chlorine dioxide has "chlorine" in its name, it is very different from chlorine. Chlorine reacts with water to form hydrochloric acid, but chlorine dioxide does not and maintains a neutral pH in water. Gaseous CD is the only decontaminating fumigant that penetrates water, decontaminating both the water and the surface beneath. If liquid is present, the sterilization efficacy of CD is not affected.

CHLORINE DIOXIDE GAS: THE SAFEST FUMIGANT

All decontamination agents are dangerous as this is their function. However, gaseous chlorine dioxide can be used safer than other fumigation methods due to its chemical properties and safety profile.

SAFETY WARNINGS (SELF ALERTING)

The best safety feature with CD is that it is self-alerting. CD has an odor threshold at or below the 8-hour Time Weighted Average (TWA), so the user is self-alerted to exposure at a low level and the reliance on external sensors is not as imperative as with VPHP. This makes CD safer since the user is self-alerted before unsafe levels are reached. With VPHP, there is no odor to provide a warning of exposure. This dangerous trait is why natural gas is given a sulfur-like odor additive, to act as an alert of exposure. VPHP users (and surrounding colleagues) become aware of a harmful exposure only when coughing and choking occurs and therefore must

SHORTER CYCLE TIMES

Chlorine dioxide is the fastest acting decontaminating gas or vapor. For the various decontamination methods, cycle times can range from 3½ hours to over 12 hours to decontaminate a 2500 ft^3 room (70.8 m^3). With normal aeration exhaust rates, a CD cycle would be about 3½ hours or less, formaldehyde would be about 12½ hours, and VPHP could be 10+ hours when you include the aeration times. VPHP has longer cycles because of the extended aeration times due to the nature of vapor condensation and absorption issues that do not apply with a true gas. Formaldehyde has long cycles because of long exposure times and the neutralization time. This means that a potentially unsafe condition exists for a far shorter time when using CD for room decontamination.

LOWER CONCENTRATION LEVELS

Chlorine dioxide is typically used at lower concentrations for room decontamination. VPHP concentrations are typically 750-1500 ppm. Formaldehyde concentration is typically 10,000 ppm. CD concentration is typically only 360 ppm. Use concentrations for all are much higher than safe levels, however if something goes wrong, the higher concentration of formaldehyde and VPHP poses a greater risk.

EQUIPMENT LOCATED OUTSIDE THE TARGET CHAMBER

The CD generating equipment is located outside the decontamination target chamber. If equipment is inside the chamber and an issue occurs, the user may have to enter with a decontamination agent present in order to shutdown. Since CD generation equipment is located outside the chamber, if an issue occurs, the equipment can easily be shutdown by hitting the stop button located on the generator or simply pulling the plug.

QUICKER EMERGENCY AERATION

In case of an emergency during a decontamination, chlorine dioxide gas is quicker to aerate down to the 8-hour TWA compared to hydrogen peroxide based methods and formaldehyde, so the environment returns to a safe condition quicker. If something goes wrong during the CD cycle, aeration can be started and in 30-45 minutes there will be no CD left (below the 0.1ppm TWA). If something goes wrong during a VPHP cycle, catalytic conversion starts and this typically takes 12 hours. If direct aeration is utilized, this also takes hours to remove the

CARCINOGENICITY

Formaldehyde is "known to be a human carcinogen" as described by the US National Toxicology Program. The ACGIH designates VPHP as an A3, Confirmed Animal Carcinogen with Unknown Relevance to Humans. Chlorine dioxide gas is not considered to be carcinogenic, and the ACGIH does not list CD as a carcinogen of any kind. CD gas is used to treat fruits, vegetables, poultry, and other foods as well as drinking water.

COMPLETE DECONTAMINATION

Chlorine dioxide and formaldehyde are gasses that reach and penetrate all surfaces and crevices, unlike vapors which have trouble guaranteeing complete coverage and penetration. As the only decontaminating agent able to penetrate water, CD gas decontaminates the water and the surface beneath it. If the decontaminating agent cannot reach ALL of the dangerous organisms, at the proper concentration, for the prescribed amount of time, then a complete decontamination will not occur and worker safety is compromised. CD gas is able to be accurately measured in realtime using a UV-vis spectrophotometer, allowing for the correct concentration and exposure levels to be met every time, making it very reliable.

CHLORINE DIOXIDE GAS APPLICATIONS









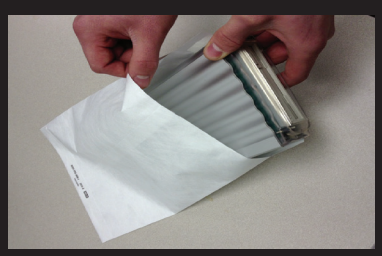










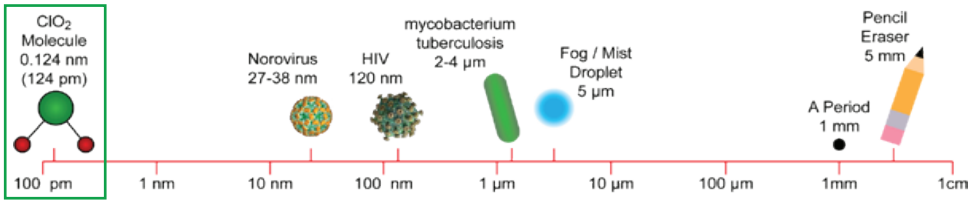




Chlorine dioxide gas can be utilized for a multitude of applications in a variety of industries. Chlorine dioxide gas is not affected by environmental factors and is not subject to dew-point or condensation issues making it a versatile decontamination agent effective in all types of environments.

METHOD COMPARISON: EFFICACY

Being a true gas, chlorine dioxide observes natural gas laws meaning that by nature, it will uniformly fill any space where it is introduced. Hydrogen peroxide vapor on the other hand, is not a true gas and will start to condense back into its liquid state at temperatures below 228˚F (109˚C), negatively affecting its distribution and penetration abilities. This "Vapor vs. Gas" differentiation leads to many of the differences between the two methods.

MOLECULAR SIZE MATTERS



	CHLORINE DIOXIDE GAS	VAPOR PHASE HYDROGEN PEROXIDE	DESCRIPTION
DISTRIBUTION	Follows natural gas laws to achieve complete and uniform distribution throughout space.	Hydrogen peroxide vapor is poor at passive diffusion because of hydrogen bonding characteristics.[1]	Contact is essential in decontamination. Poor distribution leads to poor decontamination.
PENETRATION	Able to penetrate into cracks, crevices, and some organic materials.	Unable to penetrate well due to tendency to condense on surfaces, and unable to penetrate gaps of 5mm (0.196")[2].	Cracks, crevices, gaps, and pipe threads are commonly found in rooms/chambers. Poor penetration leads to poor decontamination.
RELATIVE HUMIDITY	Typical range is between 60-75%.	Initial levels vary but final levels typically exceed 85%.	Increased humidity levels are essential in all spore reduction as the high Rh causes spores to swell and crack, allowing the agent to penetrate. However, the higher the Rh, the greater the risk of damaging electronics.
CONCENTRATION MONITORING	Integrated, validated photometric sensor which measures concentration accurately in real-time.	Chemical sensor which may be integrated at extra cost. Inaccurate concentration monitoring due to condensation and non-uniform distribution within space.	Chemical sensors can become saturated and read inaccurately. CD gas is able to be photometrically measured due to its yellow-green color to provide precise measurement and control.
EPA REGISTRATION	YES	YES	Both methods are registered with the US EPA as sterilants. Product labels must be read for approved applications.

1. Orlowski, Martin. Redifining Decontamination Safety. ALN Magazine, March 2011.
2. Steris Case Study M1941, Industry Review: Room Decontamination with Hydrogen Peroxide Vapor. Publication ID #M1941EN.2002-09 Rev. C, Steris, 2000.

Chlorine Dioxide Gas vs. Vapor Phase Hydrogen Peroxide

Chlorine dioxide gas offers a much more flexible process than hydrogen peroxide, allowing it to work more reliably across various applications and conditions.

CYCLE DEVELOPMENT	CHLORINE DIOXIDE (CD)	VAPOR PHASE HYDROGEN PEROXIDE (VPHP)
ROOM VOLUME	Volume does not affect CD cycle development. Volumes up to 70,000 ft^3 (1982 m^3) are achievable with one generator.	Volume DOES affect cycle development. VPHP generators have volume capacities between 8,000 and 12,000 ft^3 (226.5-339.9 m^3) with realistic capacities around 2,000 ft^3 (56.6 m^3).
ROOM SHAPE	Room shapes do not affect the cycle for CD. As a true gas at room temperatures, chlorine dioxide naturally disperses everywhere.	Room shape DOES affect cycle development as VPHP is injected in a line-of-sight fashion. Whatever cannot "be seen" by the generator cannot be contacted directly by VPHP and may not receive sufficient concentration to achieve full decontamination.
SHADOW AREAS/ LOADING WITHIN A SPACE	The amount of equipment and its location within a space does not affect a CD cycle. Gasses get everywhere.	The amount of equipment and its location within a space DOES affect a VPHP cycle. Equipment and items in the room can act as barriers to the VPHP distribution, blocking the line-of-sight between other surfaces and the generator. As such, cycles must be developed and validated whenever the amount, or location of equipment, changes to ensure proper decontamination.
TEMPERATURE	CD exists as a gas at temperatures above -40° F (-40° C). As a true gas, CD gets great distribution naturally and automatically. No affect on cycle development. At use concentrations, chlorine dioxide remains a gas to much lower temperatures.	Temperature DOES affect the cycle as hydrogen peroxide has a boiling point of 228° F (109° C). At temperatures below this, hydrogen peroxide starts condensing back to the liquid state. This limits its movement and causes non-uniform distribution and concentration with the possibility of some areas not getting enough VPHP to achieve full decontamination, since colder areas and surfaces scavenge VPHP from warmer surfaces and areas. This property clouds the success and repeatability of cycles.
STARTING RELATIVE HUMIDITY LEVEL **NOTE:** All decontamination methods need elevated Rh for spore log kill	Starting Rh level does not affect the cycle. Humidity is added independently from CD gas.	Starting humidity DOES affect the VPHP cycle. Humidity is added to an environment along with VPHP as it is generated by vaporizing a hydrogen peroxide/water mixture. With humidity levels affecting dew points and condensation of VPHP, the initial Rh level can significantly impact the decontamination process, as higher Rh levels will cause faster condensation and further limit its distribution.
INJECTION RATE	Cycles always use the same injection rate. No affect on cycle development.	Room geometry, room volume, and the amount of equipment within the room DOES affect the injection rate used in a cycle. The proper injection rate needs to be determined through testing and validation runs which must be performed for each room and every time the amount and location of equipment changes.
WET SURFACES	CD can penetrate water and decontaminate it and the surface beneath it. No affect on cycle development.	The presence of wet surfaces DOES affect VPHP cycles. VPHP dilutes and breaks down in water and is unable to decontaminate it or the surface beneath.

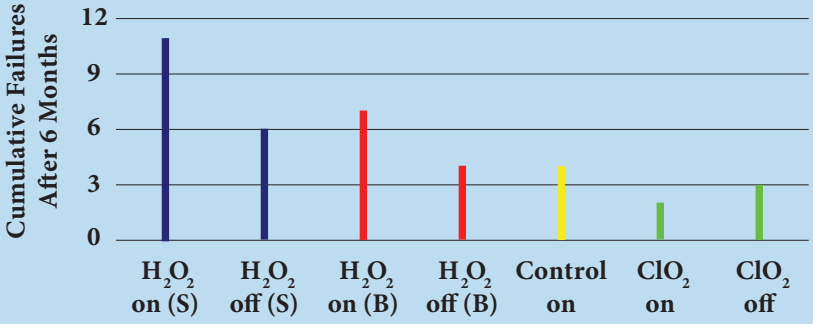
MATERIAL COMPATIBILITY

Chlorine dioxide is an oxidizer, as is hydrogen peroxide, ozone, bleach, and many other decontaminating agents. However, CD gas is the gentlest on materials among those options, due to it's lower oxidation potential. A higher oxidation potential means it's a stronger oxidizer and more corrosive. Chlorine dioxide has an oxidation potential of 0.95V, which is lower than other commonly used decontaminating agents.

Biocidal Agent	Oxidation/Corrosion Potential (V)
Ozone	2.07
Peracetic Acid	1.81
Hydrogen Peroxide	1.78
Sodium Hypochlorite	1.49
Chlorine Dioxide	0.95

While scientifically less corrosive, chlorine dioxide gas has a bad reputation due to the link with chlorine as well as the other chlorine dioxide products that lack the purity that our process uses. Other methods of generating chlorine dioxide mix an acid and a base which forms a chlorine dioxide solution which is then off-gassed to fumigate a space. That generation method produces two acidic components, acidified sodium chlorite and chlorous acid, alongside chlorine dioxide which makes these methods more corrosive. Our method of generating pure chlorine dioxide gas is accomplished by passing a low concentration chlorine gas through a proprietary sodium chlorite cartridge to convert the chlorine gas into pure chlorine dioxide gas. This allows our process to be safe when decontaminating stainless steel, galvanized metals, anodized aluminum, epoxy surfaces, electronics, and the most common materials of construction. Typically, if water will not corrode an item, neither will our CD.

The US EPA shows that hydrogen peroxide is more corrosive than chlorine dioxide gas



Ref: Emily Snyder, "Indoor and Outdoor Decontamination" Presentation at the EPA Region 9 / ORD Homeland Security Research Workshop, July 14, 2011 San Francisco, CA.

The US EPA performed a study comparing the material compatibility of chlorine dioxide gas and two hydrogen peroxide vapor systems on computers. CD Gas had the least failures, while hydrogen peroxide was shown to have more failures, especially when the computer fans were turned on (signified by the "on" columns in the graph). The fans brought higher concentrations of moisture and hydrogen peroxide into the computer itself which caused more damage than when the fans were off.

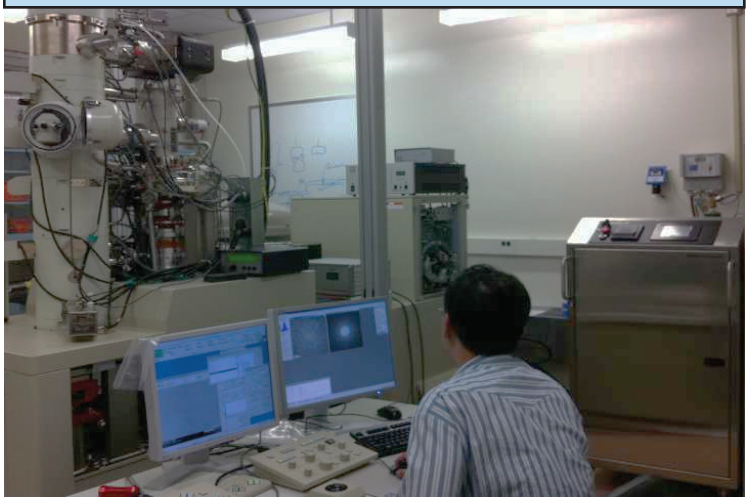
DRY STERILIZATION

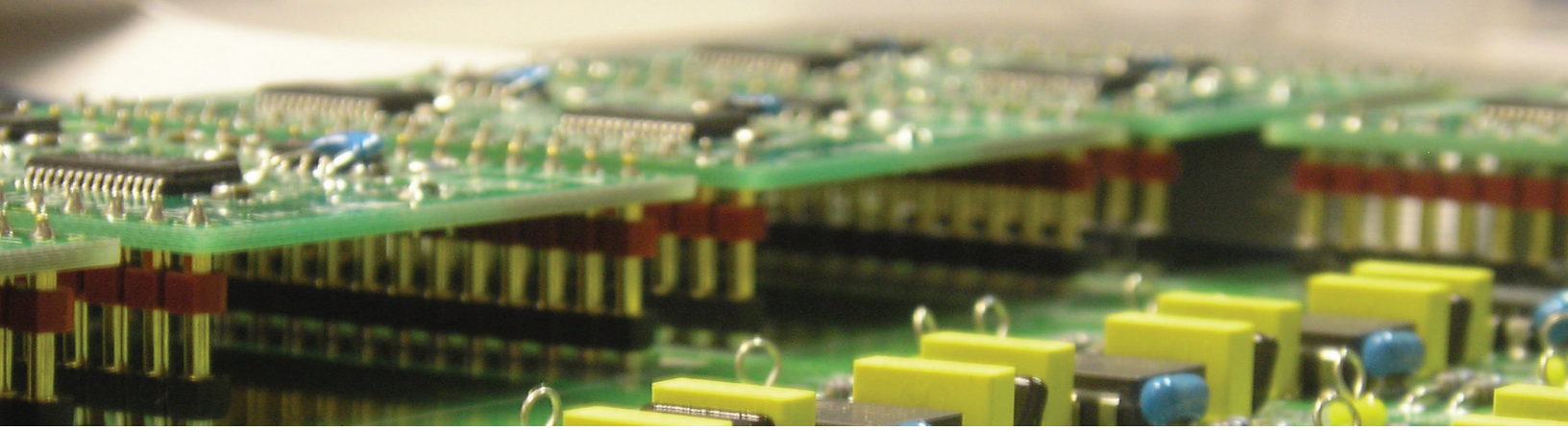
Our chlorine dioxide gas is generated through a completely dry process, leaving no concern over liquid-sensitive materials or components being affected.

RESIDUE FREE

Our CD Gas does not leave a residue on equipment and surfaces after a decontamination. Once the gas has been removed, the area is safe and does not require additional cleanup.

CD has been used to decontaminate interior components of a $3 Million Transmission Electron Microscope with no adverse effect.





OUR GENERATION METHOD

Not all chlorine dioxide products are equal. Our CD gas generators produce a pure chlorine dioxide gas without the acidic byproducts typical of other chlorine dioxide products.

OXIDATION POTENTIAL

Pure chlorine dioxide has a lower oxidation/corrosion potential than ozone, peracetic acid, hydrogen peroxide, and bleach. This means chlorine dioxide is safer on materials than those chemicals.

IF YOU DON'T TRUST US, TEST US!

We offer free* material compatibility testing for items you are concerned about.

*ClorDiSys will expose your items/equipment to chlorine dioxide gas and return to you for observation and testing. Testing is free for small items or batches less S/H. For large items or extended testing, please call.

CONTRACT STERILIZATION SERVICES

ClorDiSys offers Contract Sterilization Services where we can decontaminate your items, equipment, supplies, and products at our facility, then ship them back to to your facility or onward to a 3rd party facility. ClorDiSys uses chlorine dioxide gas for sterilization of components instead of gamma irradiation, ethylene oxide gas, or electron beam methods. Turnaround time is traditionally 24 hours, with items typically being shipped back the day after they arrive. Upon completion, a Certification Sheet is issued describing the process and showing the sterilization cycle data.

COMMON APPLICATIONS

- Sterilization of components before entering a clean facility
- Equipment contaminated with amplicons or beta lactams
- Computers, printers, keyboards, and routers
- Electronics (RFID tags, monitoring instruments, microscopes)
- Supplies (Shoes, safety glasses, clothing, animal cages)
- Sterilization of sterile products manufactured in non-sterile facility
- Medical items
- HEPA or Sterilizing Filters
- Contaminated items due to mold issues, pinworms, or user-site returns

PORTABLE CHLORINE DIOXIDE GAS GENERATORS

The ClorDiSys family of portable chlorine dioxide gas generators all automatically control the decontamination process. They have the capability to interface with nearly any chamber or room, as well as building management systems. The generators are manufactured using industrial components and feature password protected HMIs and have cycle management systems with real time trending. Easy to learn and easy to use, our portable CD generators are perfect for routine decontamination. No cycle development is needed. The same cycle works regardless of the application or space.

MINIDOX - M™ Sterilization System

Overall Size:
30" W x 56" H x 24" D

Power: 100-240 VAC
5 amp, single phase

- Accurate CD Gas concentration monitor ensures every cycle is effective
- Able to decontaminate spaces up to 70,000 ft^3 (1,982 m^3) in ideal conditions
- Fully automated process
- Efficiently decontaminate any enclosed space
- Simple control system and interface
- Multiple alarms and checkpoints for increased safety
- Dual data storage via paper printout and USB drive
- No required maintenance contracts
- Injection tubing can fit under most doors without any modifications
- Remote monitoring with laptops, tablets, and smartphones available

IDEAL APPLICATION: Any facility looking to decontaminate rooms, isolators, equipment, or supplies

MINIDOX-B™

The Minidox-B offers cost savings compared to the Minidox-M by removing the concentration monitoring system. This makes the Minidox-B closely comparable to Hydrogen Peroxide generators in that they inject based on volumetric calculation. It can be used on any room or chamber sized between 1-20,000 ft^3 (566 m^3).

MINIDOX-L™

A smaller, more economical gas generation system designed for use in any chamber under 300 ft^3 (8.5 m^3) such as an isolator, incubator, HEPA housing, or a Biological Safety Cabinet (BSC). It includes a BSC interface plate, carbon-based scrubber for removal of CD gas, and required tubing.

MINIDOX-MC™

The Minidox-MC is an all-in-one CD gas generation system designed for simple and effective decontamination and sterilization of small items. It combines a Minidox-M Gas Generator, a sterilization chamber, and an integrated aeration system to provide a full sterilization cycle with the touch of a single button.

IDEAL APPLICATION:
Small items, electronics, and sensitive items

CLORIDOX-GMP™

The Cloridox-GMP Sterilization System can be used on any room or chamber up to 70,000 ft^3 (1982 m^3) in ideal conditions. The system can also be attached to most vacuum chambers to provide a method for component or product sterilization as well. The Cloridox-GMP features fully validated software and comes standard with an accurate, real time concentration monitor, allowing for tight process control, easy validation, and repeatability.

IDEAL APPLICATION: GMP facilities or facilities where vacuum cycles need to be conducted in addition to the decontamination of rooms, isolators, or equipment.

Overall Size:
45" W x 64" H x 28" D

Power: 100-240 VAC
5 amp, single phase

MEGADOX - P™

The Megadox-P chlorine dioxide gas generation system provides a rapid and highly effective method to decontaminate large volume areas up to 280,000 ft^3 (7,928 m^3) in ideal conditions with a concentration monitor that can measure from up to 5 locations

The Megadox-P is portable in design with the same dimensions as a standard pallet for fast transport around a facility or around the world. All instrumentation, including the concentration monitoring system, can be easily calibrated to traceable standards.

Overall Size:
48" W x 76" H x 48" D

Power: 100-240 VAC
10 amp, single phase

STERIDOX-VP™

The Steridox-VP Chlorine Dioxide Gas Vacuum Sterilizer provides a rapid and highly effective method to sterilize medical devices, sterile products, instruments, and components at ambient temperatures. It includes a highly accurate sterilant monitoring system making it repeatable and easily validatable.

It is available in a variety of sizes to meet your processing needs. Automated sliding doors are also available.

Overall Size:
48" W x 66" H x 48" D

Power: 208-480 VAC
10 amp, single phase

AUXILIARY EQUIPMENT

PASS-THROUGH CHAMBERS

ClorDiSys offers custom pass-through chambers for your facility complete with decontamination ports and HEPA filters. They can be fabricated using either stainless steel or polypropylene depending on your facility's needs and applications. Pass-through chambers are fitted with two sealed doors and can be fabricated to any size.

IDEAL APPLICATION: A way to decontaminate most items so they can be safely brought into a clean facility or removed from a hazardous environment.

PORTABLE DECONTAMINATION CHAMBER

ClorDiSys' Portable Decontamination Chamber offers the ability to decontaminate small and medium sized equipment and components inside a portable chamber rather than in an entire room or a large fixed chamber. This allows for a quicker, more cost effective and versatile decontamination cycle by reducing the amount of time and consumables used.

The Portable Decontamination Chamber comes equipped with all necessary connections to easily interface with our Chlorine Dioxide Gas Generators. As both the chamber and the Gas Generators are easily portable, this allows for a decontamination station to be set up anywhere in your facility. Contaminated components can then be treated near the point of contamination reducing the possibility of spreading the potential risk.

DECONTAMINATION ROOM DOOR

The Decontamination Room Door allows you to turn any room into a sterilization/ decontamination room. This door provides a cost effective method to decontaminate components, parts, supplies, and equipment entering a "sterile" or "clean" facility at room temperatures and without the need for a specialized chamber. It can also be used as an exit chamber for a BSL area, providing significantly better efficacy than spraying and wiping. The door utilizes a long lasting, non-inflatable gasket so that sealing a door using tape is not required. An optional interlock and control system is available. The door is available in a variety of sizes to meet your facility needs.

IDEAL APPLICATION: Facilities looking to decontaminate components, parts, supplies or equipment entering a clean facility or exiting a BSL facility.

ISOLATORS

ClorDiSys' isolators are custom fabricated from durable polypropylene or stainless steel and are made to any size specification. Whether it be a transfer isolator, glovebox, or passthrough box, our isolators and chambers can be fitted with glove ports, Rapid Transfer Ports (RTP), biological research ports and a variety of other components. A viewing window can act as visual confirmation that gas is everywhere and further verifies chlorine dioxide's distribution and penetration properties.

IDEAL APPLICATION: An easy way to decontaminate most items so they can be safely brought into a clean facility or removed from a hazardous environment. Components can be packaged in Tyvek™ to maintain sterility.

DECONTAMINATION CHAMBERS

EQUIPMENT DECONTAMINATION CHAMBER

The Equipment Decontamination Chamber is designed for use with any ClorDiSys CD generator. For many applications, the Equipment Decontamination Chamber can effectively replace a bulk autoclave inside a facility. It provides the ability to rapidly and effectively sterilize computers, electronics, medical devices, sterile products, instruments, and components at ambient temperatures. It can be used to decontaminate components entering a "sterile" or "clean" facility at room temperatures. Items can also be decontaminated before removal from a dirty area into a clean area without the concern for cross contaminations. The equipment is available in a variety of sizes to meet your facility's needs and constraints including a dual door option. We also fully integrate with BetterBuilt, Lynx, Tecniplast, Girton, Schyler, Buxton Scientific, and other manufacturers.

IDEAL APPLICATION: Decontaminating incoming equipment or supplies into a research or production area.

WHAT CAN THEY BE USED TO DECON?

	AUTOCLAVE	CD DECON CHAMBER
BEDDING BAGS	YES	NO
BEDDING	YES	YES
FEED	YES	NO
FEED BAGS	YES	YES
LIQUIDS	YES	NO
WASTE	YES	NO
RACKS	YES / NO	YES
CAGES	YES	YES
HEPA FILTERS	NO	YES
PLASTICS	YES / NO	YES
ELECTRONICS	NO	YES

As many facilities have multiple Autoclaves, the easiest decision might be to implement both an Autoclave and a Decon Chamber to fulfill all of your facility's needs.

The Minidox - M connects to a combination Decontamination Chamber/Rack Washer. This option offers the greatest flexibility allowing the user to use the same chamber for both decontamination methods. Energy savings are possible here as the user can run a chlorine dioxide gas cycle when there are no items within the chamber that necessitate an autoclave.

Decontamination Chambers can save energy and money compared to bulk autoclaves in terms of steam usage, water usage, electricity usage, maintenance costs, replacement costs, cost of capital equipment, and footprint. To help decide whether implementing a chlorine dioxide gas decontamination chamber, one must look at the items their facility needs to decontaminate. Chlorine Dioxide Gas is capable of decontaminating electronics, racks, cages, HEPA filters, plastics, and the outsides of bedding and feed bags. Autoclaves are still the best suited to decontaminate dense organic materials such as bedding and feed.

CONNECTION PLATES

Multi-Room Distribution System - Distribution Plate & Ceiling Plate

The Multi-Room Distribution system allows a facility to store and operate a CD Gas Generator from a single location and decontaminate rooms up to 500 ft away. The CD Gas Generator connects to the Distribution Plate which is connected to multiple rooms and chambers via the Ceiling Plate. This allows for the generator to be stationed outside of a containment or BSL area so that it can easily be used both within/outside the barrier. This system uses small plastic tubing instead of the costly heat-traced and insulated piping required for VPHP distribution systems.

Tubing and wiring is run from distribution plate to the ceiling plate

IDEAL APPLICATION: For use in a facility that has rooms in both unrestricted and restricted (containment or BSL) areas to decontaminate, such that the CD Gas Generator can stay outside the restricted area and connect to rooms both inside and outside the restricted area.

Door Plate

The Door Plate provides an easy interface between a CD Gas Generator and a room that will frequently undergo decontamination. It incorporates valved tubing connectors such that the room is sealed even when disconnected from the CD Gas Generator.

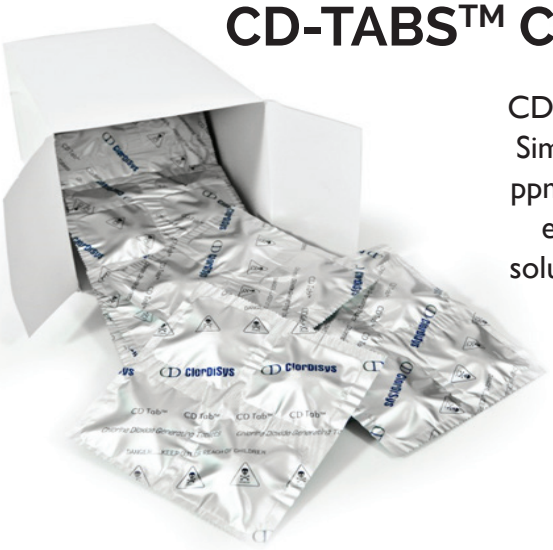
Under Door Plate

The Under Door Plate provides a portable, easy-to-seal interface between a CD Gas Generator and a room. It comes standard with all ClorDiSys generators. It is ideal for a facility with many different rooms that they wish to decontaminate, as one Under Door Plate can be used throughout the facility.

Wall Plate

The Wall Plate is used as an interface between the CD Gas Generator and a room. It also allows for a quick and easy connection to the room via valved tubing connectors. Sized to replace a mason block, the wall plate is available for stud walls as well.

CD-TABS™ Chlorine Dioxide Generating Tablets



CD-TABS™ offer a simple method for generating chlorine dioxide liquid. Simply drop one tablet into a gallon of water to produce a generic, 100 ppm solution of liquid chlorine dioxide. CD-TABS™ are inexpensive and easy to use and provide a non-acidic, chlorine dioxide odor-control solution. If higher concentrations are desired, simply add another tablet.

Chlorine dioxide keeps all of its properties when dissolved in water.

Acidic by-products generated by most other liquid methods can cause harm to equipment and surfaces. CD-TABS™ create a neutral pH solution and won't cause these issues.

CSI 3000™ Liquid Chlorine Dioxide Concentrate

CSI 3000™ is EPA-registered (#75757-2-80802) pure chlorine dioxide concentrate. No on-site mixing or "activation" is required, just dilute from the 3000 ppm to your use concentration. It is used to control microorganisms in research, production, pharmaceutical and agricultural applications. It is easier to apply, safer to handle, and more effective than chlorine or bromine-based products. It rinses clean with no residue.

APPLICATIONS:

- General disinfectant
- Spraying room surfaces
- Commercial potable water systems
- Recirculating cooling water systems
- Reverse Osmosis (RO) and Nanofiltration membranes
- Cooling towers and heat transfer systems

AVAILABLE IN 6 DIFFERENT SIZES

½ Gallon	5 Gallons	15 Gallons	30 Gallons	55 Gallons	275 Gallons

DECONTAMINATION SERVICES

Decontamination Services can be utilized for a variety of applications from tented pieces of equipment and small chambers up to entire facilities. ClorDiSys has the capability to decontaminate areas over 4,000,000 ft^3 (113,267 m^3). **Services can be arranged for contamination response or preventive control needs.** They can be scheduled as needed or contracted for routine prevention, scheduled maintenance, and shutdown periods. If you have contamination issues or are interested in overall facility decontamination prior to move-in, ClorDiSys can help you.

Chlorine dioxide gas is able to reach and kill all organisms wherever they are hiding. **CD gas naturally fills the area it is introduced into evenly and completely, and penetrates deeper into crevices than pathogens can hide because its molecule size is smaller than the smallest viruses and bacteria, resulting in complete kill.** This allows a better decontamination than traditional sanitation methods such as sprays, mists, fogs, foams, and vapors.

Only gaseous decontaminating agents are **truly effective in areas that are difficult to reach such as floor drains, HVAC grills, beneath furniture and components, inside of cabinets, hinges, instruments and components**, and other difficult to reach areas. CD is non-carcinogenic, does not require neutralization, leaves no residues, and provides an extremely fast method for decontamination.

SERVICE CONTRACTS ARE AVAILABLE FOR MONTHLY, BI-MONTHLY, QUARTERLY, OR YEARLY OCCURRENCES.

DECONTAMINATION SERVICE CASE STUDIES

NEW VIVARIUM FACILITY

A 240,000 ft^3 new vivarium was decontaminated following construction and commissioning, but just prior to the move-in date. Equipment and supplies were brought into the facility prior to the decontamination, so they would not need to be autoclaved into the barrier facility. This saved a significant amount of time at the facility, while allowing for the safe decontamination of electronics into the facility. Starting a new facility off clean is important, and decontaminating with chlorine dioxide gas is the only way to achieve a guaranteed 6-log sporicidal kill of all surfaces. Clordisys was able to fumigate the facility and eliminate any organisms present while providing sporicidal kill of Biological Indicators placed throughout the facility to ensure the process was successful.

RENOVATION

A 35,000 ft^3 facility was being completely renovated to update everything from its ventilation system to its equipment and casework. Prior to moving mice back into the facility, the area was decontaminated in order to provide a guaranteed sterile environment for research. Decontamination took one day and included all rooms, hallways, and supporting ductwork. The floors above and below the vivarium facility were inhabited throughout the decon with no chlorine dioxide gas detected and no adverse effects seen.

OCCUPIED SPACES SURROUNDED BY ROOMS BEING GASSED

An animal facility in Australia had 3 occupied rooms within its vivarium; a holding room and its adjoining procedure and necropsy rooms. These rooms were surrounded by contaminated holding and procedure rooms being gassed with chlorine dioxide. The occupied rooms were monitored for leakage throughout the decontamination. During the process, no leaks were observed in any of the areas, and all biological indicators were killed.

DUCTWORK

In some cases, facilities are interested in just decontaminating their ductwork and not the accompanying rooms. An 8 room HIV lab was built with an undersized HVAC system and was looking to replace it with a correctly sized unit. There was concern as to whether or not the exhaust ductwork was contaminated from the research performed within the lab, so a decontamination was scheduled. A recirculation loop was setup in order to ensure that the gas was migrating throughout the entire length of ductwork. Biological indicators were placed in the ductwork and the recirculation loop in order to prove efficacy. All biological indicators were dead upon completion.

"Decontaminating the Difficult since 2001"

BSL-3 LAB

A BSL-3 influenza laboratory undergoes a yearly decontamination using chlorine dioxide gas during a facility shutdown. All equipment is left within the space during the decon, as the gas will reach and contact all surfaces within the lab. Results are shown through the placement of 40 biological indicators as various locations throughout the lab. Some locations include closed drawers, inside and behind Biological Safety Cabinets, underneath tabletop equipment, as well as easy locations such as floors, ceilings and walls.

PINWORM EGGS

Pinworm eggs are known to travel very easily throughout rooms and facilities due to their small size and ability to become "airborne." Chlorine dioxide gas has been proven effective at eliminating pinworm eggs by the University of Tennessee at Knoxville. An 85,000 ft^3 facility infected with pinworms was treated with CD Gas in order to inactivate the eggs from the environment and ductwork. Animal racks were left running in order to help circulate the gas through the air plenums, cages, and filters to inactivate all eggs that may have been present. Pinworm eggs require a chlorine dioxide dosage twice the normal sterilization level dosage, so advanced notice of this concern is necessary to plan accordingly.

RBL FACILITY

The Regional Biosafety Laboratory at Tufts University's North Grafton, MA campus has been decontaminated annually using chlorine dioxide gas since 2012. The approximate 59,000 ft^3 facility is decontaminated all at once in order to eliminate any potential for cross-contamination. All 54 biological indicators placed within the facility came back negative for growth after the 36 hour incubation period, illustrating a successful decontamination.

HEPA HOUSING

While HEPA filters can block the flow of liquid/vapor based decontamination methods, gasses like chlorine dioxide are able to travel through the HEPA filter with no problem, making the decontamination quick and easy. A BSL3 facility routinely decontaminates their HEPA housing with CD gas. In order to monitor and control the process, a recirculation loop is setup and the gas is injected at the entrance to the HEPA Housing and monitored at the exit to make sure the entire housing reaches the proper dosage.

MOUSE BREEDING FACILITY

An approximately 60,000 ft^3 mouse breeding facility has been decontaminated on multiple occasions with CD Gas. Situations ranged from renovation to flood damage to contamination remediation. Due to the nature of the operation, chlorine dioxide gas has been used to ensure that the facility is completely sterile and able to breed contamination-free mice.

TRANSPORT VEHICLES

Multiple facilities use chlorine dioxide gas to decontaminate their trucks, vans, and shipping containers. A commercial breeder decontaminates their transport vehicles in between deliveries, with CD gas taking just 3-4 hours from start to finish. Another facility uses shipping containers to decontaminate equipment from their facility as an external decontamination chamber.

MULTI-STORY RESEARCH FACILITY

This new, 4 floor, 370,000 ft^3 facility in Singapore consisted of laboratories, animal holding rooms, procedure rooms, autoclaves, meeting rooms, office areas, cold rooms, storage rooms, and other areas. All four floors of the facility were decontaminated at the same time using chlorine dioxide gas. Equipment was operated from a single location outside of the barrier on the third floor with tubing transporting the chlorine dioxide gas up to 200 ft away on the other floors. All equipment was in place prior to the decontamination such that it did not need to be autoclaved into the facility.

DISINFECTION SERVICES

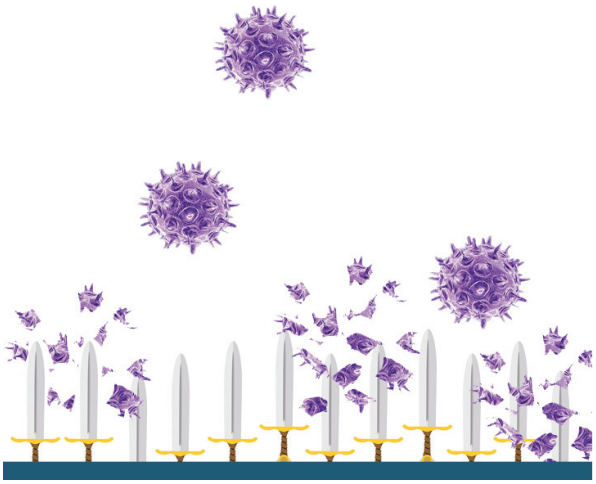
Chlorine Dioxide Electrostatic Spraying Disinfection Services

ClorDiSys provides electrostatic spraying disinfection services with liquid chlorine dioxide. Liquid chlorine dioxide is sprayed onto surfaces using a handheld sprayer. Handheld sprayers are used, so a trained technician is able to reach more surfaces than a stationary fogger, by opening drawers, cabinets and enclosures and changing the angle of application in order to minimize shadow areas which are not being contacted. Liquid chlorine dioxide is applied at concentrations capable of eliminating all viruses, bacteria, fungi and spores.

A new facility was disinfected by treating with a liquid chlorine dioxide to provide a clean start for research taking place within the facility. A high concentration liquid chlorine dioxide was sprayed throughout the facility similar to a hydrogen peroxide vapor treatment. A team opened drawers, cabinets, and equipment in order to ensure that all visible surfaces were sprayed and treated with liquid chlorine dioxide. This method offers a level of disinfection comparable to utilizing VPHP.

BioBlock90™ Disinfect and Protect Services

Using a patented, EPA registered technology, the ClorDiSys BioBlock90 Service disinfects and protects your environment from harmful microorganisms for up to 90 days. ClorDiSys will electrostatically apply a dual-threat treatment which will disinfect while leaving behind an antimicrobial surface protectant capable of inhibiting the growth of harmful microorganisms.



HOW DOES IT WORK?

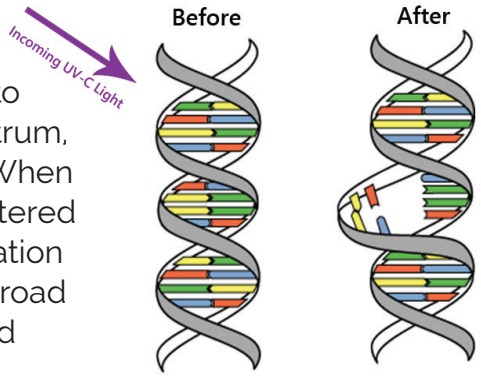
When applied, the nanoparticles form a covalent bond with the surface and create a microbiostatic antimicrobial coating. The coating forms a nano-layer of molecular "spikes", each of which carry a positive charge that attracts the negatively charged microorganisms. Once contact is made, the molecular "spikes" pierce the cell and rupture its cell membrane, causing the microorganism to die.

ULTRAVIOLET LIGHT DISINFECTION

In addition to chlorine dioxide gas, ClorDiSys offers a line of ultraviolet light products and services.

EPA Est. #80802-1

WHAT IS UV EFFECTIVE AGAINST?



Ultraviolet light is a specific part of the electromagnetic spectrum of light that offers bactericidal effects. Ultraviolet light is divided into UV-A, UV-B and UV-C rays. It is the wavelengths in the UV-C spectrum, specifically 265 nm, which offer the greatest germicidal potential. When a micro-organism is exposed to UV-C, the nuclei of the cells are altered due to the photolytic process. This process prevents further replication and causes cell death. UV-C has been proven effective against a broad spectrum of microorganisms including viruses, bacteria, molds, and spores such as mouse parvovirus (MPV).

SAFETY

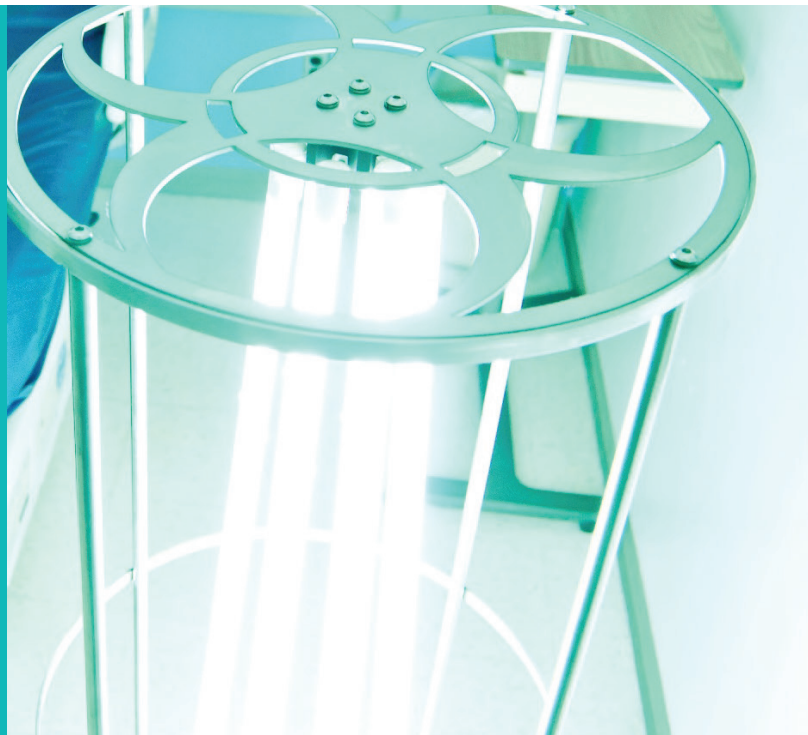
UV-C presents a hazard to skin and eyes, so direct exposure is always to be avoided. UV-C is blocked by a number of materials, including glass (but not quartz glass) and most clear plastics, so it is possible to safely observe through a window. UV-C is chemical-free, so there are no dangerous residues to be wiped down or neutralized after the disinfection occurs.

BENEFITS

- Disinfection in minutes, which allows for extremely fast turnover times
- Quick to learn and extremely easy to operate
- Unaffected by temperature, pressure, or humidity level
- No sealing of doors, vents, or windows is necessary
- The cost to run is very low, with a typical treatment cost under 2 cents.
- Requires little maintenance or upkeep
- UV-C bulbs last thousands of hours

COMMON APPLICATIONS

- Empty animal holding rooms
- Water systems
- Electronics, parts, tools, and supplies
- Feed and bedding bags
- Transport vehicles
- Processing tanks and vessels
- Reduction of airborne organisms
- Elimination of odors
- Packaging and components
- Boots and shoes



the TORCH™ and TORCH+ ™

Ideal for Room Disinfection

the TORCH and TORCH+ are inexpensive, easily transportable, powerful disinfection systems designed to provide a rapid and highly effective method to disinfect surfaces, components, and common touch points. The TORCH and TORCH+ contain eight high powered UV-C lamps to provide quick disinfection times. They plug into standard wall outlets and produce an efficient UV-C output of 200 µw/cm² at 8 feet (12 mJ/cm² per minute) to get a calculated 99% reduction of harmful organisms in seconds and spores in minutes.

Specs

Overall Size:
23" W x 23" D x 68" H

Weight: 72 lbs

Power: 110-240VAC
6 Amps, 50/60 Hz

Bulb Lifespan: 16,000 Hours

The TORCH+ comes with an iPad™ for remote operation and monitoring. Data recording and management becomes easy and efficient with cycle data stored on the iPad™ at the end of every use. Data stored includes date, time, address, room number, and operator name. Disinfection cycles can be controlled based on time or by accumulated UV-C dosage using the integrated UV sensor in order to provide the right process to meet your needs.

the LANTERN™

Ideal for Small Spaces & Transport Vehicles

The Lantern is a lightweight, easily transportable UV-C generator that can be used in both the upright and inverted positions, allowing it to be hung from railings or hooks. Both an exposure and delay timer allow for operators to safely exit the space, but also achieve desired disinfection time.

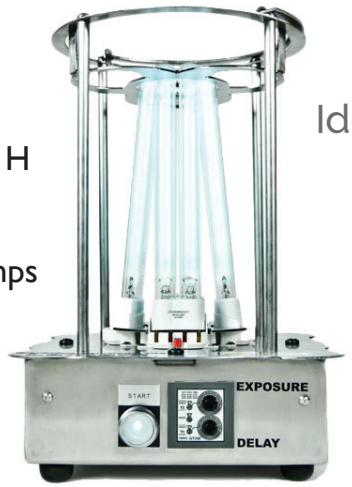
Specs

Overall Size:
10" W x 10" D x 14" H

Weight: 10 lbs

Power: 115 VAC, 4 Amps

Bulb Lifespan:
9,000 Hours



The Lantern produces an efficient UV-C output of over 130 mw/cm² to get a calculated 99% bacterial kill in 1 minute and a 99% reduction of spores in 5 minutes for surfaces within 4 feet. Farther distances take just a few more minutes or utilize multiple units to disinfect simultaneously.

the LIGHTNING VOLT™

Battery-Powered Disinfection System

The Lightning Volt delivers the benefit of UV-C disinfection without the restriction of needing available power. Battery operated and easily transported on wheels, the Lightning Volt allows for added flexibility as it can be positioned anywhere. With typical treatment times of mere minutes, the 2.5 hour battery life can disinfect multiple areas before needing to recharge. The Lightning Volt produces an average UV-C output of over 260 $\mu w/cm^2$ at a 4 foot distance to get a 99% reduction of most viruses and bacteria within 1 minute and spores within 5 minutes.

Specs

Overall Size:

13.5" W x 24" L x 54.25" H

Weight: 150 lbs

Power: 115 VAC, 7 Amps

Bulb Lifespan:
9,000 Hours

Applications include

- Elevators
- Transport vehicles
- Bathrooms
- Labs
- Hallways
- Cold Rooms/Freezers

Ultraviolet Light Disinfection Services

ClorDiSys offers ultraviolet light disinfection services for contamination response or routine preventive disinfection. Rooms, vehicles, and other enclosed spaces can be disinfected quickly and safely using this chemical free, residue free process. UV-C is effective against a broad spectrum of microorganisms including viruses, bacteria, molds, and even spores.

An animal holding room was treated with ultraviolet light to eliminate a Mouse Parvovirus contamination. UV light works in a line-of-sight fashion, so multiple UV treatments took place to disinfect all sides of the equipment and animal racks within the room.

the FLASHBOX™ and FLASHBOX-MINI™

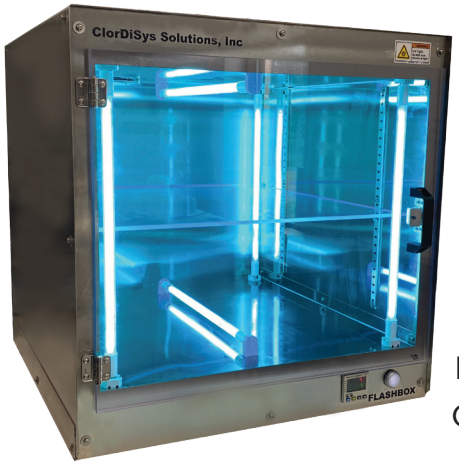
Ideal for Handheld Electronics and Small Items

The Flashbox and Flashbox-mini UV Disinfection Chambers provide a rapid and highly effective method to disinfect laptops, tablets, keyboards, phones, electronics and components. Both offer a calculated 99% reduction of common viruses and bacteria in 30 seconds and spores in minutes, disinfecting components without removing them from the room, minimizing the chance for cross-contamination.

The Flashbox-mini contains 2 protected UV-C bulbs, one on the top and one on the bottom, and a quartz glass shelf. The Flashbox contains 6 protected UV-C bulbs and a quartz glass shelf to provide increased disinfection coverage of items placed inside. Quartz glass shelving allows for full exposure of all surfaces on items being disinfected.

Specs

Usable space for items:
5" H x 6" D x 12" W
Overall Dimensions:
9" H x 8" L x 14" W
Weight: 11 lbs.
Power: 115 VAC, 2 Amps
Bulb Lifespan: 11,000 Hours



Specs

Usable space for items:
14" H x 23" D x 18.5" W
Overall Dimensions:
25.75" H x 24" D x 24" W
Weight: 90 lbs.
Power: 115 VAC, 3 Amps
Bulb Lifespan: 16,000 Hours
Optional 2nd Shelf Available

A 2017 MIT study determined the Flashbox-mini was the most effective and consistent method for sanitizing smartphones.

the FLASH TUNNEL™

Ideal for Bedding, Feed Bags, & Other Items Entering a Barrier Facility

The Flash Tunnel is a UV Disinfection system providing a quick, chemical-free, liquid-free method of aseptically bringing feed and bedding bags into a barrier facility. The Flash Tunnel can be customized to fit specific needs and requirements of any space.

Compared to Spray Tunnels:

- No more chemical changeouts
- No more chemical handling
- No more chemical storage
- No more chemical waste disposal
- No more chemical costs
- No more wet supplies

the FLASH-THRU™

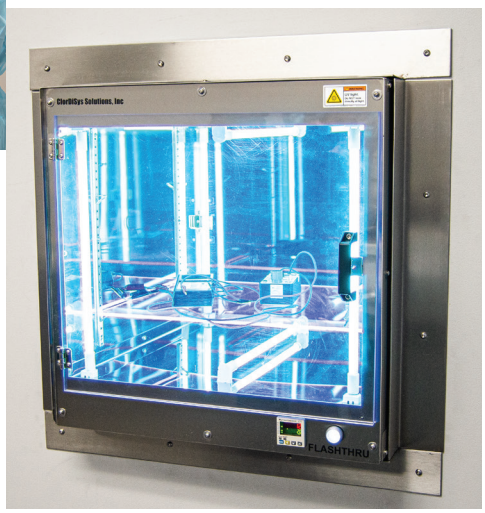
UV-C Pass-Through Chamber

Flash-Thru provides a swift and highly effective method to disinfect equipment, tablet computers, laptops, keyboards, phones, electronics, instruments, and components entering a clean room. Flash-Thru offers dual-door design to disinfect components in between an ordinary room and a clean room or barrier facility without any cross-contamination.

The Flash-Thru contains quartz glass shelving to support the item(s) being disinfected. The chamber produces an efficient UV-C output of 60 mJ/cm² every minute to get a calculated 99.9% reduction of MRSA in 10 seconds and a 99% reduction of spores in 1 minute. Bulbs last up to 16,000 hours.

Specs

Usable space for items:
14" H x 23" D x 18.5" W
Overall Dimensions:
25.75" H x 24" D x 24" W



the FLASHBAR™

Ideal for Creating Custom Disinfection Rooms or General Room Disinfection

The 2-bulb, 4 foot Flashbar outputs UV-C light at 68 µW/cm² at ten feet to provide rapid disinfection of surfaces.

Turn any room into a quick and cost-effective disinfection room using our Flashbar UV-C lighting system. A custom design can be made using as many or as few units necessary for the desired application. A UV-C room provides effective disinfection of instrumentation, animal racks, tables, tools, equipment, and other surfaces. Flashbars can be operated after hours to fully disinfect an entire space.

the TORCH AIRE-RECESSED™

Ideal for Any Laboratory or Research Setting

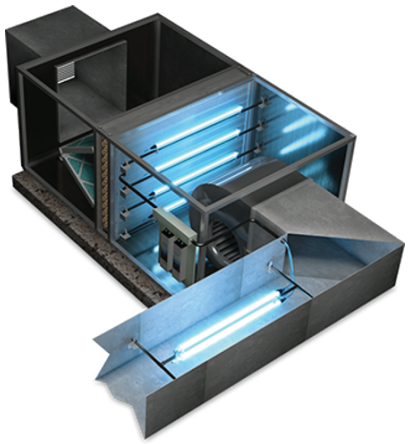
Designed to replace a standard ceiling tile, the Torch Aire-Recessed installs easily to help reduce airborne pathogens. Air passes over enclosed UV-C bulbs to kill harmful organisms and sent through a filter to catch large particulates, then returned into the environment. This design prevents UV-C exposure to those in the room, making it safe for people to be in the space at all times. Bulbs last up to 10,000 hours or 416 days if running continuously.

Specs

Overall Size:
9-7/8" H x 46-5/8" L x 22-1/8" W
Power: 110 VAC, 50/60 Hz, 4.2 Amps
Max Capacity: 12,600 ft³ per hour

the AIRGLOW™

In-Duct Ultraviolet Light Disinfection



The AirGlow helps reduce and/or eliminate the growth of bacteria, mold and spores on supply and return airflow or within cooling coils. Designed for continuous and long-term use, the AirGlow is constructed out of corrosion-resistant stainless steel and uses UV-C bulbs with a lifespan of 13,000 hours (approx. 18 months).

When used in the ductwork, it kills airborne organisms. When used on cooling coils, the AirGlow is used to reduce biofilms that can accumulate on the coils. Biofilms are known to increase static pressure and cause the HVAC system to work harder and less efficient. Clean coils can deliver a 30% increase in cooling capacity which in turn reduces energy consumption and costs.

Specs

Overall Size*:
16-13/16" H x 8-1/8" W
x Various Depths
Power:
120/230 VAC

the FLASH FLOOD™

Ultraviolet Light Water Purifier

The Flash Flood is a UV-C water treatment device that operates inline with your water system. Ultraviolet light is a superior method of water disinfection because harmful organisms are destroyed simply by light and without the need for any chemicals. Chemical water treatments may result in taste and odor problems, undesirable chemical reactions with substances present in the water, or dangerous handling issues.

Available in multiple sizes, the Flash Flood ranges in capacity from 3 to 416 gallons per minute to fulfill just about any industrial system. Units with a capacity of 12 gallons per minute and higher are NSF/ANSI 61 & 372 certified.

ULTRAVIOLET LIGHT DISINFECTION DOSAGE TIMES

The degree of inactivation by ultraviolet radiation is directly related to the UV dose applied. The UV dose is the product of UV intensity [I] (expressed as energy per unit surface area) and exposure time [T]. Therefore: DOSE = I x T. The relationship between dosage and the reduction of micro-organisms follows a logarithmic scale. A single log reduction is a 90% reduction of organisms. A two log reduction is a 99% reduction of organisms, followed by a three log reduction (99.9%), etc. A more comprehensive chart is available upon request.

UV DOSE (mj/cm2) for a GIVEN LOG REDUCTION

	1-Log	2-Log	3-Log	4-Log	5-Log	Reference
SPORES						
Bacillus anthracis spores - Anthrax spores	24.32	46.2				Light Sources Inc. 2014
Bacillus subtilis ATCC6633	24	35	47	79		Mamane-Gravetz and Linden 2004
Clostridium difficile spores	13.0	26.0	39.0	52.0		UV-Light.co.UK
BACTERIUM						
Bacillus anthracis - Anthrax	4.52	8.7				Light Sources Inc. 2014
Campylobacter jejuni ATCC 43429	1.6	3.4	4	4.6	5.9	Wilson et al. 1992
Clostridium tetani	13.0	22.0				Light Sources Inc. 2014
Corynebacterium diphtheriae	3.37	6.51				Light Sources Inc. 2014
Escherichia coli O157:H7	1.5	3	4.5	6		Tosa and Hirata 1999
Klebsiella pneumoniae	12	15	17.5	20		Giese and Darby 2000
Legionella pneumophila	1.9	3.8	5.8	7.7	9.6	Oguma et al. 2004
Mycobacterium tuberculosis	6.2	10.0				Light Sources Inc. 2014
Pseudomonas aeruginosa	5.5	10.5				Light Sources Inc. 2014
Salmonella typhosa - Typhoid fever	2.15	4.1				Light Sources Inc. 2014
Shigella dyseteriae - Dysentery	2.2	4.4	6.6	8.8		UV-Light.co.UK
Staphylococcus aureus ATCC25923	3.9	5.4	6.5	10.4		Chang et al. 1985
Vibrio comma - Cholera	3.375	6.5				Light Sources Inc. 2014
Yersinia enterocolitica ATCC27729	1.7	2.8	3.7	4.6		Wilson et al. 1992
MOLDS						
Aspergillius flavus	60.0	99.0				Light Sources Inc. 2014
Aspergillius niger	132.0	330.0				Light Sources Inc. 2014
VIRUSES						
Adenovirus type 15	40	80	122	165	210	Thompson et al. 2003
Calicivirus canine	7	15	22	30	36	Husman et al. 2004
Calicivirus feline	5	15	23	30	39	Husman et al. 2004
Coxsackievirus B3	8	16	24.5	32.5		Gerba et al. 2002
Hepatitis A HM175	5.1	13.7	22	29.6		Wilson et al. 1992
Influenza	3.4	6.6				Light Sources Inc. 2014
Poliovirus 1	8	15.5	23	31		Gerba et al. 2002
Rotavirus SA-11	8	15	27	38		Sommer et al. 1989
PROTOZOAN						
Cryptosporidium parvuum, oocysts, tissue culture assay	1.3	2.3	3.2			Shin et al. 2000
Giardia lamblia	<2	<2	<4			Mofidi et al. 2002
Nemotode Eggs	45.0	90.0	135.0	180.0		UV-Light.co.UK
Paramecium	11.0	20.0				Light Sources Inc. 2014

BIOLOGICAL EFFICACY OF CHLORINE DIOXIDE

ClorDiSys' Chlorine Dioxide Gas is registered with the United States Environmental Protection Agency as a sterilizer. The U.S. EPA defines a sterilizer as able "to destroy or eliminate all forms of microbial life including fungi, viruses, and all forms of bacteria and their spores."

Below is a table of some of the more commonly seen organisms that chlorine dioxide has been proven to eliminate. **To date, no organism tested against Chlorine Dioxide Gas has proved resistant.**

PRODUCT: CSI CD CARTRIDGE	**EPA REGISTRATION #:** 80802-1

BACTERIA	VIRUSES	ALGAE, FUNGI, MOLD, & YEAST
Blakeslea trispora[28]	*Adenovirus Type 40*[6]	*Alternaria alternata*[26]
Bordetella bronchiseptica[8]	*Calicivirus*[42]	*Aspergillus spp.*[12,28]
Brucella suis[30]	*Canine Parvovirus*[8]	*Botrytis species*[3]
Burkholderia spp.[36]	*Coronavirus*[3]	*Candida spp.*[5, 28]
Campylobacter jejuni[39]	*Feline Calici Virus*[3]	*Chaetomium globosum*[7]
Clostridium botulinum[32]	*Foot and Mouth disease*[8]	*Cladosporium cladosporioides*[7]
Clostridium dificile[44]	*Hantavirus*[8]	*Debaryomyces etchellsii*[28]
Corynebacterium bovis[8]	*Hepatitis A, B & C Virus*[3,8]	*Eurotium spp.*[5]
Coxiella burneti (Q-fever)[35]	*Human coronavirus*[8]	*Fusarium solani*[3]
E. coli spp.[1,3,13]	*Human Immunodeficiency Virus*[3]	*Lodderomyces elongisporus*[28]
Erwinia carotovora (soft rot)[21]	*Human Rotavirus type 2 (HRV)*[15]	*Mucor spp.*[28]
Franscicella tularensis[30]	*Influenza A*[22]	*Penicillium spp.*[3,5,7,28]
Fusarium sambucinum (dry rot)[21]	*Minute Virus of Mouse (MVM-i)*[8]	*Phormidium boneri*[3]
Helicobacter pylori[8]	*Mouse Hepatitis Virus spp.*[8]	*Pichia pastoris*[3]
Helminthosporium solani (silver scurf)[21]	*Mouse Parvovirus type 1 (MPV-1)*[8]	*Poitrasia circinans*[28]
Klebsiella pneumonia[3]	*Murine Parainfluenza Virus Type 1 (Sendai)*[8]	*Rhizopus oryzae*[28]
Lactobacillus spp.[1,5]	*Newcastle Disease Virus*[8]	*Roridin A*[33]
Legionella spp.[38,42]	*Norwalk Virus*[8]	*Saccharomyces cerevisiae*[3]
Leuconostoc spp.[1,5]	*Poliovirus*[20]	*Stachybotrys chartarum*[7]
Listeria spp.[1,19]	*Rotavirus*[3]	*Verrucarin A*[33]
Methicillin-resistant Staphylococcus aureus[3]	*Severe Acute Respiratory Syndrome (SARS)*[43]	**PROTOZOA**
Multi-Drug Resistant Salmonella typhimurium[3]	*Sialodscryoadenitis Virus*[8]	*Chironomid larvae*[27]
Mycobacterium spp.[8,42]	*Simian rotavirus SA-11*[15]	*Cryptosporidium*[34]
Pediococcus acidilactici PH3[1]	*Theiler's Mouse Encephalomyelitis Virus*[8]	*Cryptosporidium parvum Oocysts*[9]
Pseudomonas aeruginosa[3,8]	*Vaccinia Virus*[10]	*Cyclospora cayetanensis Oocysts*[41]
Salmonella spp.[1,2,4,8,13]	**BACTERIAL SPORES**	*Giardia*[34]
Shigella[38]		**OTHER**
Staphylococcus spp.[1,23]	*Alicyclobacillus acidoterrestris*[17]	*Beta Lactams*[29]
Tuberculosis[3]	*Bacillus spp.*[10,11,12,14,30,31]	*Pinworms Eggs*[46]
Vancomycin-resistant Enterococcus faecalis[3]	*Clostridium. sporogenes ATCC 19404*[12]	*Volatile organic compounds (VOCs)*[47]
Vibrio spp.[37]	*Geobacillus stearothermophilus spp.*[11,31]	*Biofilms*[45]
Yersinia spp.[30,31,40]	*Bacillus thuringiensis*[18]	

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