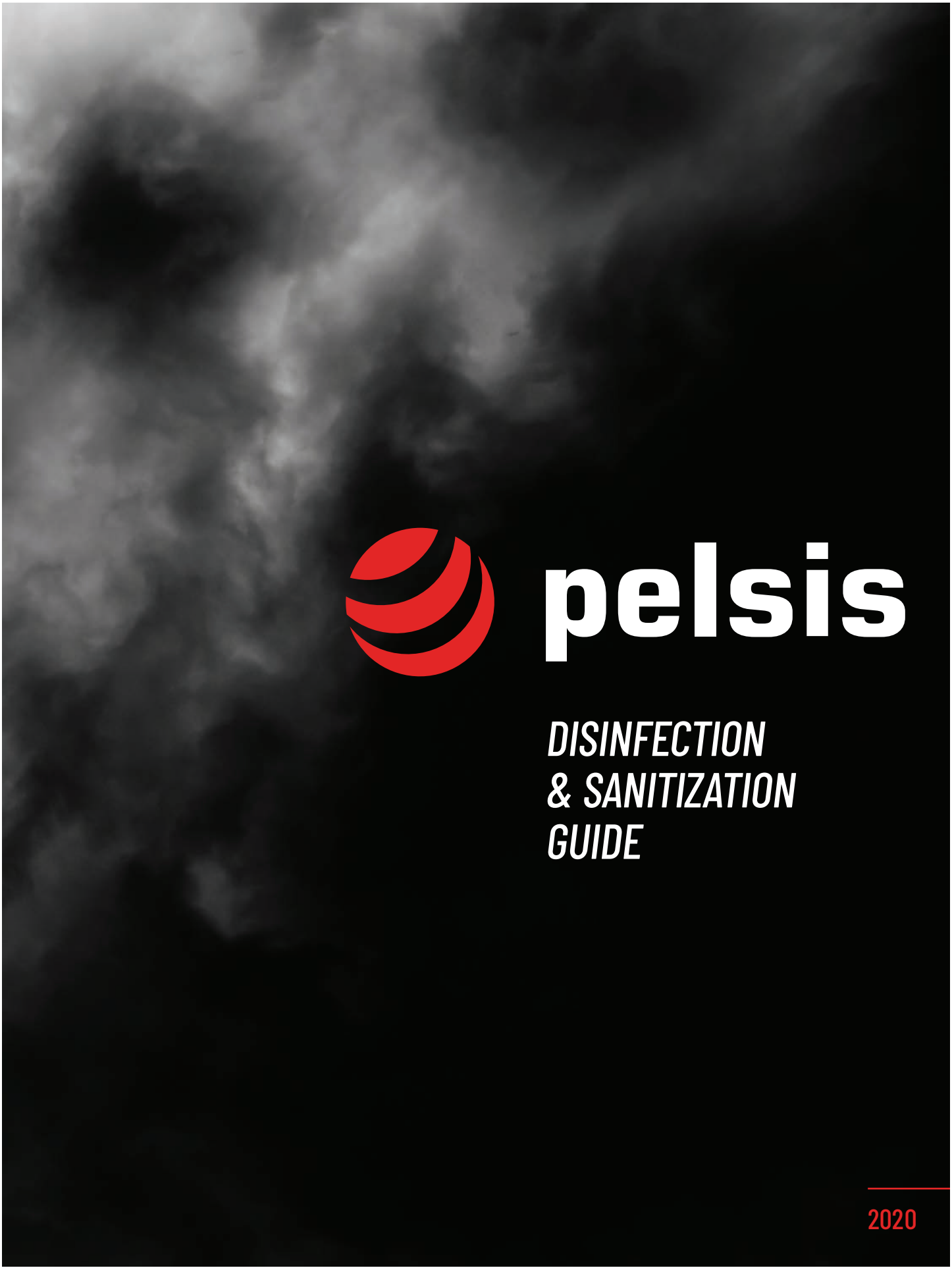


pelsis

DISINFECTION & SANITIZATION GUIDE

2020

THE BEST DISINFECTION EQUIPMENT WHERE IT MATTERS MOST.

Disinfecting and sanitizing surfaces and indoor spaces is a complex process—much more than simply adding chemicals to a fogger tank and turning it on. The process of eliminating disease-causing organisms from a living space or working place is a job for professional products and equipment. The lives of people exposed to pathogenic organisms may depend on the results. Before an application starts, the parameters must be understood and procedures must be clear and followed carefully. The sanitation or disinfection job must be successful and repeatable.

CLEANING	SANITIZING	DISINFECTING	STERILIZING
Removes dirt particles by mechanical, manual or chemical methods.	Uses chemical or physical agents to reduce microbes to a safe level.	The elimination of all organisms that are alive and reproducing.	The complete destruction of all organisms, including spores.

SANITIZATION

Sanitizing surfaces requires first the removal of organic material and other dirt. This cleaning removes microorganisms and organic substrates that allow them to grow. Once surfaces are cleaned, sanitizing can be done to eliminate the microbes remaining. Dirty surfaces protect microbes from sanitizers. Cleaning is the first step to using the various methods of sanitizing, such as steam and hot water, ultraviolet light, and liquids. Sanitizing means the reduction of occurrence and growth of microorganisms on a surface. Bacteria and other organisms are reduced by 99.9% (3 Log 10). Log reduction is a term used to indicate the relative number of microbes eliminated from a surface after treatment. A 4-Log reduction on a surface with 1,000,000 microorganisms would leave 100, which is written as 99.99% reduction. A 5-Log reduction means the number of germs is 100,000 times smaller than it was at the start. For example, if a surface has 100,000 pathogenic microbes, a 5-Log reduction would reduce the number to 1. It is technically not possible to achieve a reduction to zero or a condition of no microorganisms.

> Log numbers represent the number of nines in the percentage reduction and may be given as a Log 10: 1-Log = 90%, 2-Log = 99%, 3-Log = 99.9%, 4-Log = 99.99%, 5-Log = 99.999%, and so on.

STEAM AND HOT WATER

can be used to sanitize surfaces, but their use is often difficult and not useful for every surface. Steam temperature must be high enough to reach or kill all microbes in the target area. Hot water has similar limitations. Water temperature must be at least 180°F (82°C) to eliminate bacteria and other microorganisms. Pouring hot water on surfaces is not reliable because an effective temperature is not retained long enough to be effective. Sterilization is typically done at 185°F (85°C) for 15 minutes, or 20 minutes at 180°F (82°C). Maintaining high water temperature for a long time is difficult.

ULTRAVIOLET GERMICIDAL IRRADIATION

uses UVC (Far-UVC, 207-222 nm) light to kill or inactivate microorganisms. The efficacy of the UV light rays is linked to them hitting the microbes that are exposed. Pre-cleaning target surfaces is important, because grease, dust, and dirt particles will shield microorganisms and reduce the UVC efficacy. Some bacteria are somewhat resistant to radiation and require long exposure time to kill. UVC light can be used to kill microbes and other pathogens in the air. However, not all locations and surfaces are suitable for sanitizing with UVC light.

SANITIZING CHEMICALS (LIQUIDS)

clean surfaces by removing organic matter and reducing the presence of bacteria to a safe level. Before sanitizing surfaces, they must be cleaned (dirt removed). Sanitizing materials can be applied to various inert surfaces, including some foods. The three primary chemical compounds used as sanitizers are chlorine-based cleaners, quaternary ammonium, and iodine sanitizers. Chlorine is a commonly used chemical sanitizer agent; it is highly effective and relatively inexpensive.

DISINFECTION

Disinfection products kill or inactivate microorganisms, including bacteria, fungi, and viruses on inert surfaces. Some of the common disinfecting agents do not inactivate bacterial spores, but products that include hydrogen peroxide do control the spore stage of bacteria. Disinfectants work by destroying the cell wall of microbes or interfere with their metabolism. Disinfection means to kill nearly 100% of the microorganisms on a surface. The bacteria and other organisms are reduced by 99.9999% (6 Log 10).

CHEMICALS AND CONCENTRATION

The product label directions for mixing and applying disinfectant chemicals must be followed carefully. The label provides information on preparing the correct concentration, which determines contact time and its toxicity to microorganisms. Some disinfectants are single-chemical formulations, while others may be combinations of two or three chemicals; each has a role to play in the mixture. Commercial formulations of single or multiple-ingredient chemicals are unique and have specific mixing and application directions. Before application, the user must read and understand the label completely and follow all safety precautions. These products are registered with the EPA or cleared by the FDA.

ULTRA-LOW VOLUME (ULV) APPLICATION

The terms used to describe the amount of liquid applied include high volume (HV), very low volume (VLV), and ultra-low volume (ULV). The quantity applied depends on the desired surface coverage by droplets and the size of the droplets. The concentration of some disinfectants can be high, and they can be applied as a concentrate (undiluted) at ultra-low volume to surfaces. Droplets 8 to 10 microns are usually considered to be ULV, but this definition is variable.

SAFETY AND PRECAUTIONS

Disinfectants are registered as pesticides by the U.S. EPA (Environmental Protection Agency). When a pesticide (disinfectant) is sprayed, there is risk to the applicator of breathing the chemical into his/her lungs. The average person breathes 56 cubic feet (1.6 cubic meters) of air per hour. Disinfectants are strong chemicals used in concentrations that kill pathogenic organisms; however, they should not be a health threat to those applying them.

DISINFECTING AGENTS

are applied at specific concentrations to protect the user from excessive exposure. Health problems linked to the use of disinfectants include respiratory disease, asthma, and reactive airway disease. Gloves and adequate ventilation during application should be considered for all users. Sodium hypochlorite used at concentrations in household bleach (5.25 to 6.15%) can produce eye irritation and-/-or throat burns. Other problems accompanying the use of hypochlorites include the release of toxic chlorine gas when mixed with ammonia or some cleaning agents.

SPACE SPRAYING

concentrates a large number of small droplets suspended in the air of a confined space. When treatment results in an unusually high concentration, the droplets are capable of propagating flame from one to another if an ignition starts the process. Ignition sources include gas pilot lights, sparks from electric switches, and static electricity. A safe level of small droplets in a space is the equivalent of 1 gallon per 50,000 cubic feet (2.7 liters per 1,000 cubic meters). The volume of the treatment space and the recommended application volume (gallons or liters per cubic feet or meters) must be calculated and not estimated.

Foggers must not operate unattended in confined spaces. This can result in excess residue around the fogger, or a dangerous concentration of airborne particles.

ACCURATE CALCULATION

The volume of the treatment space determines application time and the fogger flow rate setting. Volume of a treatment space is determined by multiplying the length, width and height (L x W x H). Large objects in the space decrease the actual volume and must be considered when determining chemical application rate. Determine the volume of these objects and subtract from the total space volume. Application rates on disinfectant labels and other biocides may be based on gallons per square feet, which is simply L x W, instead of cubic feet.

ENVIRONMENTAL CONDITIONS

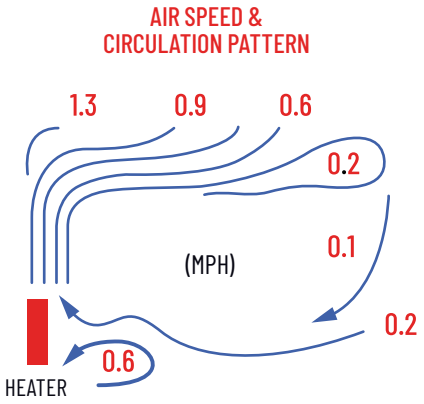
The movement and final deposit of droplets after application are influenced by conditions inside the space. These include entering and mixing of outside air around doors and windows, and normal air currents along walls and ceiling. Mechanical air distribution systems can create directed air currents and cross-ventilation.

AIR TEMPERATURE

Above 80°F and low (35%) relative humidity can increase evaporation of droplets. Rapid evaporation during application reduces droplet size and limits effectiveness on surfaces. The large surface area and small volume of small droplets favors evaporation because these droplets remain airborne for a long time in the treatment space. A 20 micron diameter droplet can shrink to about 7 microns before landing on a surface. The 50 micron droplets in a mist can shrink to 17 microns in about 2 seconds in a hot and dry air space.

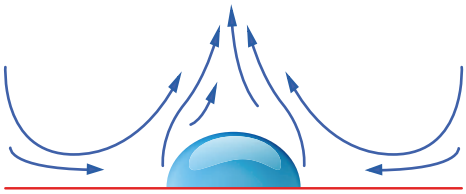
AIR CURRENTS

In a typical room are not easily detected because they are low speed. But they can be strong enough to influence movement of droplets. Small droplets are carried in air streams that move up walls to the ceiling, and currents moving along the floor. These air streams move small droplets in a spray away from the target surface.



CONTACT TIME AND EVAPORATION OF DROPLETS

Contact time or dwell time is the amount of time a disinfecting agent needs to be on a surface to kill the exposed microorganisms. Contact times are between 30 seconds and 15 minutes. Modern disinfectants dry on a surface in less than 5 minutes and reach their peak in efficacy 60 seconds after deposition. The lifetime of droplets on surfaces must match the required contact time on the product label. Research has demonstrated significant microbial reduction with contact times of 30 to 60 seconds. Factors that influence droplet lifetime are size, surface contact, and environmental conditions surrounding the droplet.



DROPLET SIZE

The large surface to volume ratio of small droplets results in faster evaporation than large droplets. Evaporation is a function of vaporization and small droplets lose volume quickly due to their size. Lifetime of a 100 micron droplet is about 10 times that of a 30 micron droplet. After contact with the treatment surface, droplet size decreases with the onset of evaporation. On upward-facing surfaces droplets become flat and the surface absorbs heat and evaporation increases.

COVERAGE

The objective of treating surfaces is maximum coverage without runoff of large droplets. When surfaces are uniformly covered with droplets and there is no runoff, evaporation time is reduced. When droplets are separated by a distance comparable to their radius the evaporation is significantly reduced due to the saturation of the surrounding air.

EVAPORATION

The rate of evaporation decreases when ambient temperature and humidity are high because this can result in water condensation on droplets. Exposed to 60°F and 58% RH, a 56 micron droplet from a cold fogger has a lifetime of about 7 seconds in the air. A 150 micron droplet delivered from a spray nozzle has a lifetime of about 1 minute. Small droplets may not meet the contact time requirement of disinfectants if they have limited coverage area and evaporate quickly.

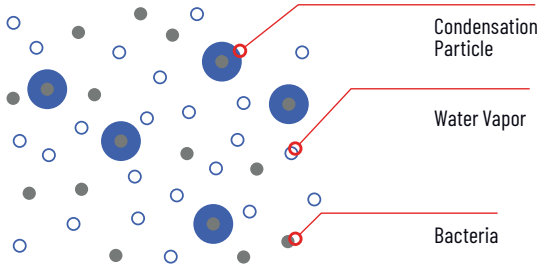
DROPLET LIFETIME

The short lifetime of a disinfectant droplet is due to liquid vaporizing from the droplet surface. It diffuses into the surrounding air until the droplet disappears. Vaporization depends on the active ingredient and surfactants in the formulation. Standardizing the lifetime of a droplet based on size is difficult. A disinfectant may be available in several formulations, and each can a different contact time because the droplets from each may have a different lifetime.

AIRBORNE DISINFECTION

Bacteria and viruses can be attached to airborne particles and contaminate indoor spaces. Airborne bacteria are 2 to 3 microns in diameter, 25% of airborne viruses are 3 to 6 microns, and mold spores are 6 microns and larger. A disinfectant must be sprayed into the air to achieve complete mixing of droplets in the space. Lethal action of the droplets is due to collision and condensation of the germicide onto microbial cells. High relative humidity increases efficacy of airborne disinfection because it extends the life of droplets.

Disinfection of air-borne microorganisms is generally effective with 10 micron droplets; this size matches most infectious particles. Efficacy of aerial disinfection is based in part on the collision of droplets and air-borne bacteria. Killing action is also linked to condensation on bacteria-containing particles. Disinfection of an air space requires a germicide in a vapor state. A small-droplet spray increases the potential of creating a vapor throughout the space.



HAND-HELD COLD FOGGERS

Can be effective for air-space disinfection. These foggers can be adjusted to deliver droplets in the range of 10 to 20 micron diameter, which have a fall time of less than 15 minutes. The size of these droplets is suitable for contact with airborne bacteria and mold spores. These foggers can be used to direct the spray to corners and ceiling to ensure the entire space receives droplets. When spraying is completed the room can be closed for 30 minutes to ensure air streams do not influence droplet distribution.

SURFACE DISINFECTION

Disinfection of surfaces generally requires the application of liquid agents in the form of a spray of large droplets to cover the surface. Contaminated surfaces must be exposed to a germicide or disinfectant for the minimum contact time to be effective. Contact times for modern disinfectants can be 10 minutes, but efficacy may be achieved before that time. Exposure of 60 seconds has been shown to be effective against the pathogenic microorganisms Listeria, Escherichia coli, and Salmonella.

SPRAY-AND-WIPE APPLICATION

Complete disinfection includes treating the surfaces exposed to human contact, providing the validated contact time, and finishing by wiping the surfaces. The objective of a controlled application of liquid disinfectant is to create a film on the surface. If insufficient disinfection is applied, it may dry before the contact time is reached. While securing the contact or dwell time is essential, wiping afterwards contributes by removing the residue.

Wiping surfaces after the proper contact time should be with a cloth that is wet, but not saturated. A wipe cloth with excess liquid may leave behind residue on the surface. Folding and refolding the wiping cloth will ensure a new surface is used after about 10 wipe lengths. Wiping should not be done in a circular motion, although this is the most convenient motion. The best practice is wiping in straight lines with overlapping strokes. This ensures the disinfected surface is completely covered in the process.

SURVIVAL OF COVID-19 VIRUS ON SURFACES

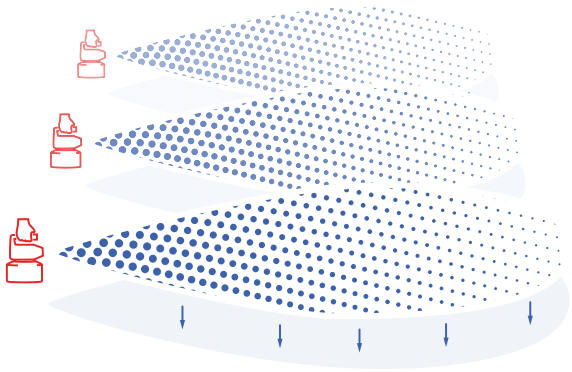
TYPE	TIME (Hrs)
Cardboard	24
Copper	4
Plastics & Stainless Steel	48-72
Aerosols	3+
Surgical Face Masks	7 Days

FOGGING APPLICATION

Surface disinfection relies on uniform-sized droplets applied evenly over contaminated surfaces. These droplets are subject to evaporation soon after spraying and after settling on a target surface. On the surface they must remain intact long enough to provide an effective dwell time. Once droplets dry the residue may not be effective as a disinfectant. Hand-held cold foggers are effective in delivering 20 to 50 micron droplets suitable for surface disinfection. The benefit of disinfectant fogging is the coverage provided by droplet coverage on a surface. Applying 50 micron droplets from a cold fogger is the optimal droplet size for delivering surface-cleaning liquids. While some disinfectants are optimal with 20 micron droplets, the time a 20 micron droplet remains on a surface before drying may not be the optimal 10-minute contact time. However, disinfectants reach their peak activity in the first 60 seconds of contact, as an example, accelerated hydrogen peroxide has a contact time of about 1 minute, but a drying time of 3 to 4 minutes.

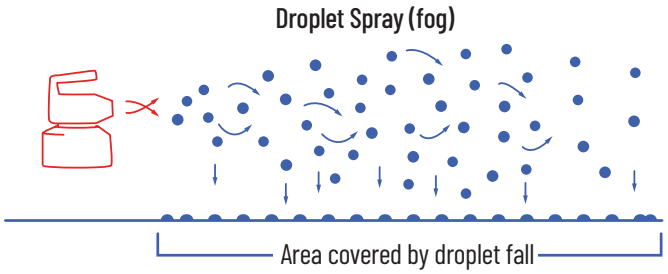
SURFACE AREA METHOD

This method uses the droplet spray pattern to treat surfaces. The goal is to apply the spray horizontally above target surfaces. Droplet fall from fog will treat the surface area directly below. The operator positions the spray pattern over the target surface and selects a time (seconds) to spray. At the end of the selected time, the fogger can be moved to the adjacent or next location. The distance moved to an adjacent location is based on the width of the spray pattern and allows for overlap. New locations are treated for the same spray time, then the fogger moved to the next location. Coverage of all surfaces will be nearly uniform.



APPLY TO OVERLAP AND
COVER SURFACES BENEATH FOG

The droplet spray from the fogger nozzle has a width and length. This feature is only partially visible because most of the spray is composed of small (less than 50 micron) droplets. The characteristics of the spray pattern are distinct to the nozzle and the blower of the fogger. The flow rate to the nozzle also influences the pattern, primarily by making it wider and longer with increased flow.

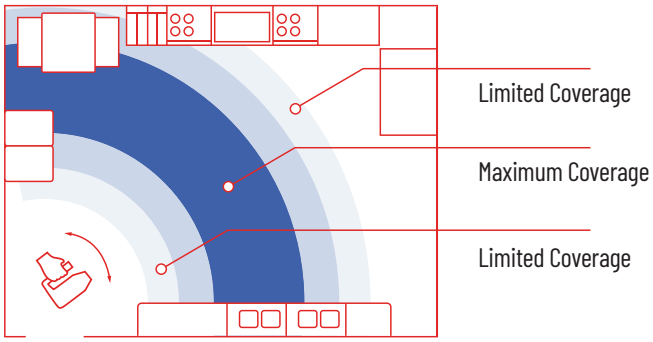


The droplet spray pattern determines the surface area treated by the valve setting on the fogger. Because of their size and weight droplets in the spray fall out along the length of the pattern. Large droplets fall out at the front of the pattern and small droplets at the end of the pattern. The droplet fall determines the size of the treatment area, which is the square foot coverage of the spray pattern.

The square foot coverage of this method is defined by the droplet fall from the spray. The size can be accurately determined by tracking the number and concentration of droplets in the area beneath the spray pattern. Air currents can influence the deposition of small droplets falling from the pattern.

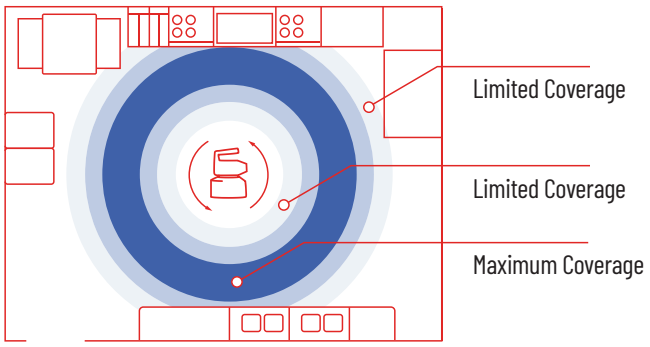
FAN FOGGING METHOD

This fogging method attempts to treat by moving the fogger side-to-side in a fan pattern to fill the space with fog. Droplet coverage is limited at the middle or end of the spray but is concentrated at the fogger location where the large droplets fall. Most surfaces will not be uniformly treated with disinfection solution. This method may appear effective because the space is filled with fog, but the key surfaces will have little or no disinfectant residue.



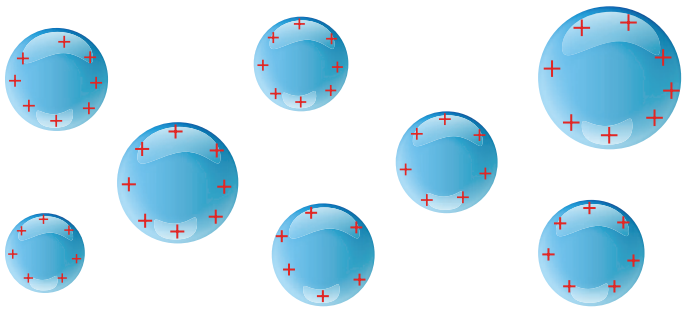
SET-IN-PLACE METHOD

This fogging method attempts to treat a space by operating a fogging in the center of the space. Expectation is that a spray directed upward will deliver droplets to the entire room. The result is a treated area limited to the space surrounding the fogger, and little residue on other surfaces. When the spray is projected upward, the large and medium-sized droplets fall out immediately, small droplets may move a short distance. There is little uniformity to the disinfectant residue on surfaces in the space.



ELECTROSTATIC APPLICATION

Electrostatic sprayers give droplets a positive or negative electrical charge, depending on the machine. The charge is on the surface of water molecules in the droplet, not on the active ingredient. The charge has no effect on the efficacy of the formulation being applied. Electrostatic application is usually done with hand-held foggers using a flow rate that produces large droplets. The droplets receive a positive charge when they pass an electrode positioned at the nozzle. Positive charged droplets are attracted to charged or neutral target surfaces, which ensures uniform coverage with the droplets in the spray. The benefit of electrostatic spraying is the coverage achieved by the spray droplets on surfaces. Charged droplets resist joining into larger droplets on the treated surface. This gives optimal residue from insecticides and the surface contacted with disinfectants. The airborne droplet charge gradually decreases due to ions in the air. Droplets are applied close to the target surface and do not remain airborne for a long time.



NON-ELECTROSTATIC FUNCTIONS

Although the electrostatic feature is limited to a zone close to the nozzle, the overall performance of the fogger remains intact. The spray pattern, coverage area and droplets delivered at distances from the nozzle are not changed, and the fogger performs a surface spray. The repellency of like-charged (+) electrostatic droplets in the spray pattern, may enhances the movement of droplets close to the nozzle and results in a more uniform delivery. Electrostatic droplets are maintained in the spray pattern for only a short distance.

THRESHOLD DISTANCE

Nozzles of electrostatic foggers are directed at the target surface to ensure contact and coverage by the charged droplets. The electrostatic zone or threshold distance for electrostatic foggers is typically 12 to 18 inches, depending on the strength of the air stream. The droplets are charged as they leave the nozzle and retain the charge for a short time. As the liquid exits the nozzle orifice it is further broken up into smaller droplets by the electrostatic charge. Coverage on the surface may be dominated by small droplets, and there is a dense pattern of droplets on the reverse surfaces.

DISINFECTANT CHEMICALS

Disinfectants target a wide spectrum of microorganisms, including bacteria, viruses, and fungi, depending on their active ingredient. The 1 to 15-minute contact time is linked to the active ingredient(s) and formulation. The higher the concentration, the greater the efficacy and the shorter the time to achieve microbial kill. Reducing by half the concentration of a quaternary ammonium compound requires doubling its disinfecting time but cutting by half the concentration of a phenol solution increases its disinfecting time.

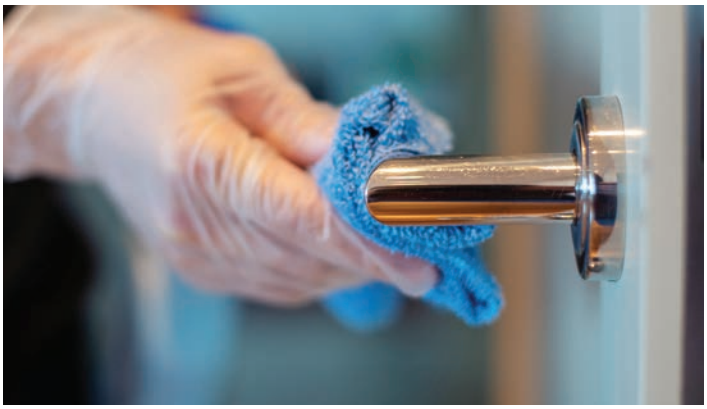
The EPA has established protocols that allow antimicrobial product developers to register disinfection and sanitizer products intended for fogging or misting applications. The protocol confirms a product's antimicrobial efficacy against public health organisms when tested in a dedicated fogging and misting testing room. In the past, the EPA did not require manufacturers to submit data when fogging or misting product claims were registered. The EPA Pesticide Program now requires disinfection claims to be substantiated by submitting GLP-compliant data to demonstrate efficacy when the product is applied using a fogging or misting device.

ISOPROPYL, ETHYL ALCOHOL

Alcohols require time to work and they may not penetrate organic material. They evaporate quickly which make long exposure time difficult to achieve. Isopropyl alcohol (IPA), is commonly used within pharmaceutical manufacturing facilities, hospitals, and electronics and medical device manufacturing. Different concentrations and alcohol types provide excellent cleaning and disinfection properties when applied correctly. Isopropyl alcohol in solutions between 50 percent and 70 percent alcohol and purified water is effective against bacteria, fungi, and viruses. Concentrations below 50 percent and above 90 percent IPA are less effective; solutions above 90 percent kill bacteria but require a longer contact time.

Water in isopropyl alcohol solutions is important in killing pathogenic microorganisms. Water acts as a catalyst in denaturing the proteins of bacteria cells. Solutions of 70 percent IPA penetrate the cell wall and enters the entire cell; the cell water content slows evaporation, which increases surface contact time.

> Ethyl alcohol at concentrations of 60 percent to 80 percent, is effective in killing a wide range of viruses, such as influenza, rhinovirus, and rotaviruses.



QUATERNARY AMMONIUM COMPOUNDS (QUATS)

QACs are disinfectants used alone or added to cleaning products. They provide anti-microbial activity. QACs are solids dissolved in a liquid to make a solution. These chemicals are membrane active that affect the outer membrane of gram-negative bacteria that result in a rapid collapse of the cell. They are antibacterial and the EPA considers them a pesticide.

PERACETIC ACID, ELECTROLYZED WATER

Peracetic acid combined with hydrogen peroxide reduces bacteria on various surfaces. This product has an odor like vinegar. Electrolyzed water (hypochlorous acid) disinfectants are produced by passing an electric current through a salt water solution. This material reduces bacteria on surfaces better than quaternary ammonium disinfectants. These disinfectants have an EPA safety rating of category IV (applicators do not need personal protection equipment while using).

CHLORINE AND CHLORINE COMPOUNDS

Hypochlorites are available as liquid (sodium hypochlorite) and the most prevalent chlorine products are water solutions of 5.25 percent to 6.15 percent household bleach. Chlorine compounds have a broad spectrum of antimicrobial activity, do not leave toxic residues, are fast acting, and remove dried or fixed organisms and biofilms from surfaces. Toxic activity of chlorine is attributed to hypochlorous acid (HOCl) in the solution. Low concentrations of chlorine (HOCl) kill bacteria in seconds. Sodium hypochlorite solutions are alkaline (pH 11+), and the more microbicidal type of chlorine is believed to predominate in solutions.

HYDROGEN PEROXIDE

Hydrogen peroxide is effective against bacteria, yeasts, fungi and viruses. A 0.5 percent accelerated hydrogen peroxide provides kill of bacteria and viruses in 1 minute and fungicidal activity in 5 minutes. Commercially available 3 percent to 6 percent hydrogen peroxide is an effective disinfectant when used on inanimate surfaces and is effective in spot-disinfecting fabrics.

APPLICATION EQUIPMENT

Hand-held foggers and portable aerosol sprayers are the most practical application equipment for sanitation and disinfection treatments. Hand-held foggers and aerosol sprayers are designed for directional application to surfaces. They use a metering valve to regulate liquid flow to the nozzle to control droplet size. Droplet sizes from 30 to 50 microns provide the contact time or dwell time for most disinfectants and sanitizers.

ULV

Ultra-low volume (ULV) is defined as the minimum volume of chemical, such as a disinfectant, per unit area required to achieve a level of control. When small volumes of are applied, the liquid is finely divided to provide a sufficient number of droplets on the surface to achieve disinfection or sanitation. ULV is often defined as a specific droplet size, such as 8 to 10 microns, and foggers may be described as having ULV delivery. In fact, ULV is an application method, and the effective droplet size can range from 8 to 20 microns. Cold foggers are often distinguished from thermal foggers by calling them ULV foggers.

COVERAGE

Droplet throw and droplet size influence the coverage achieved. The distance droplets move from the nozzle will determine the surfaces and space treated, and the droplet size will determine how long droplets remain airborne. The most effective application method is to direct the droplet spray to the target surface. Stationary foggers will not treat all surfaces equally, but only the area around it. This may result in excess deposit and a ring of residual liquid around the machine.

FLOW RATE

Is the amount of liquid flowing to the nozzle from the formulation tank. The amount determines the size of the droplets in the spray: the higher the flow rate, the larger the droplets; the lower the flow rate the smaller the droplets. The metering valve on the formulation tank determines the ounces or milliliters of liquid flowing to the nozzle. Stainless steel meters prevent corrosion and have consistent measuring when there is a range in formulation viscosity. The viscosity of the formulation can influence the droplet size and may require a larger setting.

DROPLET SIZE AND THROW

are determined by adjusting the metering valve. Instruction manuals for foggers provide information on meter setting, flow rate, and droplet size per flow rate. Hand-held foggers have a powerful blower and can produce a range of droplet sizes; however, there is a technical limit based on flow rate. Droplet throw is the distance a droplet can travel into the air before it loses momentum and starts to drop. The distance depends on the droplet diameter and the speed leaving the nozzle. Small droplets have a longer throw distance than large droplets, but they evaporate rapidly after exiting the nozzle.

FOGGERS

HURRICANE ES

A hand-carry electric (cord) ULV fogger with a 1-gallon tank that uses electrostatics to put a positive (+) charge on droplets. Stainless-steel metering valve provides flow rates for 10 to 50 micron droplets delivered through three air-shear nozzles. Droplet throw is 15 to 20 feet, the width of the droplet spray is about 4 feet and height about 6 feet. Estimated coverage for a typical application is 60 to 80 square feet. Electrostatic threshold distance is 12 to 18 inches from the front of the fogger. This fogger delivers water-based formulations with moderate to high viscosity. Cannot be used without operator grasping the handle.

HURRICANE ULTRA II

A hand-carry electric (cord) ULV fogger with a 1-gallon tank that uses three duel-vortex, air-shear nozzles to create droplets. Stainless-steel metering valve provides three positions for flow rates for 10 to 50 micron droplets delivered through the unique nozzles. Droplet throw is 15 to 20 feet, the width of the droplet plume is about 4 feet and the height is 6 feet. Coverage for a typical water-based application is 60 to 80 square feet. The nozzle system enables the delivery of oil- and water-based disinfectant formulations with moderate to high viscosity.

CYCLONE ULTRA

A hand-carry electric (cord) ULV fogger with a 1-gallon tank that uses the DynaFog Microtec™ nozzle to create droplets. Stainless-steel metering valve provides three positions for flow rates of 1.4 to 3.1 ounces per minute for 8 to 10 micron droplets. Formulations with high viscosity have larger droplets, in the range of 15 to 20 microns. Droplet throw is 8 to 12 feet. The nozzle enables the delivery of oil- and water-based disinfectant formulations with moderate to high viscosity. The delivery can be directed to 30° above horizontal to 20° below.

FOGGERS (CONT.)

TORNADO, TORNADO FLEX

A hand-carry electric (cord) ULV fogger with a 3-gallon tank that uses the DynaFog Microtec™ nozzle to create droplets. The large handle and lightweight frame make these foggers portable. The multi-turn metering valve provides continuous positions for flow rates of 2.4 to 11.4 ounces per minute for droplet sizes that ranges from 5 to 40 microns. The nozzle enables delivery of oil- and water-based disinfectant formulations with moderate to high viscosity. The Typhoon Flex model has an 18-inch hose extension of the nozzle for directed spraying.

FLEX-A-LITE 2600

A hand-carry electric (cord) ULV fogger with a 1.5- gallon tank and a 18 inch application hose. Flow rate is adjusted at the nozzle to deliver a maximum of 2.5 ounces and 39 micron droplets. Droplet throw is about 15 feet, and the width of the droplet plume is 2.5 feet and height 2 feet. The blower motor delivers a powerful air stream through the exclusive 2600 air-shear nozzle. Estimated coverage is about 40 square feet. Application can be with water- or oil-based formulations with low to moderate viscosity. It is best carried and used as a point-and-spray fogger with the 18-inch hose extension.

PORTABLE AEROSOL SYSTEM (PAS)

An aerosol electric (corded) ULV fogger with flow rate adjustabile from 4 ounces to 10 ounces per minute. At maximum flow rate (gauge 30 pounds per square inch) droplet size is 40 to 50 microns. Droplet throw is 15 feet, with a 10-foot effective distance. Plume width is 2 feet and height is1.5 feet. Coverage at 30 pounds per square inch is 20 square feet. Compressor provides 35 pounds per square inch nozzle pressure and a powerful air stream. Applies water- or oil-based formulations with low to moderate viscosity. Best use as a point-and-spray fogger for disinfecting surfaces; 10 foot. hose provides mobility.

PORTABLE AEROSOL SYSTEM (PAS), CART MOUNTED

An aerosol electric (corded) ULV fogger mounted on a hand cart. Flow rate adjustable from 4 to 10 ounces per minute. Maximum flow rate (gauge 30 pounds per square inch) droplet size is 40 to 50 microns. Droplet throw is 15 feet, with a 10- foot effective distance. Plume width is 2 feet and height 1.5 feet. Coverage at 30 pounds per square inch is 20 square feet. Compressor provides 35 pounds per square inch nozzle pressure in a 3-gallon tank. Applies water- or oil-based formulations with low to moderate viscosity. Best use as a point-and-spray fogger for disinfecting surfaces; 10-foot hose provides mobility.

NIGHTSTAR

An automated, electric (corded) ULV fogger that can be used for large-area disinfection treatments. It can treat 60,000 square feet without assistance from other fans. It has a large capacity nozzle, and a 22-inch diameter axial fan that delivers 8000 cubic feet per minute. Fan housing and an air-shear nozzle adjust to vertical, horizontal, and upward / downward positions. Flow rates and droplet sizes are: 0.8 gallons per hour equals 8 microns; 2.0 gallons equals 20 microns, 2.5 gallons equals 30 microns; 4.1 gallons equals 50 microns. Droplet throw with fan and nozzle is 300 feet; nozzle only is 50 feet. Automated and programable to start, stop, and flush on a 24-hour time schedule.

VERSA-FOGGER

A gasoline-powered, backpack ULV fogger that can be used for large-area disinfection treatments. It has a 4-stroke engine (no mixing oil with the gas), and a 1-gallon pressurized formulation tank. It has a high-strength aluminum frame. The flow rate is adjustable on the nozzle at the end of a 4-foot hose. Droplet size ranges from 33 to 40 microns. Oil-based formulations provide 20 micron droplets. The effective droplet throw is 10 to 12 feet. For disinfection spraying the flow rate can be reduced to deliver droplets to surfaces without wetting and runoff. The application hose provides a point-and-spray feature to this fogger.

FOGGERS (CONT.)

TWISTER XL3

A gasoline-powered, backpack ULV fogger that can be used for large-area disinfection treatments. It has a 4-stroke engine, and a 1-gallon formulation tank. It has a lightweight frame. The flow rate to the Microtec™ nozzle is adjustable at the end of a 4-foot hose. Droplet size ranges from 10 to 34 microns, depending on the orifice used. Oil- and water-based formulations can be applied. The droplet throw is 10 to 12 feet. For disinfection spraying the flow rate can be reduced to deliver droplets to surfaces without wetting and runoff. The application hose provides a point-and-spray feature.

DYNA-JET L-30

A battery-powered, rotary-atomizer ULV fogger that weighs 147 pounds (with battery) and fits on an electric cart. It can be used indoors to deliver a uniform droplet size of disinfectant. Droplet throw is about 50 feet. The mobility and quiet operation make it ideal for treating large indoor spaces. Pumping system delivers up to 14 ounces per minute and 20 micron droplets in the plume. The droplets are produced by a spinning disc and projected hundreds of feet by a high-output axial fan. The direction of the droplet spray can be rotated horizontally 360° and can be directed to 55° above horizontal.

EQUIPMENT SELECTION GUIDE

OUTDOOR SPACES

Label directions must be read, understood and followed. Personal protection equipment (PPE) prevents exposure during application by hand-carry and backpack foggers. Air currents outdoors will reduce coverage and carry droplets away to non-target sites. Open doors and air vents near treated areas may allow fog to enter. Consider the length and width of the droplet plume when using hand-carry foggers. Over-application to surfaces results in runoff on wet surfaces. Use ear-protection when using backpack foggers.

LOCATION	EQUIPMENT TYPE	PRODUCT
LARGE OPEN SPACES		
Surfaces in sports stadiums, auto-racing venues, amphitheaters	Backpack ULV fogger (gasoline power)	Twister XL3 Versa-Fogger
CRITICAL SURFACES		
Hand rails, door handles, vending machines, water fountains, golf carts	Hand-carry ULV fogger (electric)	Hurricane ES (electrostatic) Hurricane Ultra II
SEMI-OPEN SURFACES		
Bus, tram and train station platforms, car-park elevators	Backpack ULV fogger (gasoline power) Hand-carry ULV fogger (electric)	Twister XL3 Versa-Fogger Hurricane ES (electrostatic) Hurricane Ultra II

INDOOR SPACES

Label directions must be read, understood and followed. Personal protection equipment (PPE) prevents exposure during application by hand-carry foggers in small spaces. Air currents in confined spaces will distribute small droplets during and after application. Re-entry of treated areas must take into consideration that the deposition of small droplets in the fog may require 30 minutes. Consider the length and width of the droplet plume when using hand-carry foggers. Over-application to surfaces will result in runoff on wet surfaces.

LOCATION	EQUIPMENT TYPE	PRODUCT
ENCLOSED SPACES		
Rooms, office cubicles, hallways, kitchens, elevators, school and commercial buses, train cars, commercial trucks	Hand-carry ULV fogger 1, 1.5-gal tank (electric) Carry-case and cart-mounted ULV fogger 1, 3-gal tank	Hurricane ES Flex-A-Lite 2600 Hurricane Ultra II Cyclone Ultra Portable Aerosol System
CRITICAL SURFACES		
Hand rails, doors, hospital bed frames, vending machines, water fountains	Hand-carry ULV fogger 1-gal tank	Hurricane ES (electrostatic) Hurricane Ultra II
LARGE ROOM SURFACES		
Office desks, chairs and breakrooms, gym bleachers and locker rooms, training rooms, large commercial kitchens, hotel lobbies, luggage storage rooms, theaters	Hand-carry electric ULV fogger 1, 3-gal tank Carry-case and cart-mounted ULV fogger 1, 3-gal tank Automated ULV fogger (cart mounted)	Flex-A-Lite 2600 Hurricane Ultra II Cyclone Ultra Tornado, Tornado Flex Portable Aerosol System Nightstar
LARGE CLOSED SPACES		
Airport and hotel lobbies, sports arenas, convention centers	Cart-mounted ULV fogger with 300 ft droplet plume to treat 60,000 cu ft	Nightstar Dyna-Jet L-30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