



SAFETY & EFFICACY REPORT

SAFETY

The CASPR technology generates an extremely low level of gaseous hydrogen peroxide, H₂O₂. The OSHA and NIOSH standard for safe use in occupied spaces is 1 ppm (parts per million) of H₂O₂ in the air. CASPR industrial-grade technology generates below 0.01ppm, or is 100x below the standard, and our healthcare-grade is below 0.03ppm. The healthcare-grade technology has been installed in hospitals across the world for multiple years in areas including the ICU and Neonatal ICU, where people are bedridden for weeks and months at a time. To measure safety of our output, CASPR has completed third party OSHA standard testing in chambers and in live environments. Our customers have also completed and shared their own results.

Although California has usually more restrictive limits, the California PEL for H₂O₂ is also set at 1 ppm for workplaces under its jurisdiction (see: https://www.dir.ca.gov/title8/5155table_ac1.html#_blank). The Department of Industrial Relations of the State of California clarifies in that document that ppm is to be understood as “Parts of gas or vapor per million parts of air by volume” See footnote (e) on page 24.

The only fully validated analysis and sampling method for H₂O₂ that OSHA provides is method number 1019. Please note that the reliable quantification limit of that method is 36.6 ppb (parts per billion, i.e. 0.0366 ppm, which is less than 4% of the permissible exposure limit, PEL of 1 ppm). In other words the OSHA analysis and sampling method no. 1019 would not be able to quantify H₂O₂ concentrations below the limit of 36.6 ppm. That limit could be considered the OSHA limit concentration of concern.

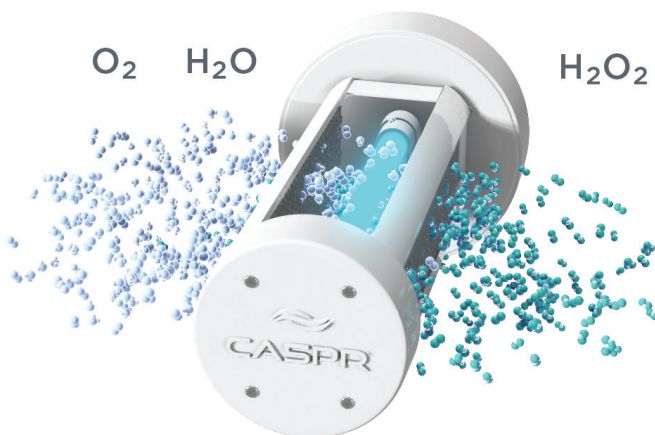
CASPR in-duct units are sized by square footage, e.g., the CASPR 1000 is for a 1,000 square foot space, the CASPR 5000 covers 5,000 square feet, and the CASPR Compact+ is recommended for spaces up to 1,500 square feet. We need to calculate the space to ensure adequate coverage. We use a square foot calculation rather than a cubic foot calculation because the oxidizing molecules are slightly heavier than air. They will be mainly

concentrated about eight feet from the floor - the space occupied by people. Aerosol droplets that may be of concern will eventually fall down into this space to be treated. If the air supply vents are higher in areas with high ceilings, the oxidizing molecules will cover that higher space and fall down over time.

Considering the recommended distribution of CASPR units to cover a space, the H_2O_2 concentrations as estimated at 30 ppb (i.e. 0.03 ppm) for the Compact+ device and about 1 ppb (i.e. 0.001 ppm) for the CASPR in-duct technology. Our testing shows on the in-duct technology shows that we are below 0.01 ppm (i.e. 10 ppb) in the laboratory setting which allows for no air flow and could potentially have built up/over saturation.

We are at these same limits in the live setting which include just traces of H_2O_2 are synthesized by the CASPR catalytic units and dispensed to the room environment, the anti-microbial effect is highly effective. The molecular power to oxidize or decompose pathogens is independent of the concentration: The reduction/oxidation potential (ROP) is a measure of the reduction or oxidation tendency/power of a substance. H_2O_2 for example has an ROP of 1.77V on the scale between zero for hydrogen H_2 , and the strongest oxidizer, fluorine, F at 2.87V. In our Monday phone call Dr. Suchy referred to the cleaning power of fresh air in the sunlight. For example, gas-phase hydrogen peroxide concentrations in the atmosphere ranged from less than 0.05 to about 1 ppb and from less than 0.05 to 2 ppb at the urban and rural sites respectively in North Carolina. This is a concentration we target indoor with the CASPR PRO technology. Please note that although the concentrations are perceived very low to be effective, a H_2O_2 concentration of 1 ppb (i.e. 0.001 ppm) represents about 27 billion H_2O_2 molecules per cubic centimeter.

A mole is the measurement for an amount of substance, in our case gaseous molecules. One mole (SI unit mol) is 6.022×10^{23} particles, the number six with 23 zeros. At sea level, and 32 degrees Fahrenheit, 1 mol of air can be reasonably assumed to have a dimensional extension of 22.4 liter. 22.4 liter have 22,400 (2.24×10^4) cubic centimeters. 1 ppb represents 1×10^{-9} . With that, 1 ppb (of H_2O_2 concentration) multiplied with 1 mol (of air molecules) divided by 22,400 cubic centimeter per liter results in 2.7×10^{10} (i.e. 27 billion) H_2O_2 molecules per cubic centimeter.



In layman terms, plenty of oxidizing or disinfectant power in the ambient air. Therefore, the CASPR technology provides its impressive disinfecting results.

COMPLETED TESTS

Laboratory: Hydrogen Peroxide (using OSHA test method #1019 on industrial-grade unit)



ADVANCED CHEMICAL SENSORS

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Reviewed by: *WKC*
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Laboratory Director

TO: Att: Dan Marsh
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DATE: 10/17/2017

HYDROGEN PEROXIDE VAPOR ANALYSIS REPORT

SAMPLE NO	DATE	NAME	EXPOSURE TIME (hr)	CONCENTRATION (ppm)
46098	10/11/17	Dan Marsh CASPR Microchem Testing	9:20 - 9:20 = 24.00	Less than 0.01

The OSHA permissible exposure limit is 1 ppm, based on personal monitoring for an 8 hour period. There is no short-term limit based on a 15 minute period.

Note: "Less than" value is the minimum level of quantitation for the exposure period used.

Method of Analysis: OSHA Method VI-6

Reporting Limit(8 hr Basis): 0.02 ppm

Date Received: 10/13/17

Date Analyzed: 10/17/17

Sample Condition: ok

Page 1 of 1

19182

The values reported are the average concentrations for the monitoring period used, based on the information provided by the user. Analysis results for unexposed samples ("Blanks"), used for quality assurance testing, are not subtracted from the sample results reported.

COMPLETED TESTS CONT.

Live Environment: Healthcare Customer Draeger Tube (medical-grade unit)

To: CASPR Group

From: Confidential Healthcare Customer

Re: Hydrogen peroxide notes on SMC Room 500 at startup, July 7 to 24, 2017.

Date: July 28, 2017

COMPLETE LIST OF H2O2 MEASUREMENTS

Room / date	ACS diffusion monitor result	Time	Draeger tube grab sample result	PortaSens result
Bed 7/7/17 BG	<0.02 ppm	8 hrs		none
RA 7/7/17 BG	<0.02 ppm	8 hrs		none
Bed 7/19/17	0.02 ppm	8 hrs	7/19 4:30pm trace	none
RA 7/19/17	<0.02 ppm	8 hrs		none
Bed 7/19-20/17	<0.01 ppm	15 hrs		none
RA 7/19-20/17	<0.01 ppm	15 hrs		none
Bed 7/20/17	<0.02 ppm	8 hrs	7/20 7:30am trace-	none
RA 7/20/17	0.03 ppm	8 hrs	7/20 3:30pm trace	none
Bed 7/21/17	<0.02 ppm	8 hrs	7/21 8:45am trace	none
RA 7/21/17	<0.02 ppm	8 hrs		none
Bed 7/24/17	<0.02 ppm	8 hrs	7/24 9:20am trace+	none
RA 7/24/17	<0.02 ppm	8 hrs		none

For Draeger tube grab sample (about 2-3 minutes only) trace = approximately 0.02 ppm for the time period sampled

Bed= 6" above head of bed, RA= one foot below the return air grill on ceiling
 < = less than

- **Live Environment: Rail Yard Third-Party OSHA testing** (industrial-grade unit)
 - » Ozone (using OSHA test method #214): The ozone samples were collected per the Occupational Safety and Health Administration (OSHA) method #214 utilizing personal sampling pumps and nitrite-impregnated glass fiber filters (IGFFs). The 8-hour samples ran at approx. 0.5 liters per minute to surpass the collection of a minimum of 180 liters of air. The 15-minute samples ran at approx. 1.5 liters per minute to achieve the collection of 22.5 liters of air. Samples were collected and by third-party accredited laboratories.

- 14 total 8-hour samples, including:
 - Seven (7) samples, including three (3) samples per car and one (1) outdoor sample;
 - 14 total 15-minute samples, including:
 - Seven (7) samples, including three (3) samples per car and one (1) outdoor sample.
- » Hydrogen Peroxide (using OSHA test method #1019): The hydrogen peroxide samples were collected per the Occupational Safety and Health Administration (OSHA) method #1019 utilizing personal sampling pumps and 25-mm quartz filters coated with titanium oxysulfate. The 8-hour samples ran at approx. 1 liter per minute to surpass the collection of a minimum of 240 liters of air. Samples were collected and by third-party accredited laboratories.
 - 16 8-hour samples, with eight (8) samples collected on each car in the following locations:
 - Three (3) samples at passenger standing head height, approximately 71 inches above the floor, including two (2) samples directly below the active NCC Cells, will be collected from a passenger car;
 - Three (3) samples at passenger seated head height, approximately 52 inches above the floor, including two (2) samples directly below the active NCC Cells, will be collected from a passenger car;
 - One (1) sample at passenger standing head height and one (1) sample at passenger seated head height will be collected from an operator cab.
 - Four (4) total field blank samples for ozone and two (2) additional field blank samples for hydrogen peroxide shall also be collected and submitted for analysis.

