

EOS Extraoral Suction System

This document is intended for the exclusive use for improving the understanding of the EOS Suction System operation principle. If you can not find out any satisfied answers here, please contact to ADS services center directly.



The EOS Extraoral suction system is designed to absorb aerosols and droplets coming out of the patient's oral cavity to reduce the risk of infection to dentists, staff and patients.

ADS EOS Extraoral suction system, is a suction filtration piece of equipment, the system does not have an air disinfection function, it is NOT an air sterilizer.

Proper precautions must still be taken to protect themselves and their patients.

Droplets & Aerosols Terminator

Technical Specifications

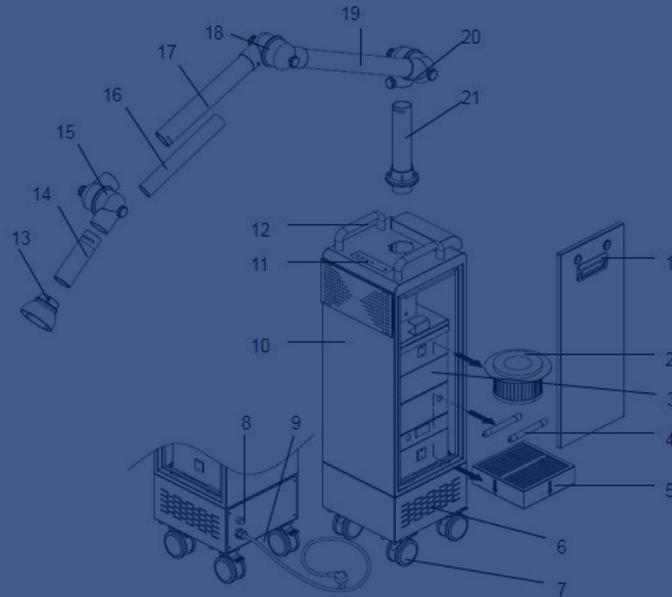


EOS Technical Specifications			
Model	EOS Extraoral Suction System		
Voltage	AC110V 60Hz	Electric current	12-20A
Power	1160W	Fuse wire	20A 250V
Flow	105CFM	Suction Power	10KPa (10 Different Levels)
Fine Filter	F8	Average Efficiency (EM) for 0.4MM particles (%),90<EM<95 Minimum efficiency* for 0.4MM particles (%),55 (F8 matches European standard EN 779:2012 and ISO16890)	
HEPA Filter Level	H14	H14, blocking virus and germs $\geq 0.3\mu\text{m}$ with 99.995% filtration efficiency (H14 matches European standard EN 1822:2009, ISO16890 and DOE-STD-3020-2015 Specification for HEPA Filters Used by DOE Contractors)	
Noise Decibel	58dB (Tested under laboratory environment and 0.6-0.89 Inch distance from the suction mouth piece hood)		
Suction Arm Caliber	$\Phi 2''$		
Size (millimeter)	275*275*980mm	275*275*980mm	

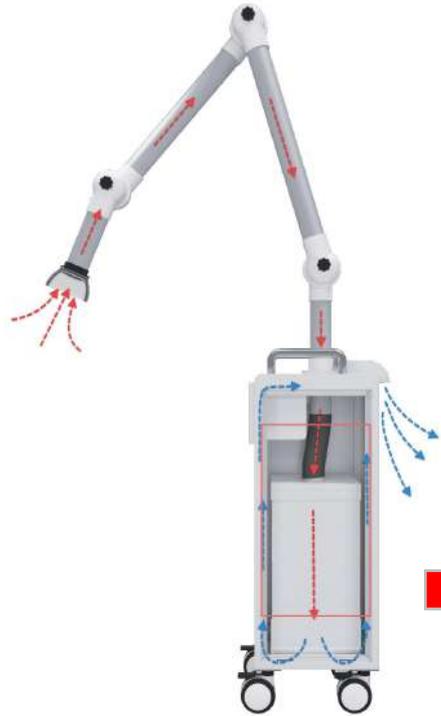
UV Light Specifications			
Type	UVC	Lamp Tube Length	5.3''
Lamp Tube Caliber	0.6''	Lamp Cap Caliber	0.7''
Wave Length	254nm	Glass Tube	Ozone-free quartz glass
Power(W)	4W	Voltage (V)	30 \pm 15%
Electricity (mA)	145 \pm 15%	Radiation Intensity ($\mu\text{W}/\text{cm}^2$)	$\geq 8 @ 39.4''$
Steady time (min)	5	Average Lifetime (h)	> 8000 (Continuous use)
Lamp Cap	G5 Aluminum head	Wire Material	Molybdenum Wire
Gas-filling	Pure Argon	Mercury	Pure Liquid Mercury<15mg

Packing Specifications		
	Suction arm	Case
Packing Size	27.2*10.2*9 inch	14.0*14.2*39.4 inch
Net Weight	2.8 lbs	94.2lbs
Gross Weight	5 lbs	98.6lbs

Product Structure



1	8026695	Case Panel	12	8026722	Handle
2	8026722	Fine Filter	13	A121945	Suction Mouth Piece Hood
3	8026635	Motor	14	8026746	Suction arm of the third joint
4	8026623	UV-C Light	15	A121944	The third joint
5	8026563	HEPA filter	16	8026608	Noise filter stick
6	8027319	Transformer	17	A121943	Suction arm of the second joint
7	8026605	Castor	18	A121942	The second joint
8	8027343	Fuse 6GFU-F25A250V	19	A121941	Suction arm of the first joint
9	8027340	Power cable	20	A121940	The first joint
10	8026686	Case	21	A121939	Centre Post of the first joint
11	8027316	Panel sticker			



Operation Principle

The EOS system collects aerosols, droplets, dust and pathogens produced during routine dental procedures through a suction mouthpiece hood. Particulate matter is filtrated by the dust/particulate filter. The HEPA filter captures particles down to 0.3 microns with 99.995% efficiency. Clean dry air is exhausted from the base cabinet.

The UVC lights are positioned on the HEPA filter and kills any remaining bacteria and viruses captured by the HEPA filter and are exhausted from the cabinet base.

The second filter bank usually consists of high-efficiency filters. This filtration system is adequate for most patient-care areas in ambulatory-care facilities and hospitals, including the operating room environment and areas providing central services.¹²⁰ Nursing facilities use 90% dust-spot efficient filters as the second bank of filters,¹²⁰ whereas a HEPA filter bank may be indicated for special-care areas of hospitals. HEPA filters are at least 99.97% efficient for removing particles $\geq 0.3 \mu\text{m}$ in diameter. (As a reference, *Aspergillus* spores are 2.5–3.0 μm in diameter.) Examples of care areas where HEPA filters are used include PE rooms and those operating rooms designated for orthopedic implant procedures.³⁵

Maintenance costs associated with HEPA filters are high compared with other types of filters, but use of in-line disposable prefilters can increase the life of a HEPA filter by approximately 25%. Alternatively, if a disposable prefilter is followed by a filter that is 90% efficient, the life of the HEPA filter can be extended ninefold. This concept, called progressive filtration, allows HEPA filters in special care areas to be used for 10 years.²¹³ Although progressive filtering will extend the mechanical ability of the HEPA filter, these filters may absorb chemicals in the environment and

 **HEPA**

**UV
Light**


Why do we use HEPA+ UV-C light?

HEPA filters are at least 99.997% efficient for removing particles greater than 0.3 microns in diameter, examples of care areas where HEPA filters are used include PE rooms and those operating rooms designated for orthopedic implant procedures.

UV Light
In a supplemental air-cleaning measure, UVGI is effective in reducing the transmission of airborne bacterial and viral infections in hospitals.

Guidelines of infection control from CDC.
<https://www.cdc.gov/infectioncontrol/guidelines/environmental/background/air.html>

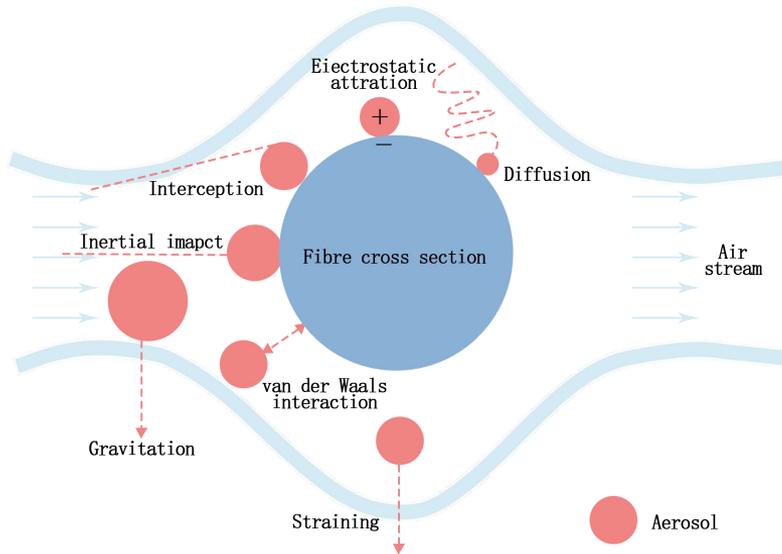
c. Ultraviolet Germicidal Irradiation (UVGI)

As a supplemental air-cleaning measure, UVGI is effective in reducing the transmission of airborne bacterial and viral infections in hospitals, military housing, and classrooms, but it has only a minimal inactivating effect on fungal spores.^{223–228} UVGI is also used in air handling units to prevent or limit the growth of vegetative bacteria and fungi. Most commercially available UV lamps used for

What is a HEPA filter? HEPA (High Efficiency Particulate Air Filter)

HEPA is an acronym which stands for High Efficiency Air Particulate, which is made by the fiberglass that is a disorder fibrous mat arranged. The fiberglass caliber is 0.5~2.0 micron and its high level of filtration efficiency for the smallest as well as the largest particulate contaminants can stop virus and germs $\geq 0.3\mu\text{m}$ with 99.995% efficiency.

The HEPA filter is developed during the period of the Manhattan Project that belongs to the US Nuclear Weapons Development, and it was used to capture extreme and dangerous radioactive particles. Nowadays, when scientists found out its high efficiency for capturing Droplets, Aerosols, and the particles of Bacteria & viruses, the HEPA filter is used in the medical industry at large.



Filtration Mechanisms

There are four basic ways media captures particles:

Inertial Impaction

Inertia works on large, heavy particles suspended in the flow stream. These particles are heavier than the fluid surrounding them. As the fluid changes direction to enter the fiber space, the particle continues in a straight line and collides with the media fibers where it is trapped and held.

Diffusion

Diffusion works on the smallest particles. Small particles are not held in place by the viscous fluid and diffuse within the flow stream. As the particles traverse the flow stream, they collide with the fiber and are collected.

Interception

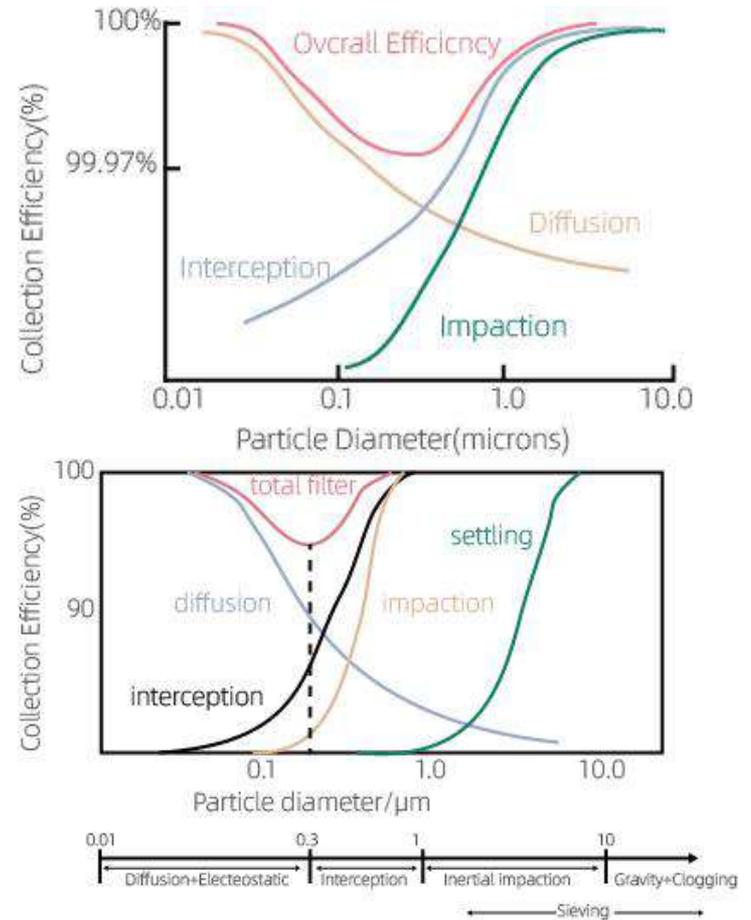
Direct interception works on particles in the mid-range size that are not quite large enough to have inertia and not small enough to diffuse within the flow stream. These mid-sized particles follow the flow stream as it bends through the fiber spaces. Particles are intercepted or captured when they touch a fiber.

Sieving

Sieving, the most common mechanism in filtration, occurs when the particle is too large to fit between the fiber spaces.

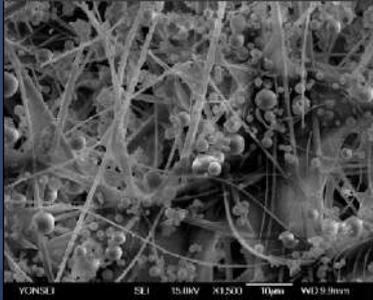
What Are The Principles Behind Filtration?

The filter efficiency chart below a filter that is approximately 90% efficient against a range of particle sizes. A HEPA filter would follow the same filtration principles but would have a total filtration efficiency greater than 99.97%. In other words, the worst that a HEPA filter would perform would be to capture 99.97% of particles.



**Smallest Viruses 0.02um ,Coronavirus 0.1um, MPPS 0.3um
Bacteria 0.5um,PM 2.5 2.5um,PM 10 10um**

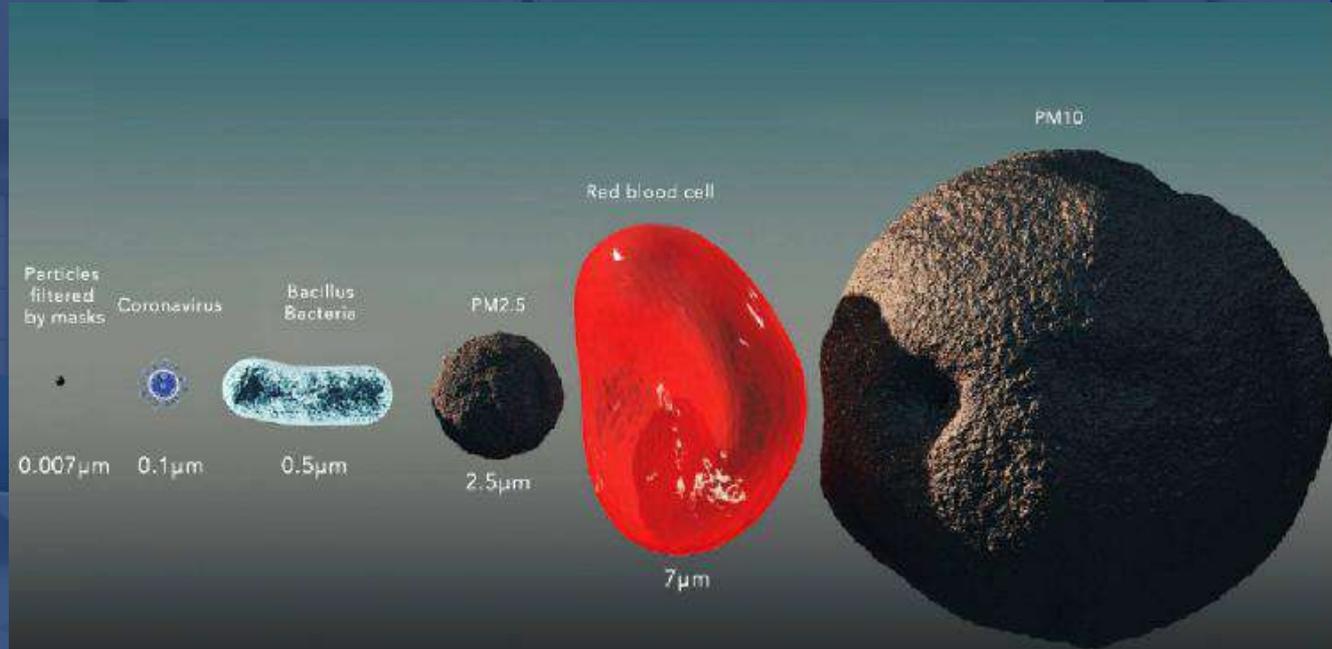
Will the smallest viruses pass through the HEPA filter?



Enlarge 1500 times to inspect the particles captured by HEPA filter.

The virus sizes are within with $0.02\mu\text{m} \sim 0.3\mu\text{m}$. The corona virus size is $0.15\mu\text{m}$ around. Both of them are captured by the HEPA filter through the diffuse and static effect.

As the Filtration Mechanisms we learn above, the 0.3 micron benchmark is used in efficiency ratings, because it approximates the most difficult particle size for a filter to capture. HEPA filters are even more efficient in removing particles that are smaller than 0.3 microns and larger than 0.3 microns. The fact that a HEPA filter's removal efficiency increases as particle size decreases below 0.3 microns is counter intuitive. However, this is a proven and accepted fact in the filtration sciences.



Usage	Class	Performance	Performance test	Particulate size approaching 100%retention	Test Standard
Coarsr filters (used as promary)	G1	60%	Average value	>5um	BS EN779
	G2	65-80%	Average value	>5um	BS EN779
	G3	80-90%	Average value	>5um	BS EN779
	G4	90%-	Average value	>5um	BS EN779
Fine filters (used as Secondary)	M3	40-60%	Average value	>5um	BS EN779
	M6	60%80	Average value	>2um	BS EN779
	F7	80-90%	Average value	>2um	BS EN779
	F8	90-95%	Average value	>1um	BS EN779
	F9	95%-	Average value	>1um	BS EN779
Semi HEPA	E10	85%	Average value	>1um	BS EN1822
	E11	95%	Average value	>0.5um	BS EN1822
	E12	99%	Average value	>0.5um	BS EN1822
HEPA	H13	99.95%	Average value	>0.3um	BS EN1822
	H14	99.995%	Average value	>0.3um	BS EN1822
ULPA	U15	99.9995%	Average value	>0.3um	BS EN1822
	U16	99.99995%	Average value	>0.3um	BS EN1822
	U17	99.999995%	Average value	>0.3um	BS EN1822

Classification of filter classes and standards

In ISO16890, European standard EN 1822:2009, EN 779:2012 and DOE-STD-3020-2015

Specification for HEPA Filters Used by DOE Contractors, all mention HEPA filter H14 is medical grade filter which filter minimum 99.97% particles @ 0.3 microns (PM 0.3) or larger.

When you are dealing with filtering viruses and bacteria from the air you want an air purifier with a medical-grade HEPA filter. Medical-grade refers to top tier H13 or H14 efficiency rated filters which will filter minimum 99.97% particles @ 0.3 microns (PM 0.3) or larger. These filters are relied upon in infection control isolation rooms and operating theaters. Made from a very fine pleated paper they maintain minimum efficiency at 99.95% or 99.995% @ 0.3 microns for the life of the filter. Most viruses are estimated to be 0.1-0.125 microns in size. H13/H14 HEPA are effective in filtering approx. 95% or greater of particles @ 0.1 microns. The CDC recommends N95 masks for front line medical workers which filter 95% @ 0.3 microns to reduce exposure and chances of infection. The EOS is using H14 HEPA filter is much more effective than N95.



NOT MEASUREMENT
SENSITIVE

DOE-STD-3020-2015
June 2015
Supersedes DOE-STD-3020-2005
December 2005

DOE TECHNICAL STANDARD

Specification for HEPA Filters Used by DOE
Contractors



U.S. Department of Energy
Washington, D.C. 20585

AREA SAFT

- Consider the use of a portable HEPA air filtration unit while the patient is actively undergoing, and immediately following, an aerosol-generating procedure.
 - The use of these units will reduce particle count (including droplets) in the room and will reduce the amount of turnover time, rather than just relying on the building HVAC system capacity.
 - Place HEPA unit within vicinity of patient's chair, but not behind DHCP. Ensure DHCP are not positioned between the unit and the patient's mouth. Position the unit to ensure that it does not pull air into or past the breathing zone of the DHCP.

In response to the COVID-19 pandemic in the United States, in March, 2020, CDC recommended that dental settings should prioritize urgent and emergency visit* and delay elective visits and procedures to protect staff and preserve personal protective equipment and patient care supplies, as well as expand available hospital capacity.



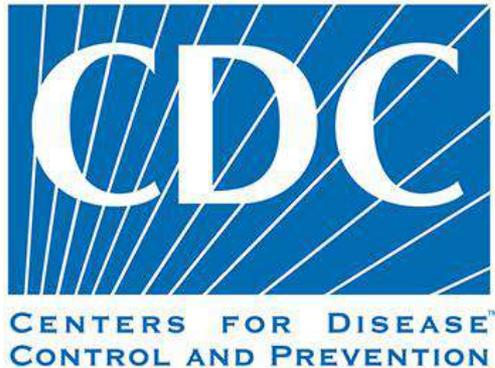
Why we don't choose ULPA U₁₇ to be the filter in the EOS?

The filtration result of ULPA is better than HEPA for sure, but on the other hand, the density of the fiberglass filter is also higher than a HEPA filter, so the suction will be weaker, because the wind resistance is higher, this will make the suction system with low efficiency. Secondly, the life of the ULPA is shorter than HEPA, because the density is higher so it is easy to be full, probably use half a year or shorter time, it need to be replaced. Thirdly, most of the surgical rooms in hospitals are using H14 HEPA filter, the result has been proven.

Compare with all the reasons, H14 HEPA is the best choice for our suction system.

Use UV Light To Be a Supplement

- CDC guidelines for Environmental Infection Control in Health-Care Facilities require HEPA filter is the primary means of cleaning the air, and UV light as a supplemental air-cleaning measure, UVGI is effective in reducing the transmission of airborne bacterial and viral infections in hospitals, military housing, and classrooms, but it has only a minimal inactivating effect on fungal spores.



- The checklist in "Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC)" is a document we should all be using. It gives dental manufacturers all the recommendations from the CDC in one place and allows ADS to evaluate our own program.



Guidelines for Environmental
Infection Control in Health-Care
Facilities

Recommendations of CDC and the Healthcare Infection Control
Practices Advisory Committee (HICPAC)

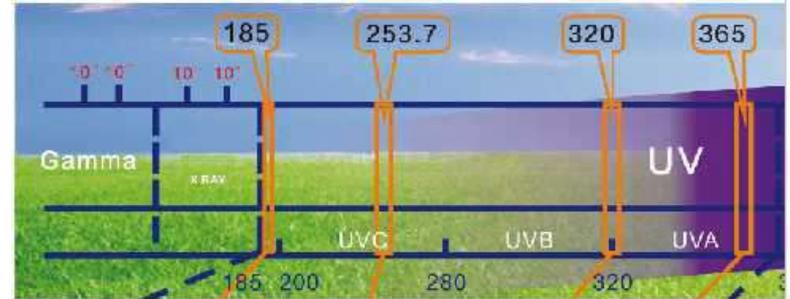
U.S. Department of Health and Human Services
Centers for Disease Control and Prevention (CDC)
Atlanta, GA 30329

2003
Updated: July 2019

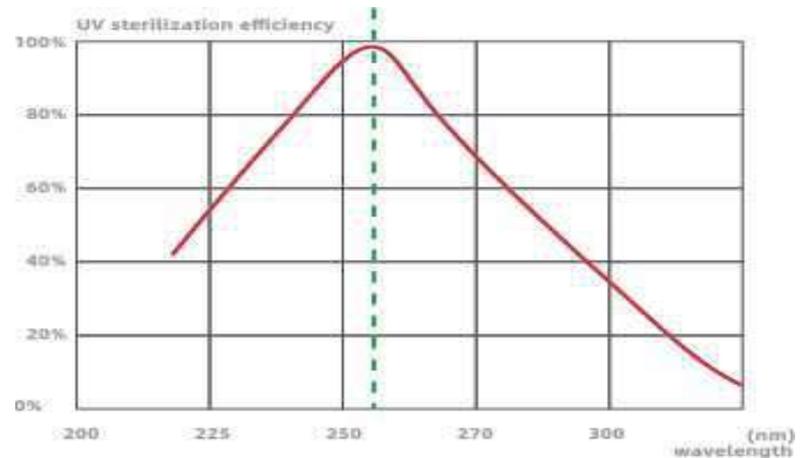
Guidelines for Environmental Infection Control in Health-Care Facilities, CDC
<https://www.cdc.gov/infectioncontrol/guidelines/environmental/background/air.html>
<https://www.cdc.gov/infectioncontrol/guidelines/disinfection/disinfection-methods/miscellaneous.html>

What is UV Light?

- UV(Ultraviolet) Light refers to the region of the electromagnetic spectrum between visible light and X-rays, with a wavelength falling between 400 and 10 nanometers. This electromagnetic radiation is not visible to the human eye, because it has a shorter wavelength and higher frequency than the light our brain perceives as images.
- An easy way to remember UV light's placement on the electromagnetic spectrum is to examine the ends of the visible light spectrum: Red is the light with the longest wavelength, and Violet is the light with the shortest wavelength. Therefore, light with a wavelength longer than any light in the visible spectrum is called Infrared Light, and light with a wavelength immediately shorter than any light in the visible spectrum is called Ultraviolet Light.



UVC–The killer of the bacteria and viruses

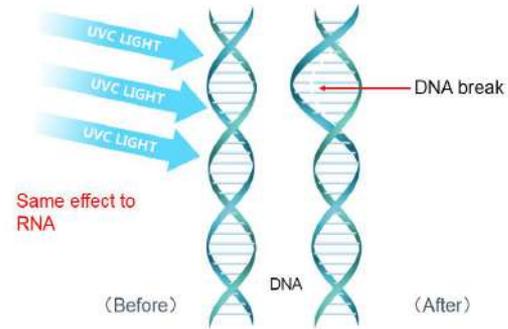


UV Light Antivirus Principle

- Anne Rammelsberg, a chemistry professor at Millikin University, offers the explanation of the UV light kills the cells: Ultraviolet(UV) light kills cells by damaging their DNA. The light initiates a reaction between two molecules of thymine, one of the bases that make up DNA. The resulting thymine dimer is very stable, but repair of this kind of DNA damage--usually by excising or removing the two bases and filling in the gaps with new nucleotides--is fairly efficient. Even so, it breaks down when the damage is extensive.



How dose UVC light kill the bacteria and virus?



- The longer the exposure to UV light, the more thymine dimers are formed in the DNA and the greater the risk of an incorrect repair or a "missed" dimer. If cellular processes are disrupted because of an incorrect repair or remaining damage, the cell cannot carry out its normal functions. At this point, there are two possibilities, depending on the extent and location of the damage. If the damage is not too extensive, cancerous or precancerous cells are created from healthy cells. If it is widespread, the cell will die.

UVA,UVB, and UVC Comparison

UV light,Stanford EDU

<http://solar-center.stanford.edu/about/uvlight.html>

The Difference Between UVA,UVB,and UVC by Adult
Congenital Heart Disease Center

<https://share.upmc.com/2014/07/infographic-abcs-uv-difference-uva-uvb-uvc/>

Ultraviolet(UV)Radiation,FDA

<https://www.fda.gov/radiation-emitting-products/tanning/ultraviolet-uv-radiation>

	UVA	UVB	UVC
Spectral Range	315 – 400 nm	280 – 315 nm	100 — 280 nm
Summary	ILV (CIE S 017/E:2011)	ILV (CIE S 017/E:2011)	ILV (CIE S 017/E:2011)
Wavelength	Longest wavelength	Medium–wavelength	Shortest wavelength
Antiviruses	Noneffective	Noneffective	Effective
UV radiation Effect	Prolonged exposure to UV–A waves without adequate protection can have dangerous health consequences.	All effects are similar with UVA,but higher doses of UVB cause sunburn which increases human likelihood of developing cancer.	It's extremely harmful and almost completely absorbed by Earth's atmosphere.UV radiation can make DNA molecular bond rupture,resulting in bacteria can not breed and die. The ozone can be effectively kill bacteria.It is commonly used as a disinfectant in food, air, and water to kill microorganisms by destroying their cells' nucleic acids.
Applications	Technically often used for the adhesive UV bonding and curing of varnishes.	Play an important part in the photo stability.	

The suction motor in the EOS Extraoral Suction System is giving ultrastrong power, low level noise, and long life.

It is UL recognized, category PRGY2 (E47185), the rotation is 24435/min, flow is 42.8L/second, power is up to 1400W, suction power is 1303mmH₂O, it is a heavy duty motor.



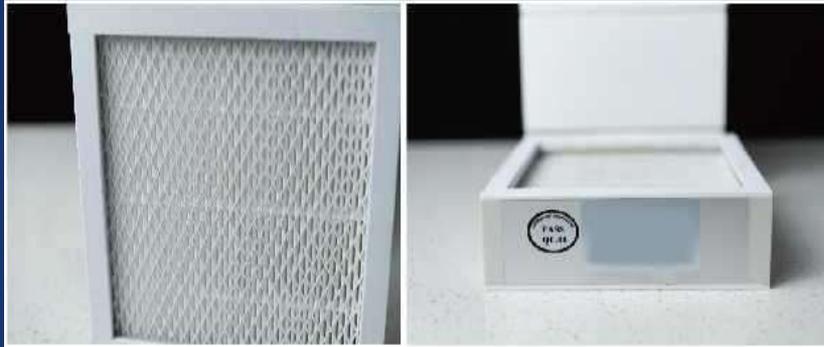
**Reliable
Motor from
famous
American
brand**

AMETEK®

The motor brand AMETEK is a leading global manufacturer of electronic instruments and electromechanical devices with annual sales of approximately \$5 billion.

Well sealed module structure

- With our special module design in the EOS Extra oral Suction System, fine filter, suction motor, UV light and HEPA filter are tightly buckled together into one metal module which is well sealed, this reliable structure helps to trap the dirty air inside, will not be leaked.



HEPA metal frame

- In the article from CDC infection control online, mention the HEPA filter must be well sealed, a wooden or metal frame is required, a metal frame is much better. The EOS Extra- oral Suction System is using a metal frame for a HEPA filter.



ADS Dental System

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