ADS Dental System

# 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.

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# Droplets & Aerosols Terminator

**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.**

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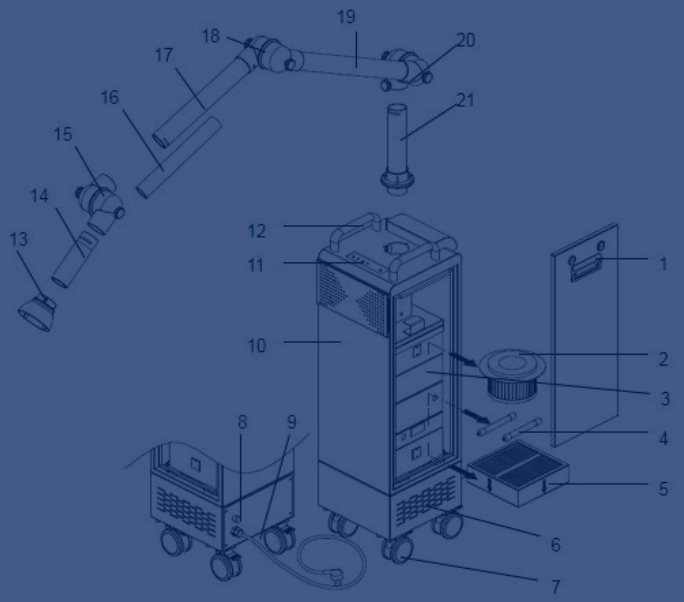
# Technical Specifications

| 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 ≥0.3μm 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** | Φ2" | | |
| **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±15% |
| **Electricity (mA)** | 145±15% | Radiation Intensity (μW/cm2) | ≥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 | | | |

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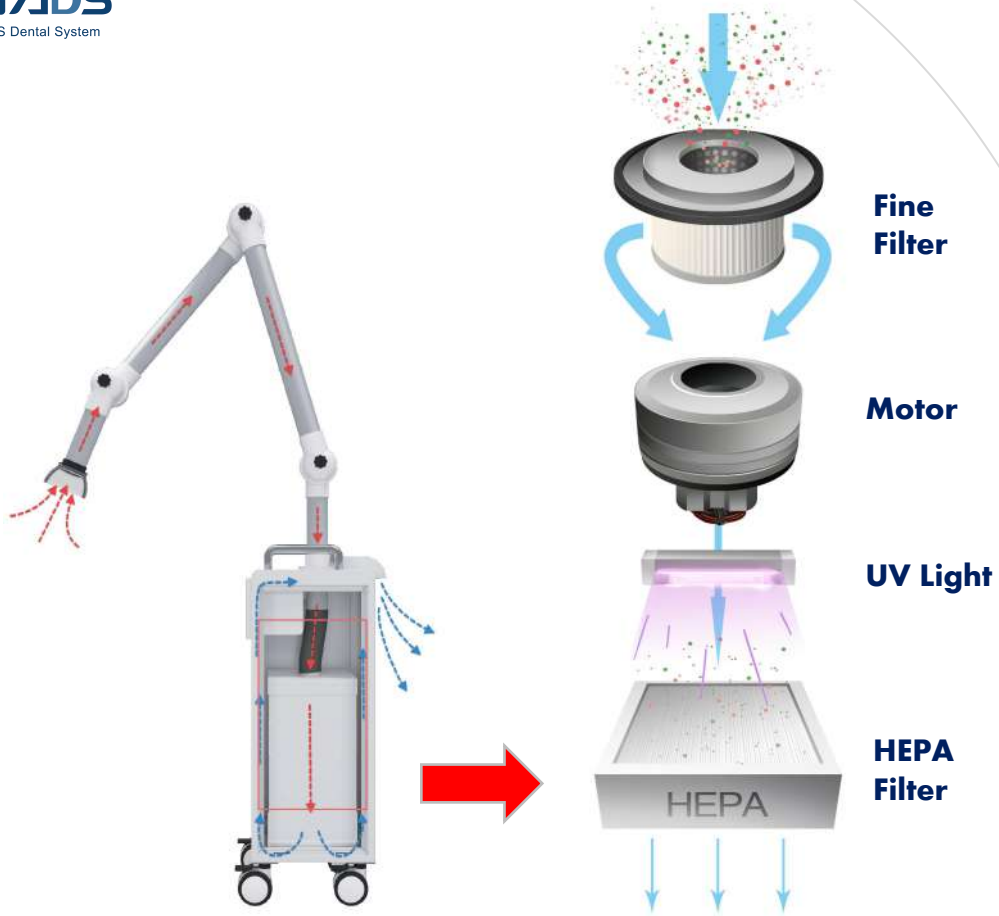



Fine Filter

Motor

UV Light

HEPA Filter

# 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 ≥0.3 µm 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 partibles 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

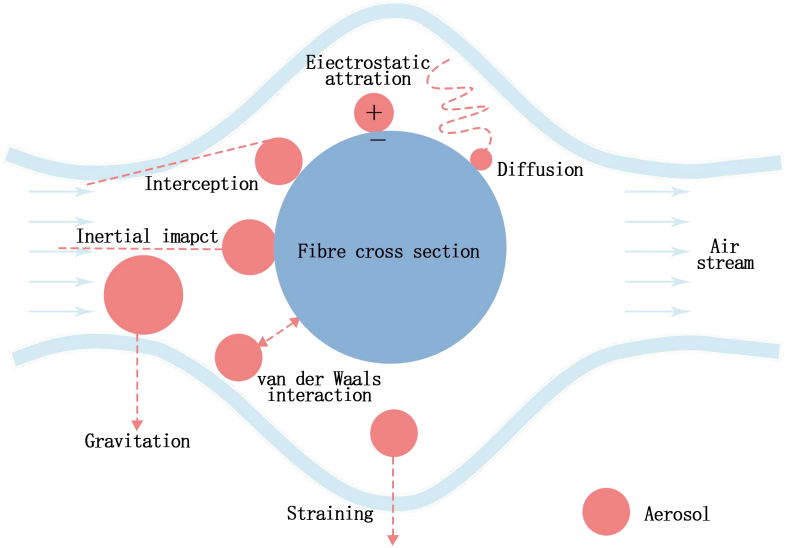
## c. Ultraviolet Germicidal Irradiation (UVGI)

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 ≥0.3μm 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.

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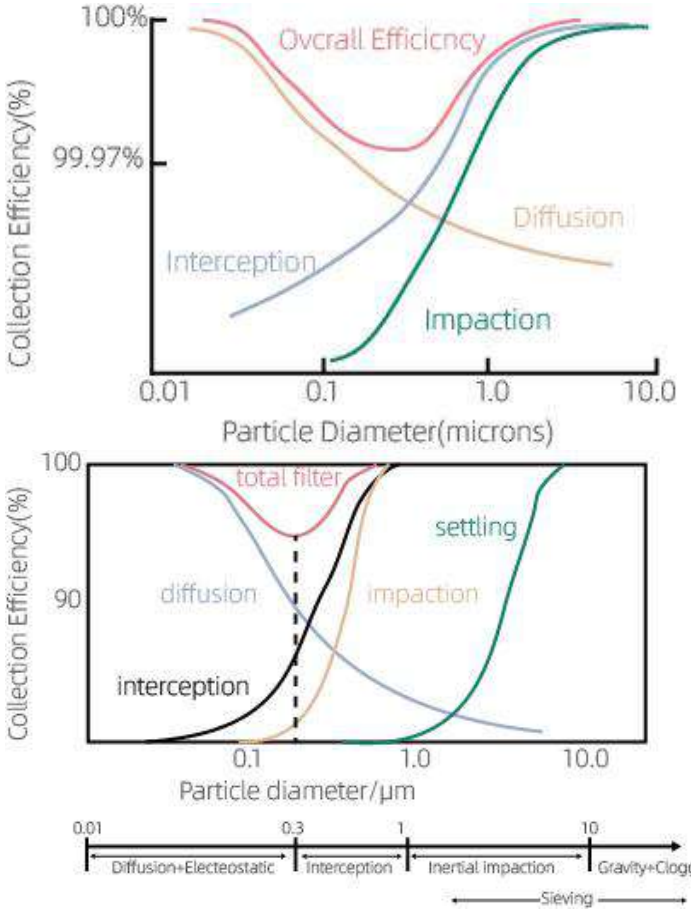
# What Are The Principles Behind Filtration?

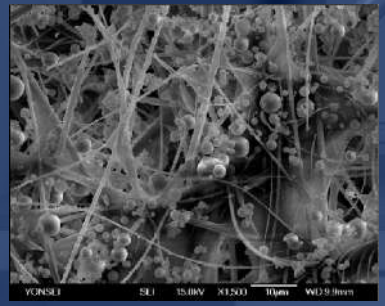
The filter efficiency chart below a filter that is approximately 90% efficient against a range of particle sizes. A HEPA filter would follow the same filtration principles but would have a total filtration efficiency greater than 99.97%. In other words, the worst that a HEPA filter would perform would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



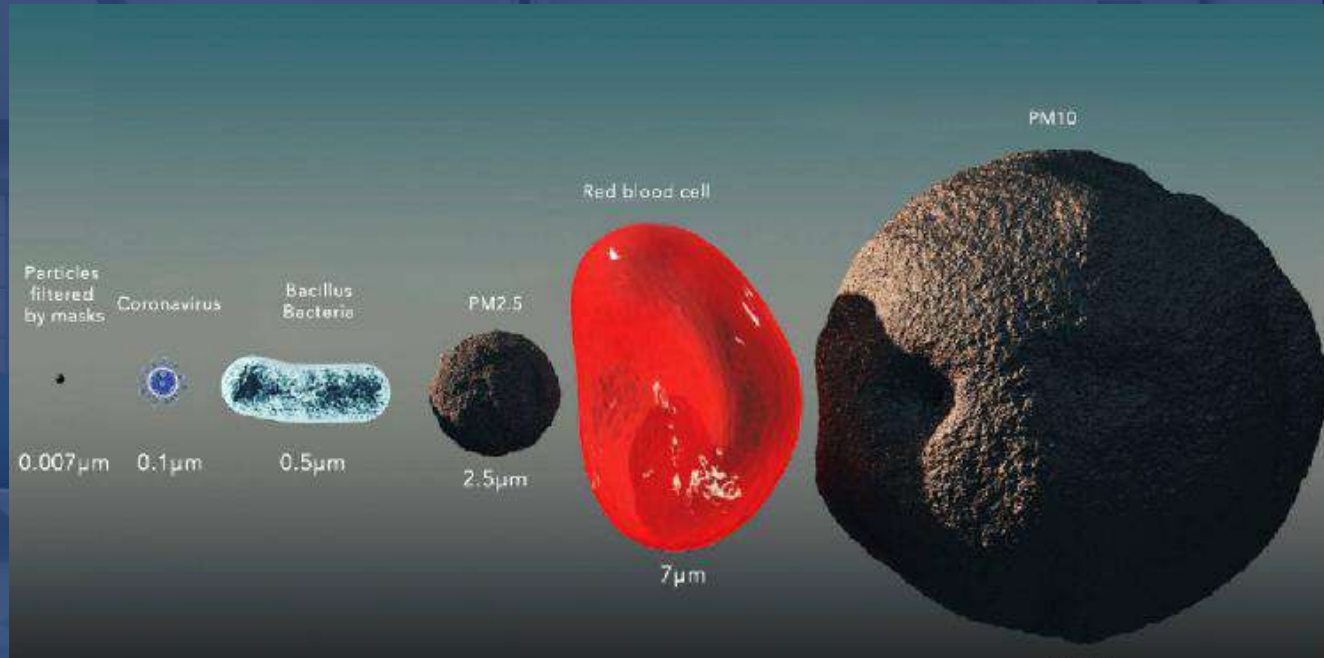

**Smallest Viruses** 0.02um ,Coronavirus 0.1um, MPPS 0.3um
Bacteria 0.5um,PM 2.5 2.5um,PM 10 10um

# Will the smallest viruses pass through the HEPA filter?

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.



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




The virus sizes are within with 0.02um~0.3um. The corona virus size is 0.15um around. Both of them are captured by the HEPA filter through the diffuse and static effect.

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| 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.

TS

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**

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- 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.

Guidance for Dental Settings,CDC
https://www.cdc.gov/coronavirus/2019-ncov/hcp/dental-settings.html

**In response 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.

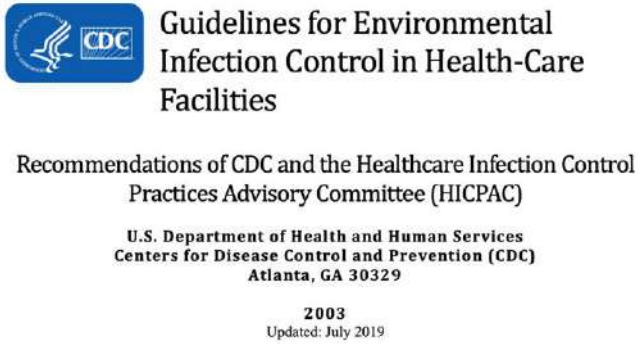
# Use UV Light To Be a Supplement

- **CDC guidelines for Environmenta 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 is has only a minimal inactivating effect on fungal spores.**

CDC

CENTERS FOR DISEASE CONTROL AND PREVENTION

- **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.**

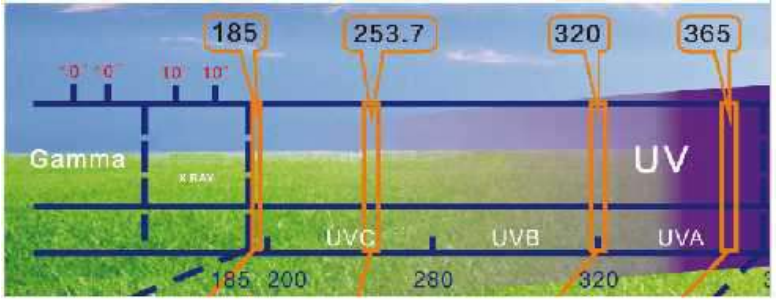



Guidelines for Environmental Infection Control in Health-Care Facilities,CDC
https://www.cdc.gov/infectioncontrol/guidelines/environmental/background/air.html
https://www.cdc.gov/infectioncontrol/guidelines/disinfection/disinfection-methods/miscellaneous.html

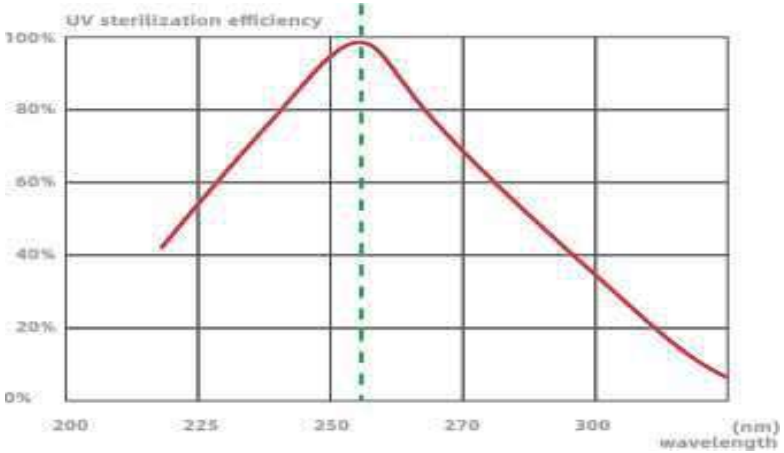
# What is UV Light?

- 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 pectrum is called Ultraviolet Light.

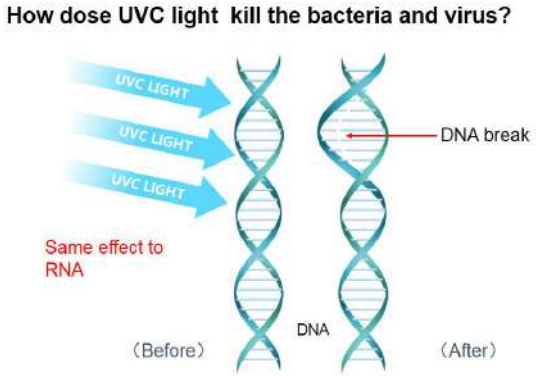



**UVC–The killer of the bacteria and viruses**



# 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.




- 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

| | 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. | |


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

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.

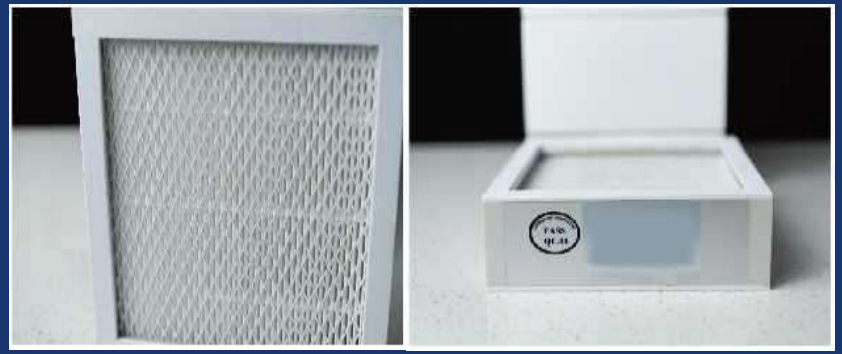
# Reliable Motor from famous American brand

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 ora I 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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