Understanding UV-C and VR

UVISAN

Contents

UVISAN

What is UV-C?

How does UV-C kill bacteria & viruses?

Ultraviolet (UV) light is produced naturally by the sun. Ultraviolet is a spectrum of light just below the visible range and it is split into four distinct spectral areas, of which UV-C is one.

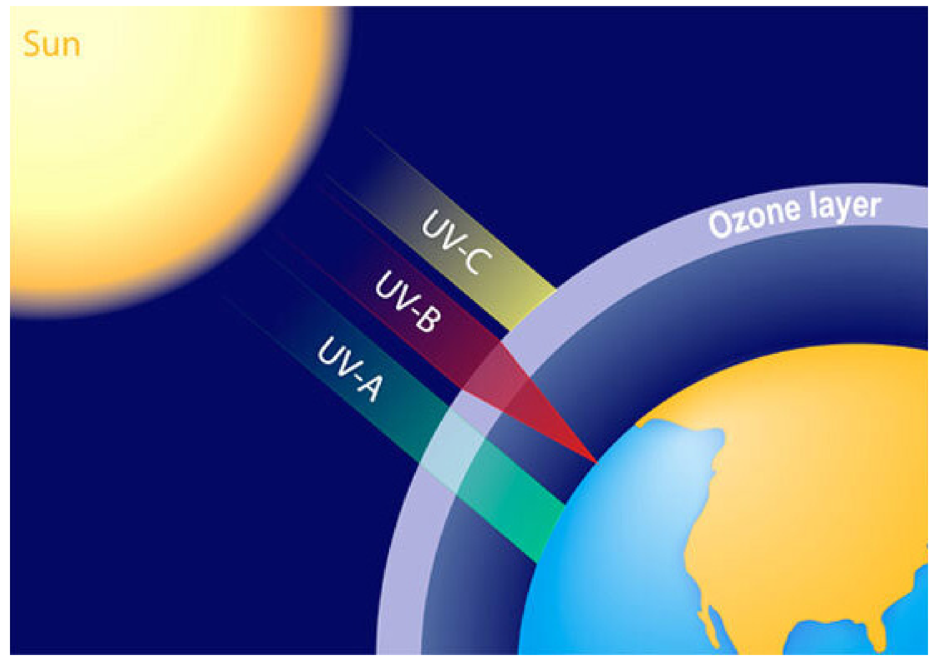


fig.1

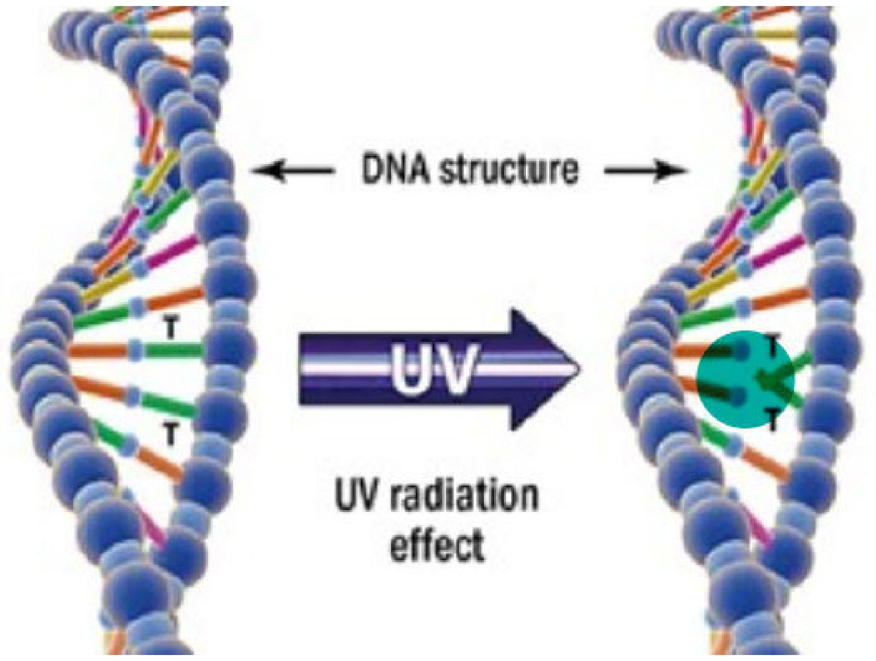


fig.2

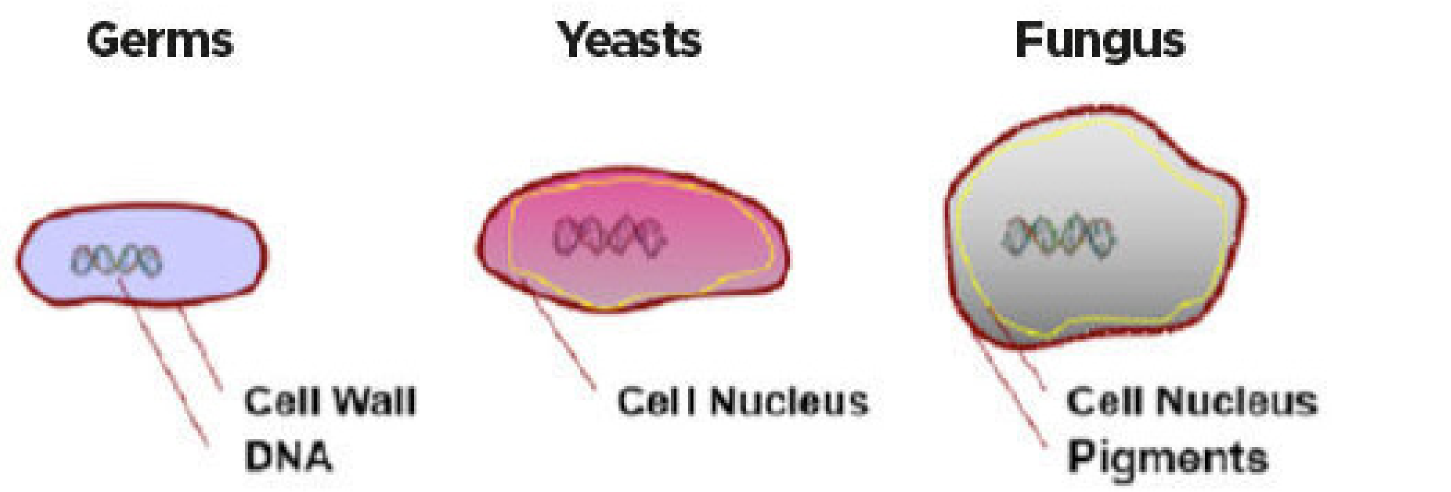
The UV-C Spetrum

The entire UV spectrum can to some extent kill or inactivate microorganism species like bacteria, viruses, spores and protozoans. It does this by preventing them from replicating, but the most effective, UV light - UV-C, does not naturally reach the Earth's surface (fig.1).

High-intensity UV-C light, generated by special fluorescent tubes at a wavelength of 253.7 nanometres provides a germicidal effect many thousands of times greater than UV in nature; this is the technology used in Uvisan products. The application of UV-C energy to inactivate microorganisms is also known as Germicidal Irradiation or UVGI.

UV-C exposure inactivates microbial organisms such as bacteria and viruses by destroying their DNA, the 'blueprint' these organisms use to develop, function and reproduce (fig.2).

By r
expo
micrc
of



	Germs	Yeasts	Fungus
Typical size	1 - 10um	5-8um	2-100um
Dosage needed	2 - 40mJ/cm²	10-30 mJ/cm²	50-400 mJ/cm2

fig.3

Uvisan UV-C Effectiveness

The effectiveness of germicidal UV depends on the duration, intensity, and wavelength of the UV-C the microorganism is exposed to, and to the organism's size and opacity.

The rule of thumb is: the larger the microorganism the higher is the UV-C dose required for deactivation (fig.3). Uvisan cabinets have been calibrated to be effective using a pre-set 2-minute UV-C exposure time against a wide range of microorganisms. The cabinets can be programmed for longer cycles too. Uvisan Cleanroom solutions are designed before installation to provide the correct dose for the room to be disinfected.

Uvisan Surface Disinfection

The success of surface disinfection is dependent on the type of the material to be disinfected.

This not only relates to the type of microorganism, but also to the texture of the surface. Disinfection can only occur if the microorganisms can 'see' the UV-C. Microorganisms which are in shadow will not be treated due to the limited exposure to UV-C. Uvisan cabinets are designed to minimise shadowed areas by bouncing the UV-C light around the inner space to reach these areas.

Fomites - transmission of infectious agents

A fomite is an object capable of transferring a pathogen, such as a virus, spore or bacterium from one person to another.

Many objects can act as fomites, some examples include:

- kitchen surfaces;
- handrails;
- doorknobs,
- light switches;
- mobile phones;
- VR Headsets; and
- even clothing.

Several factors and conditions can influence how easily bacteria or viruses present on a fomite, can transmit to a person, including: temperature; humidity in the room; how porous the fomite is; and the type and concentration of the pathogen.

Even the positioning of the fomite can affect how it transmits; different areas of buildings will have differing communities and amounts of pathogens.

Fomites can transfer pathogens to hands, and hands are a primary transport route for pathogens, which may then be transferred by touching to the eyes, nose and mouth, spreading infection.

Reducing your risk from transmission from fomites day to day is best achieved by thorough hand washing after touching communal surfaces, this is a very effective method, but is of course reliant on the diligence (or memory!) of the individual.

Reducing other peoples' risk from fomites, where you or your organisation is providing a potential fomite is trickier. In general, the longer an object is handled, and the more people handle it, the greater the number of potential pathogens will build up on a surface, and the more active the fomite becomes.

Depending on good hand hygiene from users is of course just that, dependent on them. Some will assiduously follow your advice; some will completely ignore it.

There are active steps that you can take to reduce risk and take the onus away from the user to ensure good hygiene.

VR/XR and AR Headsets and controllers are excellent examples of devices used in education, industry, medicine and entertainment that present a particular fomite risk.

These headsets are worn very close to the eyes and nose, particularly vulnerable areas to cross infection, where bacteria and viruses on the skin or mucus membranes are easily transferred to, and from, the inside of the headset, including the lenses.

Handling of the exterior, when putting on and taking off the headset, and handling the controllers, can also transfer pathogens from the hands to their outer surfaces and then on to the next user.

These headsets, for example in a teaching environment, may be shared between many pupils over the course of a day, subjecting each to the risk of cross infection. Conjunctivitis, noroviruses, colds and flu and many other conditions are all capable of transmission by fomites.

Ultraviolet light in the 'C' band (UV-C) is a proven and extremely effective method of disabling these pathogens on fomite surfaces. Just two minutes' exposure can be enough to reduce surface pathogens by 99.99% without the use of time-consuming, and potentially instrument-damaging, alcohol or chlorine wipes.

Uvisan UV-C cabinets have been laboratory tested to prove their effectiveness against pathogens on both the inside and outside of headsets and are trusted by organisations, including the NHS and Microsoft, to safely store, charge and disinfect shared objects including headsets and controllers.

Uvisan cabinets are certified to IEC 62471 ensuring complete safety from user exposure to the UV-C radiation, and testing by leading headset manufacturers has shown that our UV-C light does not damage expensive headsets or other equipment, even after very prolonged immersion.

Uvisan's Cleanroom™ whole-room UV-C smart system can safely disinfect every surface (and even the air) in rooms of almost any size in as little as ten minutes.

Standards - the importance of IEC62471

UV-C is a powerful antimicrobial. Just a couple of minutes exposure can render all manner of bacteria, viruses, moulds and spores inactive.

This awesome power must be safely controlled. Exposure to UV-C radiation is not only damaging to microorganisms but is injurious to human health.

Direct exposure to UV-C can damage the eyes and cause burning to the skin, even increasing the chance of corneal damage and skin cancers.

“The clear part of the surface of the eye happens to be very susceptible to the wavelength of the light from these [UV-C] lamps,” said Dr. Jesse Sengillo, an ophthalmologist at the Bascom Palmer Eye Institute of the University of Miami Health System.

New work has suggested that UV-C rays are indeed capable of doing damage to DNA and they could increase the risk of deadly skin cancer. The findings, which directly link UV-C rays and cancer-causing DNA mutations, have been published in Cell Reports.

When choosing UV-C products always insist on devices that have been tested and certified to IEC 62471, the international standard for photobiological safety.

This rigorous testing ensures that no harmful UV-C radiation escapes the confines of the device, and that accidental exposure is impossible.

Uvisan UV-C cabinets are all tested and certified to IEC 62471, assuring complete safety from exposure to the UV-C radiation to the user, meaning the lethal power is directed only at the microorganisms on the surface of the devices you choose to disinfect.

So, what to avoid, what should you look out for?

- the product is not certified to IEC 62471.
- there are vents in the walls or doors of the product that allow UV-C radiation to escape, if you can see in through a gap, UV-C can get out.
- the UV-C source does not automatically shut down if the door is opened, or the product can be operated with the door open.
- the UV-C source generates ozone (see link about the dangers of ozone).

Any one of the above failings may mean exposure to harmful UV-C radiation for you or your staff, or in the last example, to lung damaging ozone.

Dangers and benefits of UV-C in VR

In the mid-2010s, the first instances of UV-C implementation within Virtual Reality (VR) emerged as companies and researchers explored its germicidal potential. An early example was the introduction of automated UV-C cleaning stations in VR arcades and public VR spaces. These stations allowed users to disinfect VR headsets and controllers between sessions, minimising the risk of infections spreading among different users. This was of course pre-covid.

The Virtual Reality (VR) industry experienced a significant negative impact due to the COVID-19 pandemic. Before the outbreak, VR arcades, amusement parks, and entertainment venues were thriving, offering consumers a chance to experience VR in a social and interactive setting. However, with strict social distancing measures and lockdowns in place, these public VR spaces faced closure, leading to revenue losses and business uncertainties. The fear of potential virus transmission through shared VR equipment deterred many customers from visiting these establishments, further exacerbating the industry's struggles. Consequently, VR arcade operators and businesses had to adapt rapidly to the changing landscape, investing in rigorous sanitisation protocols, implementing UV-C disinfection systems, and adhering to strict hygiene standards to regain public trust. Despite the challenges, the resilience of the VR industry and the implementation of UV-C technology played a vital role in the gradual recovery of public VR spaces, fostering a safer and cleaner environment for users eager to experience the joy of VR in shared settings once again.

Post-covid saw the popularity of UV-C technology really skyrocket with the adoption of UV-C disinfection systems like Uvisan cabinets. Uvisan cabinets, equipped with powerful UV-C lamps, offered an automated and efficient way to sanitise VR headsets and importantly, also controllers between users. These cabinets used UV-C radiation to deactivate harmful pathogens, ensuring a clean and safe experience for each participant. These pioneering applications showcased the potential of UV-C technology to revolutionise VR hygiene, providing users with a worry-free, germ-free, and highly enjoyable virtual experience. Suffice to say, whilst Covid may have been the catalyst for UV-C technology becoming so popular within VR / AR, it has now gone far beyond that, with hygiene itself being the focal point more generally, as opposed to Covid specific prevention.

Benefits of UV-C in VR / AR

One of the most significant advantages of UV-C is its powerful germicidal properties, which make it highly effective in disinfecting VR equipment and accessories. Automated UV-C cleaning systems, such as Uvisan cabinets, provide a quick and efficient way to sanitise VR headsets, controllers, and other shared accessories, reducing the risk of cross-contamination in public VR spaces. By eradicating harmful pathogens, UV-C ensures a safer and more hygienic environment for users, instilling confidence in their virtual experiences. Moreover, UV-C technology helps to extend the lifespan of VR equipment by keeping it free from harmful microbes without the need for chemicals and mechanical cleaning, leading to cost savings and reduced equipment maintenance.

The implementation of UV-C in VR/AR not only elevates the overall hygiene standards but also contributes to a more enjoyable and worry-free immersive experience for users, ultimately advancing the adoption and growth of these transformative technologies.

Integrating UV-C into VR establishments, or any industry for that matter, demands a comprehensive understanding of the risks involved. Selecting UV-C equipment requires careful consideration, ensuring it meets stringent safety standards and is equipped with proper shielding measures to protect users from its potent radiation. Before embracing the union of UV-C and VR, it is crucial to recognise the importance of responsible implementation and the vigilance required in safeguarding the well-being of those venturing into the virtual realms.

Dangers of UV-C

UV-C, despite its remarkable benefits, presents a range of potential dangers that must be addressed with utmost care and attention. When handled responsibly, these hazards can be effectively managed to ensure the well-being and safety of users. However, any missteps in implementation could result in severe risks to health and safety.

The Harmful Impact of UV-C on Our Eyes

Ultraviolet C (UV-C) radiation, with wavelengths ranging from 100 to 280 nanometres, is the most energetic and harmful type of ultraviolet light. While natural UV-C radiation is mostly absorbed by the Earth's atmosphere, artificial sources like germicidal lamps pose a significant risk to our eyes. Below we explore the harmful impact of UV-C on our eyes, paying attention to the specific health risks and providing in-depth academic references to support the information presented.

Acute Photokeratitis: UV-C's Painful Consequence

Acute photokeratitis, also known as "welder's flash" or "snow blindness," is a painful eye condition caused by overexposure to UV—C radiation. This condition affects the cornea, the transparent outer layer of the eye, and can result in the following symptoms: eye pain, redness, excessive tearing, light sensitivity, and a feeling of grittiness. Prolonged exposure to UV-C radiation, even for a short duration, can lead to acute photokeratitis.

Pitts, D. G., & Cullen, A. P. (2000). UV and Infrared Absorption Spectra, Ultraviolet (UV) Radiation Properties, and UV Radiation-Induced Injury. Survey of Ophthalmology, 45(4), 349-361. doi:10.1016/S0039-6257(00)00169-5

Corneal Damage: A Serious Concern

The cornea is highly susceptible to damage caused by UV-C radiation. Direct exposure to UV-C rays can lead to corneal injuries, which may result in pain, blurry vision, and potential long-term vision impairment. Corneal damage requires immediate medical attention to prevent further complications and promote proper healing.

McCarty, C. A., Taylor, H. R., & Key, S. N. (2000). Corneal Light Shielding and UV-B-Induced Ocular Surface Squamous Neoplasia. Archives of Ophthalmology, 118(3), 392-393. doi:10.1001/archopht.118.3.392
Conjunctival Irritation: An Inflammation Risk

The conjunctiva, the thin, transparent membrane covering the whites of the eyes and the inner eyelids, can also suffer from UV-C-induced irritation. Prolonged UV-C exposure can cause inflammation and discomfort in the conjunctiva, making it red, swollen, and potentially leading to temporary vision disturbances.

Kuckelkorn, R., Redbrake, C., & Reim, M. (2001). Acute Ultraviolet-B-Induced Conjunctivitis and Its Mechanism. Investigative Ophthalmology & Visual Science, 42(6), 1429-1434. PMID: 11381087
Long-term Vision Issues

While acute effects of UV-C exposure are painful, long-term UV-C exposure can result in chronic vision issues. Prolonged exposure can lead to cumulative damage to the cornea and other eye structures, potentially leading to irreversible vision problems, including reduced visual acuity and other visual impairments.

Feldman, R. M., & Schultz, R. O. (1982). Ultraviolet Light-Induced Corneal Changes. Transactions of the American Ophthalmological Society, 80, 173-191. PMID: 6758506

The Harmful Impact of UV-C on Our Eyes - Summary

Ultraviolet C radiation poses significant risks to our eyes, with acute photokeratitis, corneal damage, conjunctival irritation, and potential long-term vision issues being some of the adverse effects. It is essential to be cautious and take appropriate safety measures, especially when dealing with artificial UV-C sources like germicidal lamps. The academic references provided support the scientific understanding of the harmful impact of UV-C on our eyes, emphasising the importance of protecting our eyes from this potent form of ultraviolet radiation.

The Harmful Impact of UV-C on Our Skin

Skin Burns: The Immediate Consequence of UV-C Exposure

Accidental direct exposure of the skin to UV-C radiation can result in skin burns that are similar to sunburns. These burns are characterised by redness, pain, swelling, and blistering. The severity of the burn depends on the duration and intensity of UV-C exposure.

Litchfield, D. J. (2005). Skin Cancer and UVR Exposure. In: Sunscreens: Development, Evaluation, and Regulatory Aspects. New York: Marcel Dekker, Inc. pp. 491-507. ISBN: 9780824757914.

Premature Aging: UV-C's Silent Impact

Exposure to UV-C rays from the sun can lead to premature aging of the skin.

Fisher, G. J., & Kang, S. (2002). Mechanisms of Photoaging and Chronological Skin Aging. Archives of Dermatology, 138(11), 1462-1470. doi:10.1001/archderm.138.11.1462
Skin Cancer: A Long-term Risk

Overexposure to UV radiation can lead to DNA damage in skin cells, increasing the risk of developing skin cancers like melanoma, basal cell carcinoma, and squamous cell carcinoma.

Lomas, A., Leonardi-Bee, J., Bath-Hextall, F. (2012). A systematic review of worldwide incidence of nonmelanoma skin cancer. British Journal of Dermatology, 166(5), 1069-1080. doi:10.1111/j.1365-2133.2012.10830.x
Immunomodulation: Compromising Skin's Defence

UV-C radiation can also weaken the skin's immune system, reducing its ability to defend against infections and environmental stressors. This immunomodulatory effect can make the skin more vulnerable to various diseases and ailments.

Ullrich, S. E. (2005). Mechanisms underlying UV-induced immune suppression. Mutation Research/Fundamental and Molecular Mechanisms of Mutagenesis, 571(1-2), 185-205. doi:10.1016/j.mrfmmm.2004.10.018

The Harmful Impact of UV-C on Our Skin - Summary

Ultraviolet C radiation, though naturally blocked by the Earth's atmosphere, can have harmful consequences when exposed directly to our skin through artificial sources like germicidal lamps. Skin burns, premature aging, and the potential long-term risk of skin cancer are among the concerning effects of UV-C exposure on our skin. It is vital to be cautious and take appropriate safety measures when handling UV-C-emitting devices to protect our skin from this potent form of ultraviolet radiation. The academic references provided serve as evidence of the harmful impact of UV-C on our skin, emphasising the significance of skin protection from this potentially dangerous radiation.

Navigating the Dangers of UV-C

As Ultraviolet-C (UV-C) technology gains traction across various industries, it brings with it a range of benefits, from sterilisation to improved hygiene. However, the potential dangers of UV-C radiation cannot be ignored. To ensure the safe utilisation of UV-C, particularly in scenarios such as Virtual Reality (VR) equipment sanitation, it's crucial to adopt precautionary measures. In this article, we delve into the methods and guidelines to effectively protect oneself from the potential hazards of UV-C exposure. Unfortunately, there is no governing body and no official guidelines for safety but the below gives a comprehensive overview of what to look for when assessing your UV-C product for safety.

Opt for Quality Bulbs: Prioritising Safety and Ozone Mitigation

When it comes to protecting yourself from the potential dangers of UV-C radiation, the quality of the bulbs you choose plays a pivotal role. Opting for bulbs manufactured by reputable and well-established companies is essential not only for maximising sterilisation effectiveness but also for mitigating the risks associated with UV-C exposure. A crucial factor to consider alongside quality is the bulb's potential to produce ozone. UV-C radiation can interact with oxygen molecules in the air, resulting in the generation of ozone, which can have adverse effects on respiratory health. High-quality bulbs are designed with measures to minimise ozone production, ensuring that the benefits of UV-C technology are realised without compromising air quality or personal safety. Prioritising both quality and ozone mitigation is key to harnessing the advantages of UV-C while safeguarding your well-being.

Shining Light on Safety

In the ever-expanding realm of UV-C technology, safeguarding oneself from potential hazards is paramount. The journey begins with ensuring equipment adheres to certifications like IEC 62471, establishing a baseline for safe usage. Investing in quality bulbs from reputable manufacturers not only boosts the efficacy of UV-C applications but also minimises exposure risks. By cultivating an acute awareness of signs of poor manufacture and exercising caution, individuals can actively protect themselves from the potential dangers of UV-C radiation. As UV-C technology continues to redefine industries, responsible use becomes the guiding principle, ensuring its transformative benefits come without compromising safety.

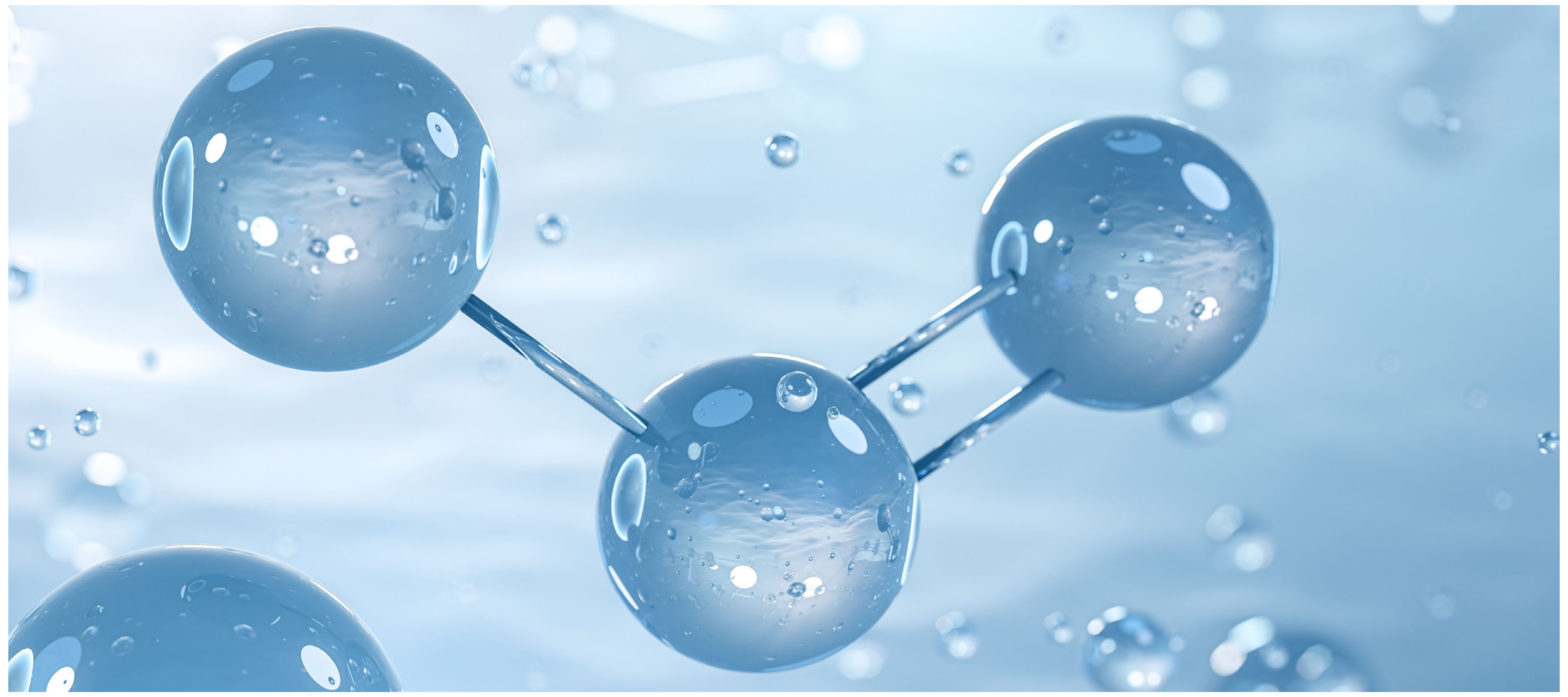
Uvisan cabinets are rigorously tested and fully certified holding certificates for :

- IEC 62471
- ISO 9001
- ISO 14001
- CE Certified
- RoHS Certified

Only high-grade UV-C bulbs are used in all Uvisan products.

Ozone - the hidden danger

UVISAN



Searching the internet for UV-C disinfection products you will often see 'produces ozone' highlighted as a potential benefit. Ozone is a gas that is produced by the interaction of ionising radiation and oxygen in the atmosphere. Ozone does have disinfection properties, but it is also harmful to humans and animals even in quite low concentrations.

UV-C emitting products that claim to produce ozone use lamps that are incorrectly shielded, and caution should be exercised when considering these units as safe for your application. Operating such products, particularly in poorly ventilated spaces, can quickly generate an ozone PPM count that can cause respiratory irritation or worse.

According to the US Environment Protection Authority ozone can:

Cause coughing and sore or scratchy throat.

- Make it more difficult to breathe deeply and vigorously and cause pain when taking a deep breath.
- Inflame and damage the airways.
- Make the lungs more susceptible to infection.
- Aggravate lung diseases such as asthma, emphysema, and chronic bronchitis.
- Increase the frequency of asthma attacks.

Some of these effects have been found even in healthy people, but effects can be more serious in people with lung diseases such as asthma. They may lead to increased school absences, medication use, visits to doctors and emergency rooms, and hospital admissions.

Long-term exposure to ozone is linked to aggravation of asthma, and is likely to be one of many causes of asthma development. Studies in locations with elevated concentrations also report associations of ozone with deaths from respiratory causes.

The HSE in the UK and the Control of Substances Hazardous to Health (COSHH) regulations explicitly set limits for the PPM maximum safe exposure levels for ozone.

The current Working Exposure Limits or WEL for ozone is 0.2 ppm in air (averaged over a 15-minute reference period). If exposure to ozone cannot be prevented then the principles of good control practice need to be applied (see Schedule 2A of COSHH regulation 7.7) to ensure that the workplace exposure limit is not exceeded, this may mean using equipment that generates ozone sparingly for short periods of time.

Further the COSHH guidelines mean that any ozone generating equipment must be assessed for risk including:

- where is ozone likely to be generated?
- is exposure likely?
- who is likely to be exposed?
- can the exposure be prevented?

  if the exposure cannot be prevented, estimate the potential level of exposures (in some cases this may involve personal exposure monitoring). If you can demonstrate that your estimate of exposure is unlikely to exceed the WEL, you do not need to take any further action;
- if exposures exceed or are likely to exceed the WEL, decide what control measures are needed and take appropriate action.

So, the use of UVC products that generate ozone also means the business has to assess the risk and may mean that these units are only capable of very limited use to ensure the WEL is not exceeded; ozone is not only hazardous for employees but its presence can put an extra burden, liability and cost on the company.

Uvisan cabinets and whole-room systems use only UV-C sources that are shielded and proven to produce no ozone.

The Uvisan range can be used safely in any environment, regardless of ventilation or room size.

Microbial resistance and UV-C

For many years the go-to method of disinfection of surfaces and equipment has been using chemicals. Whether with chlorine or alcohol-based products, wiping surfaces has enabled the removal of microbial contamination and has been the number one tool in the fight against cross infection.

In tests conducted on behalf of Uvisan, evidenced that the use of chemical wipes is far less effective in killing bacteria and viruses than the use of UV-C light but there is a deeper and more insidious problem with the widespread use of chemical disinfection – resistance.

In simple terms organisms that survive the cleaning process, either because as an individual they are more resistant to a substance (e.g spores) or because they have received only a partial dose, can, over time, reproduce and through mutations in their DNA pass on this trait and give rise to offspring that are increasingly resistant. Ultimately this process can lead to microorganism species that are entirely unaffected by certain chemicals removing that product as a means of combating infection.

Studies have shown (1) that certain bacteria adapt, either through cellular mutation or by the acquisition of genetic elements, to possess increasingly impermeable cell walls, meaning that the active chemical cannot enter the organism and kill it.

UV-C works differently. UV-C radiation passes directly through the cell membrane and acts directly on the organism's DNA and RNA, breaking the molecules, resulting ultimately in the death of the organism but also preventing it from reproducing; consequently, it has no offspring and the ability to adapt or become resistant is removed. Indeed, even were some organisms to survive, due to shadowing or too low a UV dose, the nature of the germicidal process means that it is almost impossible for an organism to adapt its cell wall to such an extent that damage to its DNA would not occur with the correct exposure to UV-C.
So, in practice, the more we rely on chemical disinfection, the greater the risk that we unwittingly engineer microorganisms that are no longer killed by this means. Couple this with the relatively low kill-rate achieved in the real world and the other safety and environmental disadvantages of aggressive chemicals and wipes, and reliance on chemical disinfection becomes decreasingly attractive.

Uvisan UV-C cabinets and Cleanroom whole-room disinfection systems are proven to kill 99.99% of bacteria, viruses, spores and protozoans in minutes, without chemicals, with minimum user effort, 100% safety and importantly – no chance of resistance.

Bacterial resistance to disinfectants: present knowledge and future problems
Journal of Hospital Infection- Volume 43, Supplement 1, December 1999, Pages S57-S68
A.D.Russell

In the rapidly evolving landscape of virtual reality (VR) technology, the quest for visual excellence is paramount. Pancake lenses, with their compact design and wide field of view, are fast becoming the future of immersive VR experience. However, as we venture into the intricate realm of optics, a pertinent question arises: How do these guardians of clarity fare against the invisible force of UV-C light?

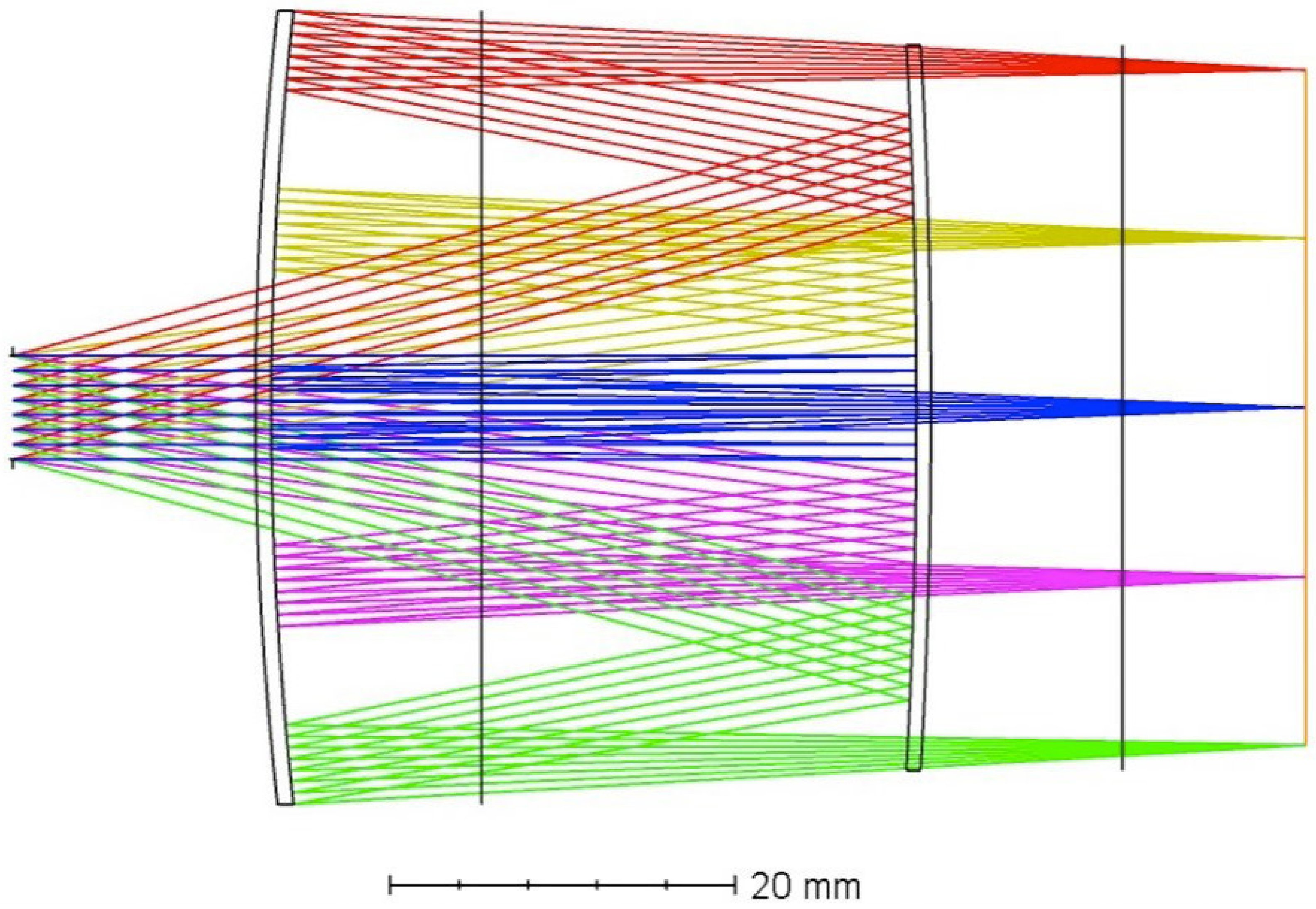
While UV-C light seldom encounters the human eye directly in natural settings, its potency cannot be underestimated. In controlled environments, UV-C finds purpose in disinfection, eliminating harmful micro-organisms with unparalleled efficiency. Yet, this very potency raises questions about its potential effects on optical components, particularly lenses. Pancake lenses, meticulously crafted to optimise visual fidelity, now face the challenge of accommodating UV-C's energetic onslaught. Understanding this interaction is crucial, not only for preserving lens integrity, but also for ensuring the longevity of virtual reality devices in environments where UV-C exposure may occur. In this context, the resilience of pancake lenses against UV-C light becomes a testament to the precision and durability of modern optics.

Pancake Lenses Demystified: Unravelling Their Inner Workings

Pancake lenses stand as the unsung heroes of visual technology, encapsulating a world of precision engineering within their compact frames. To truly appreciate their prowess in the realm of virtual reality, we must embark on a journey to understand the intricate mechanisms that define their functionality.

Inside a pancake lens, there are carefully shaped pieces of glass. These pieces are designed in a way that when light enters the lens, it's bent or refracted. This bending is crucial because it helps gather and focus the light. But here's where internal reflection comes into play. Some of the light inside the lens hits the surfaces of these glass elements. Instead of passing through, this light bounces off the surface. This is called internal reflection.

By carefully designing the shape and angles of these glass elements, engineers can control how the light bounces around inside the lens. This helps in making sure that all the rays of light are focused precisely, resulting in a clear and sharp image. The precise arrangement of glass elements and controlled internal reflection within a pancake lens enables the lens to achieve a thinner, more compact design, optimising its functionality without compromising optical performance.



Visual representation of reflection and refraction inside a pancake lens.

Pancake lenses and UV-C

UVISAN

UV-C Penetration and Lens Materials: Unveiling the Barrier

Having illuminated the extraordinary capabilities of pancake lenses in revolutionising the virtual reality experience, it's imperative that we now turn our attention to an equally crucial facet - their interaction with UV-C light. Just as these lenses stand as paragons of optical engineering, their resilience against the potent force of UV-C radiation is a testament to the precision and thoughtfulness embedded in their design. The penetration rate of UV-C into these materials, particularly glass, is a critical aspect that shapes the lens's ability to protect itself against the energetic force of UV-C radiation.

The Nature of UV-C Penetration:

UV-C light, characterised by its short wavelengths, possesses a unique ability to interact with matter. These high-energy photons have the potential to penetrate certain materials, altering their molecular structure. However, the extent of penetration is contingent on various factors, including the material's composition and density.

Glass as a UV-C Barrier:

Glass, commonly employed in the construction of high-quality lenses, boasts impressive UV-C blocking properties. Its dense molecular structure provides an effective barrier against UV-C penetration. This characteristic is fundamental in safeguarding the interior components of pancake lenses from potential harm.

Coatings and UV-C Absorption:

Beyond the inherent properties of glass, lens manufacturers often employ specialised coatings to enhance UV-C protection. These coatings are meticulously formulated to absorb UV-C radiation, further fortifying the lens against potential penetration. Through a combination of material selection and advanced coatings, pancake lenses are equipped with formidable defences against UV-C light.

Controlled Dispersion and UV-C Deflection:

Aspherical elements, integral to many pancake lens designs, play a crucial role in UV-C protection. Their precisely calculated shapes are engineered to redirect light rays. In the context of UV-C, as it is not part of the visual spectrum, these elements help disperse the radiation, preventing it from concentrating and penetrating deeper into the lens material.

Conclusion

In conclusion a reassuring revelation emerges: it is indeed safe to utilise UV-C disinfection on pancake lenses. UV-C, with its potent germicidal properties, poses minimal risk to these optical marvels. The unique design and materials of pancake lenses, coupled with their inherent ability to absorb UV-C, make them resilient against any potential harm. By harnessing the power of UV-C for disinfection, we not only safeguard the lenses from potential contaminants but also ensure a clean and hygienic VR experience.

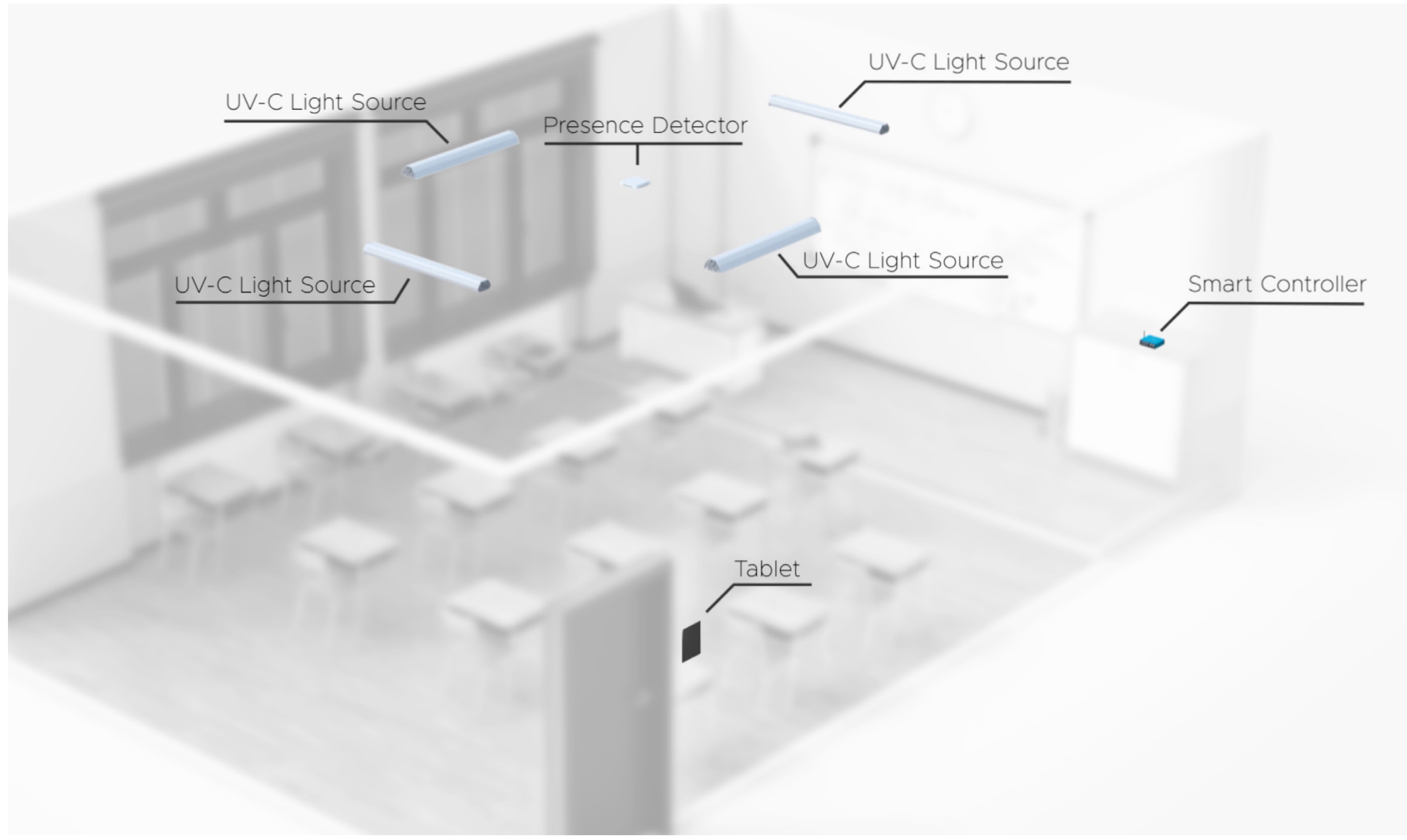
Showcase

[360 series](#)

Click here for more information

Pro series

Click here for more information



Cleanroom

Click here for more information