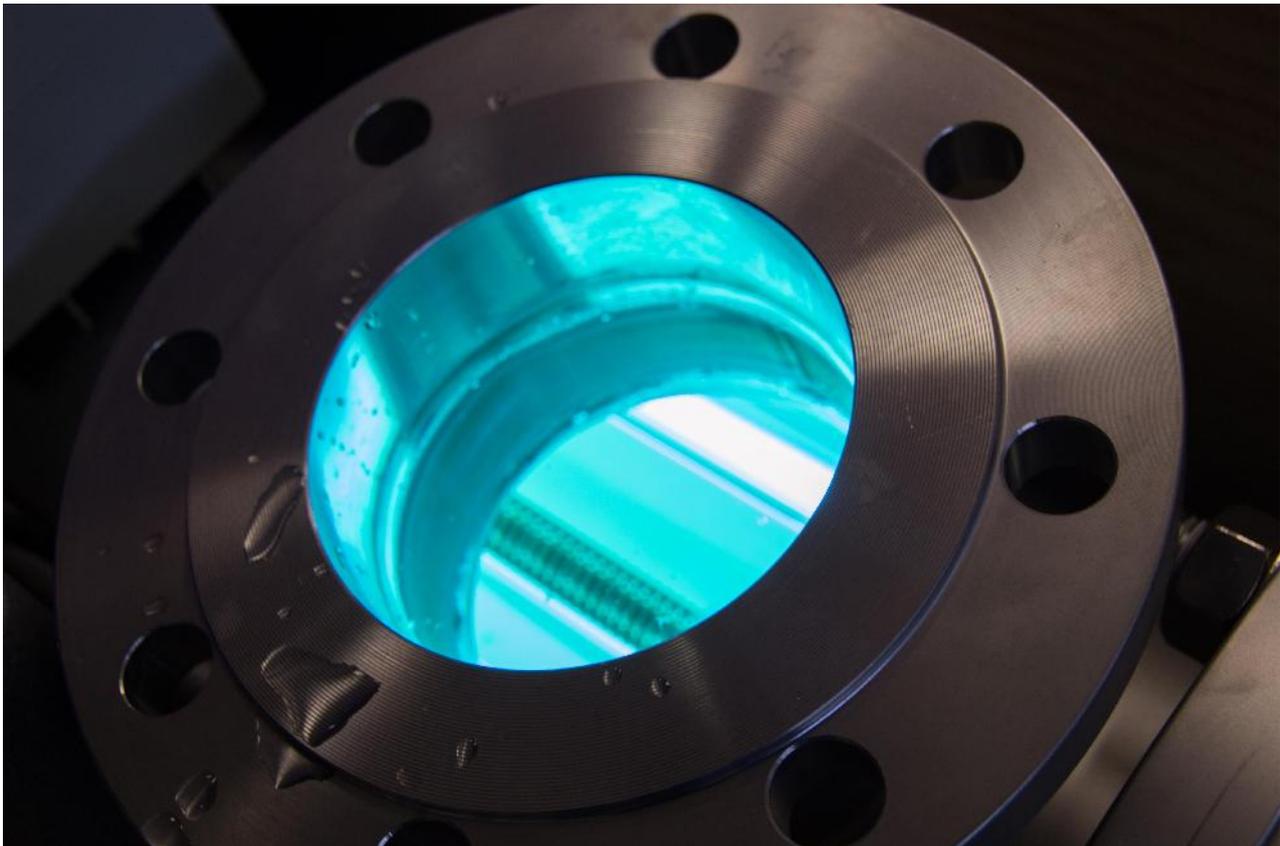


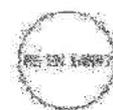


Ultraviolet Disinfection Systems

an environmentally friendly, chemical-free
solution for water disinfection



**Rodin UV Systems – High dosage ultraviolet (UV) systems
for the effective treatment of micro-organisms and
viruses in water**



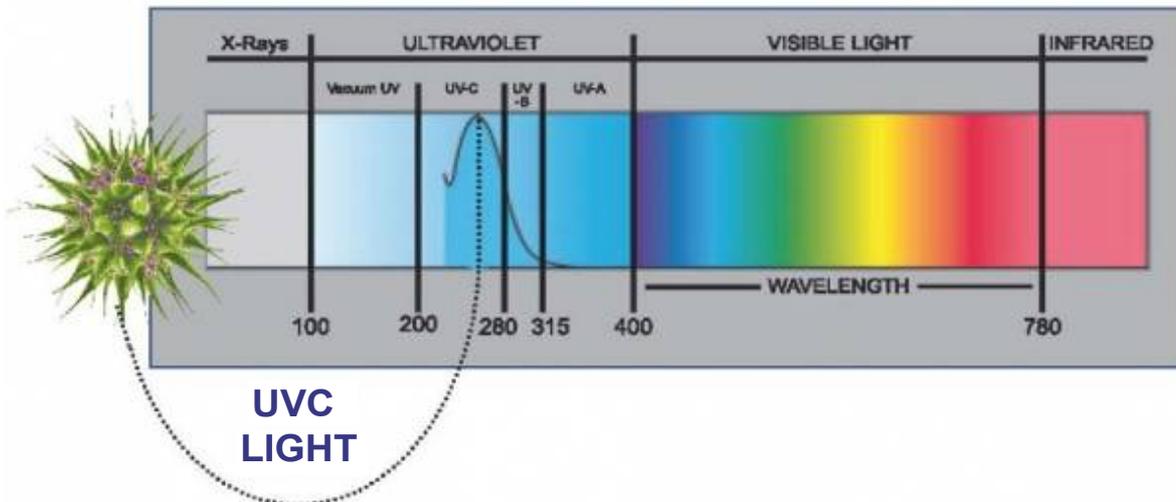
UV light offers a highly effective natural method of treatment against micro-organisms and viruses. The high dosage light provided by Rodin's WRAS approved and validated to BS EN14897 stainless steel ultraviolet systems deactivates the DNA of harmful organisms, preventing growth and replication.



- Environmentally friendly as no by-products are produced
- Approved for drinking water and does not alter its taste, colour or odour
- Cost effective - expensive chemicals are not required
- 316L stainless steel construction offers durability and corrosion resistance
- Wiper systems are available to ensure optimum operating performance
- Control units integrate with building management systems
- Simple, low-cost maintenance procedures
- Low energy consumption
- Systems available for a wide range of flow rates
- Proven track record – installed worldwide
- WRAS Approved
- Validated to BS EN14897



Rodin UV - the operating principles



UVC LIGHT

Over 100 years ago German scientists discovered that the top surface of lake water was sterile when exposed to sunlight. Investigation led to the discovery of Ultraviolet light. Situated in the electro-magnetic spectrum between X-rays and visible light, ultraviolet (UV) light has many beneficial properties. UV light is split into four main categories, UV-A, UV-B, UV-C and Vacuum UV. The area between 240 and 280 nanometres (nm) is UV-C, commonly known as the germicidal region.

UV-C light has the ability to cause permanent damage to a wide variety of organisms in water, air and other fluids. UV light is a physical, non-intrusive method of ensuring that organisms are unable to replicate, and hence remain inert. In addition to disinfection, a correctly sized UV system can also be used for de-chlorination and to de-ozone process water, and to assist in the removal of TOC (total organic carbon) and urea from ultra pure water.

UV does not affect the taste, colour, or pH of the fluid being disinfected, and as such the technique is often used where conventional disinfection with chlorine cannot be applied, such as within a brewery, soft drinks plant, pharmaceutical facility, fish farm or environmentally sensitive application. The range of applications for UV systems are shown on pages 5 and 6.

UV DOSE

UV light output at 254 nanometres is known as UV-C light (germicidal region), and has the ability to inactivate all known micro-organisms, bacteria, pathogens, virus and moulds, including chemically resistant organisms such as Cryptosporidium and Giardia. UV dose is commonly measured in mJ/cm².

Systems are typically sized in two ways: -

- 1 To provide a minimum level of UV intensity. This sizing ensures that the UV intensity at the furthest location from the UV lamp (UV-C light source) is the minimum dose the system will provide. This UV dose is known as a wall dose.
- 2 An average dose takes into account the wall dose (furthest distance from the UV lamp) and the area immediately in front of the UV lamp where the UV output is greatest.

The average dose for the system is then calculated using these values which means that the UV dose at the wall will be lower than the average dose for the system as a whole.



Rodin UV – effectiveness against micro-organisms

UV IS EFFECTIVE AGAINST ALL MICRO-ORGANISMS

Some micro-organisms are resistant to chlorine, but all are susceptible to ultraviolet light. Therefore, disinfection by UV is very effective against bacteria, algae, moulds and yeasts. Bacteria and viruses are the major cause of water borne pathogenic diseases. Enteric viruses, hepatitis viruses and legionella pneumophilia are known to survive for considerable periods in the presence of chlorine, but are effectively eliminated with UV treatment.

UV DISINFECTION HAS NO ADVERSE BY-PRODUCTS

Chlorine in contact with organic contamination found in some waters forms halogenated by-products such as trihalomethanes (THMs) which have been proven to be carcinogenic. Ozone possesses properties which require considerable care in its choice and application. In contrast UV light has no adverse effect on water quality.

TYPICAL UV DOSES FOR INACTIVATION OF MICRO-ORGANISMS

The table below shows the approximate dose values for the inactivation of 90% (log 1 reduction) and 99.9% (log 3 reduction) of waterborne organisms pathogenic to humans.

The results were achieved using laboratory cultured organisms and some studies have shown that bacteria populations in the environment will require a higher UV dose to ensure inactivation occurs. This highlights the need to size the unit correctly to achieve the appropriate wall dose. For more information on sizing and dosing of Rodin UV systems please contact the **Rodin sales office**.

Bacteria/Viruses/Protozoa				
Disease	Organism	Bacteria/ Virus/ Protozoa	UV DOSE mJ/cm ² @ 90% (log 1 reduction)	UV DOSE mJ/cm ² @ 99.9% (log 3 reduction)
Typhoid Fever	Salmonella typhi	Bacteria	6	17
Dysentery	Shigella dysenteriae	Bacteria	3	8
Cholera	Vibrio cholerae	Bacteria	2	7
Gastroenteritis	Escherichia coli	Bacteria	5	14
Legionnaire's disease	Pneumophilia	Bacteria	8	23
Infectious Hepatitis	Hepatitis A virus	Virus	6	17
Poliomyelitis	Poliovirus type 1	Virus	7	22
Gastroenteritis	Rotavirus SA-11	Virus	10	29
Cryptosporidiosis	Cryptosporidium	Protozoa	3	12
Giardiasis	Giardia	Protozoa	2	11

Data references

Bacteria and viruses - Hijnen WAM, EF Beerendonk and GJ Medema 2006. Inactivation credit of UV radiation for viruses, bacteria and protozoan (oo) cysts in water: a review. Water Res 40:3.22

Protozoa – US Environmental Protection Agency

COMPARISON OF UV TO SIMPLE CHLORINATION

As well as being effective against all known micro-organisms, Rodin systems have a low operating cost and are designed specifically for ease of installation and maintenance. This is shown below compared with the most common alternative primary disinfectant, which is simple chlorination.

	Ultraviolet	Simple Chlorination
Initial capital cost	Low	Lowest
Ease of installation	Excellent	Good
Overall operating cost	Very low	Low
Ongoing maintenance cost	Low	Low
Ease of maintenance	Excellent	Good
Maintenance frequency	Annually	Frequent
Virucidal performance	Good	Poor
Hazards to personnel	None	High
Requires toxic chemicals	None	Yes
Trihalomethanes formation	No	Yes
Operational problems	Low	Medium
Water residence time	0.1 - 5 seconds	30 - 60 seconds
Performance with variable flows	Excellent	Poor



Rodin UV – applications

A wide range of Rodin UV systems exist with a common control unit that allows integration into a variety of applications. Market leading designs allow for the systems to be optimized to suit any operational requirements for a vast range of industry applications and processes, some of which are set out below.

DRINKING WATER

From small well water supplies to large water treatment works UV disinfection is a proven barrier to pathogenic micro-organisms including Cryptosporidium and Giardia.

FOOD & BEVERAGE

The importance of bacteria free products combined with the need to vastly reduce chemical additives has established ultraviolet disinfection as a core technology.

WASTE WATER

From municipal treatment to water recovery for irrigation and re-use, UV treatment can provide the final disinfection stage required to meet increasingly strict regulations.

SWIMMING POOLS

Sparkling clear water and clean fresh air. UV destroys the chemicals responsible for poor water quality and reduces the risk of illness from chlorine resistant micro-organisms. UV can provide dual functionality within a swimming pool application with combined chlorine reduction as well as bacteria disinfection.

AQUACULTURE

Market pressures demand chemical and antibiotic free produce; to stay competitive, intensive farming requires UV disinfection to prevent infection and disease.

ELECTRONICS

High quality systems specially designed for the production of low TOC (total organic carbon) ultra pure water for use within a range of electronic production applications including semi conductors.



Rodin UV – applications

HORTICULTURE

UV treatment will not affect the chemistry of water fed to the rhizosphere. Unlike hydrogen peroxide it does not affect the organic additives, germination or seedling development.

PROCESS WATER

Chemical free UV disinfection has become a key technology for process water applications, including condensate cooling water, fountains, cooling towers, storage tanks and mains supplies.

AIR CONDITIONING

UV systems treat condensate cooling water, a prime source of bacteriological growth in air conditioning applications. Ideally suited for this application, UV is an effective barrier against viruses, bacteria and parasitic micro-organisms.

COOLING & HEATING

Micro-organisms such as legionella can thrive in cooling/heating systems. Evaporated water and spray can carry harmful micro-organisms to populated areas, posing a significant threat to public health. UV provides an effective non-chemical solution.

WATER FEATURES

UV systems effectively protect against harmful micro-organisms such as legionella, which present a significant danger in water feature applications e.g. fountains, where wind can carry infected atomised water great distances.

ICE MAKERS & VENDING

All ice makers and post mix vendors in commercial establishments are connected to a water supply. Utilising a low pressure UV unit will ensure that the water is free of harmful micro-organisms and bacteria.

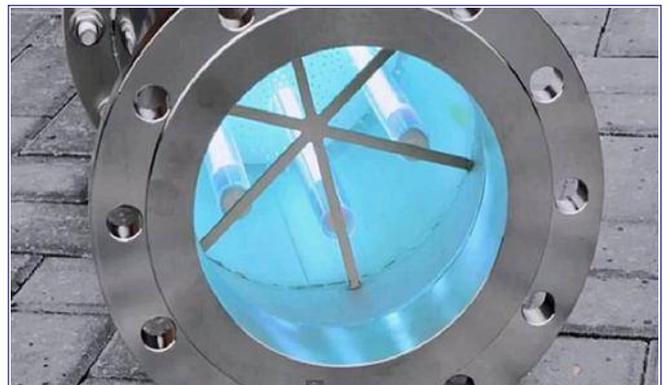
NORMAL UV DOSE REQUIRED FOR TYPICAL UV APPLICATIONS

Typical Application	Typical UVT* %	Required Dose
Drinking water	90% - 95%	30 mJ/cm ² Wall Dose
Waste water	50% - 80 %	30 mJ/cm ² Wall Dose
Swimming pools	94%	60 mJ/cm ² Average Dose
Aquaculture	85% - 90%	320 mJ/cm ² Average Dose
Rain water harvesting-irrigation	80% - 85%	150 mJ/cm ² Average Dose
Rain water harvesting-process	80% - 85%	30 mJ/cm ² Wall Dose
Process water-towns mains	90%	30 mJ/cm ²
Make-up water-towns mains	90%	30 mJ/cm ²
Cooling loops	70% - 90%	30 mJ/cm ²

*UVT – Ultraviolet Transmittance

PRE-FILTRATION

To prevent the phenomenon known as "shadowing" where micro-organisms can be shielded from the UV light by the presence of suspended solids, pre-filtration before a UV system should be considered to optimise system performance.



Rodin UV – certification and warranty

WRAS

All the Rodin range comes with full WRAS approval and you can be assured our systems are consistently engineered to the highest standards.

Our UV systems have been designed to meet exacting standards by engineers who are highly experienced within the ultraviolet industry.

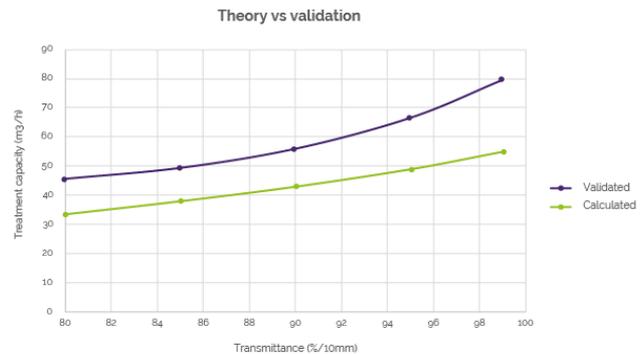
VALIDATION

For critical systems where dose delivery must be assured, we can supply 3rd party validated Ultraviolet systems for a range of applications at varying ultraviolet transmittance (UVT%). These systems are validated to BS EN 14897:2006+A1:2007

Whilst it is always beneficial to know the theoretical performance of a system and deriving an average dose for it, in reality this means is that there will be some of the water getting too little UV to inactivate micro-organisms while some of the water will be getting a lethal dose many times over, when it requires to be just the once.

Our validated systems undergo standardised tests using known quantities of bacteria traces. The level of bacterial is measured both before and after the reactor chamber which enables the actual level of biological breakdown to be measured. This process ensures that every UV-reactor actually produces the intended log reduction and UV dosage required and is therefore not solely dependent on theoretical calculations based upon lamp intensity and flow rate.

This ensures that, up until the end of the listed lifespan of the UV lamp, our UV systems are guaranteed to protect the water system from bacteria and micro-organisms for the given level of UV dosage at the given transmission value (T10).



WARRANTY

The Rodin product range is covered by a one year warranty as standard. The warranty will be extended by a further year up to a maximum of five years provided a full service contract is taken out through The Rodin Group and only genuine manufacturers approved consumable parts are used. The warranty is a sure sign of quality, demonstrating that Rodin not only works hard to provide world class system designs but continues to provide customers with a world class after sales support service. The warranty covers chambers, mechanical parts and electrical components but excludes consumable spares and labour. (UK supplied product only).



Rodin UV - questions and answers



Which is better, UV or Ozone?

Both are highly effective for disinfection, however, ozone requires considerably more knowledge and maintenance to operate and maintain it. It also takes up considerably more space than a UV system. With UV systems, you just turn on the lamp and let it run.

What is typical low pressure lamp life?

Typically, the average life of a lamp is approximately 12,000 hours. The warranty period of the low pressure lamp is 9,000 hours. However, lamp life will diminish if it is turned off and on frequently.

Does the word 'UV filter' mean the UV removes the microbes from the water?

No, UV systems do not remove the microbes from the water; they however do deactivate the bacteria by breaking down their DNA using UV-C rendering them unable to reproduce.

Is UV effective against all types of bacteria?

There are currently no known microbes that are resistant to UV treatment.

Does UV treatment affect the end products taste, colour or pH value?

UV does not affect the taste, colour, or pH value of the fluid being disinfected, and as such the technique is often used where conventional disinfection with chlorine cannot be applied.

How long has the technology been used for disinfecting water?

The first systems were installed in Eastern Europe in the 1980's with now many units installed all over the world including Sweden, Germany, France, Poland, China, Australia, the Middle East, America and more recently in the UK.

How do you size a UV system to ensure they are providing the correct level of treatment?

UV dose is measured in mJ/cm^2 and systems are typically sized in two ways: -

- 1) A wall dose (minimum dose), provides a minimum level of UV intensity. This sizing ensures that the UV intensity at the furthest location from the UV lamp (UV-C light source) is the minimum dose the system will provide. This UV dose is known as a wall dose.
- 2) An average dose takes into account the wall dose (furthest distance from the UV lamp) and the area immediately in front of the UV lamp where the UV output is greatest. The sizing method calculates and average dose for the system.

What are the possible locations and applications where Rodin UV systems could be utilised?

Drinking water, food and beverage, air conditioning, cooling and heating, water features, ice makers and vending, water supplies and swimming pools are all possible applications.



Specifying Rodin UV systems

The use of ultraviolet (UV) light has now become standard practice in a vast range of industries including municipal drinking water and waste water treatment, industrial process and manufacturing, offshore and marine and aquatics. Ultraviolet disinfection systems are used to ensure water is free from harmful organisms, and is a proven, regulated and environmentally friendly technology.

In order to provide the best ultraviolet system to suit your needs, the following variables are required to size a UV system for a specific application. The following information is helpful but not essential to providing a quotation: -

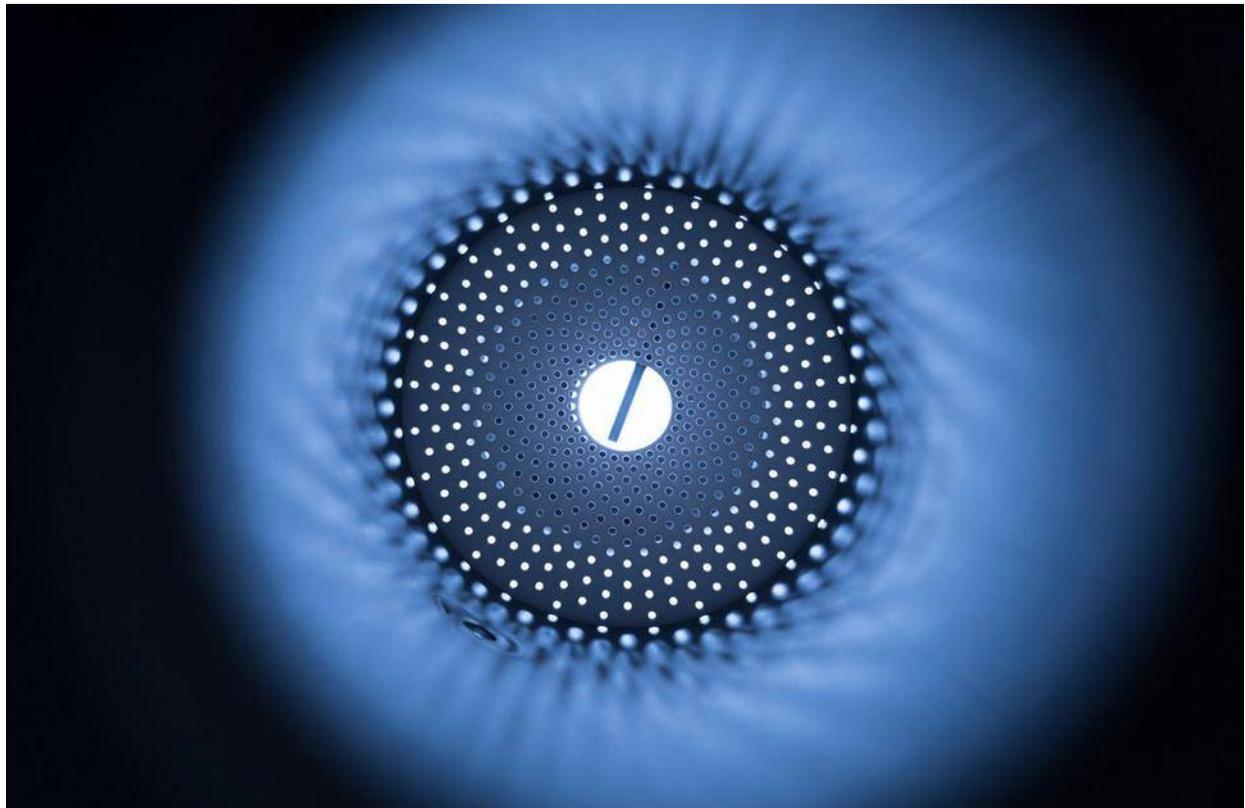
- Flow rate
- Application
- Water source
- UVT (ultraviolet transmittance) percentage
- Details of pre-treatment (if any)
- Intended use
- Known biological challenge
- Known dose standard
- Treatment Cycle

A water sample should be supplied to ensure transmission value is accurate.

RODIN SPECIFICATION

The water disinfection unit shall, subject to correct sizing and UV dose with a transmittance (T10) between 80 and 99%, deactivate all waterborne organisms and prevent them from being able to reproduce by the use of ultraviolet light with a wavelength of 254nm

- Photonic energy at a wavelength of 254nm will be produced by the lamp(s) within a chamber constructed of 316L stainless steel
- No additives shall be used in the process and no harmful residuals shall be formed
- Validated UV System according to EN 14897
- WRAS Approved
- The unit shall include a full control unit that runs from a 230VAC 50/60Hz single phase supply
- The control unit to have IP55(IP54) protection rating and to provide information output on lamp status, a lamp hour counter, system running time and volt free alarm contacts
- Chamber design incorporating flow plate with axial inflow to produce less diverse UV dosage which maximizes the use of the lamp(s) energy
- Maximum chamber pressure of 16 bar at 25°C
- Water disinfection units shall be validated UV systems supplied by The Rodin Group Ltd (www.therodingroup.co.uk) subject to a technical submittal demonstrating compliance with the above criteria.



The Rodin Group range

WATER TREATMENT PRODUCTS

ION SCALEBUSTER



ULTRA VIOLET



WATER SOFTENERS



HONEYWELL FILTERS



HONEYWELL VALVES



CARTRIDGE FILTERS



WASHROOM PRODUCTS

VELOCITY CARTRIDGES



WATERFREE URINALS



HIGH PERFORMANCE KEY VALVES



RADA SHOWER VALVES



WATER SAVING SHOWERS



MINI SHOWER VALVE

