



## UVA, UVB, UVC EXPLANATION

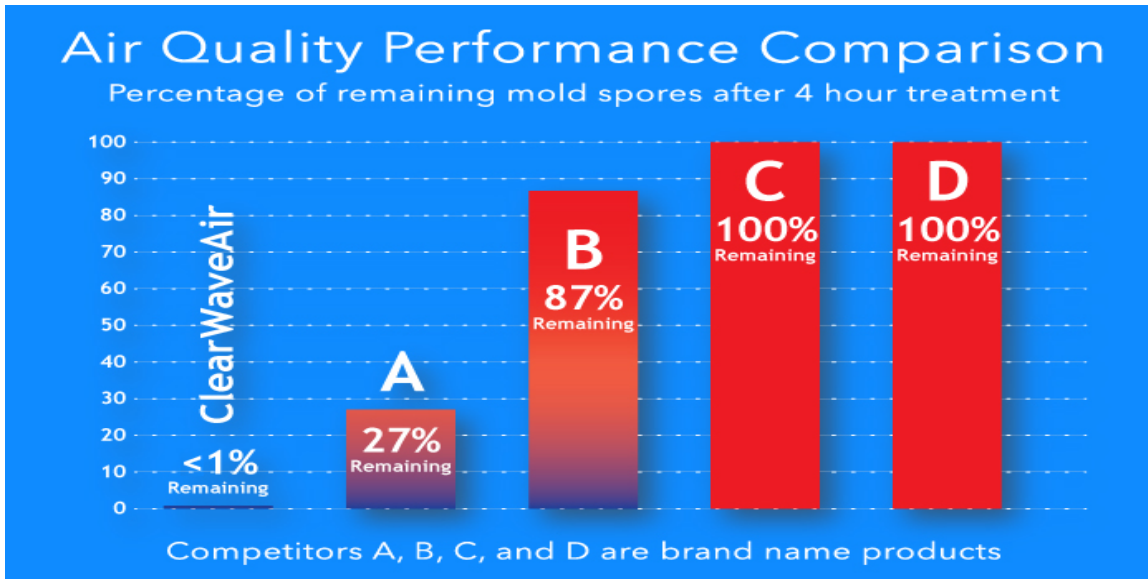
The sun radiates a broad spectrum of ultraviolet light. Listed here are the three frequency bands that are of interest to the field of air purification:

1. UVA has a wavelength of 315-400 nanometers. UVA is not absorbed by our atmosphere and reaches the earth at nearly full strength. UVA is primarily responsible for tanning our skin. It is relatively harmless to live organisms and has virtually no germicidal properties.
2. UVB has a wavelength of 280-315 nm. Our atmosphere mostly absorbs UVB. The light that reaches the earth is also responsible for suntans and sunburns.
3. UVC has a wavelength of 100-280 nm. Fortunately, UVC is completely absorbed by our atmosphere and virtually none of it reaches the earth's surface. UVC is harmful to skin and eyes. UVC includes the germicidal wavelength of 254 nm, which is highly destructive to most living microorganisms including parasitic cysts, mold and fungal spores, bacteria, viruses, etc. An adequate dose of UVC will destroy harmful microorganisms in fractions of a second. As such, UVC is ideal for purifying air from harmful microbial organisms. Any germ/microbe that is exposed to UVC radiation is inactivated.
4. UVC AIR PURIFIERS. ClearWave Air has developed a highly effective, patented UVC microbial kill chamber, which is the heart of the CWA purifier. This cylindrical kill chamber is flooded with high intensity UVC light, which irradiates all air passing through it. CWA air purifiers have been extensively tested and certified by Intertek laboratories. To test CWA air purifiers' ability to destroy microorganisms, *Penicillium citrinum* was used as the test organism. *Penicillium citrinum* is known to be 85 times more difficult to destroy than *E. coli*. As such, destruction of *Penicillium citrinum* proves that air purifier's ability to destroy most any other bacteria/virus with a lower UV susceptibility.

April 2015 Intertek tests of the current production CWA200 air purifier resulted in a 99% reduction of *Penicillium citrinum* over a 4-hour period. At the start of the tests, the test chamber was populated with 1.7 billion test organisms. After 240 minutes, it reduced these organisms to zero. These tests proved that the CWA purifier was able to destroy 7.1 million organisms per minute, a number unprecedented by any of the other air purifiers we have investigated or tested.

CWA instructed Intertek to test four of the most commonly sold air purifiers on the market to the identical standard with which the CWA200 unit was tested. All of these units were marketed as mold-destroying purifiers. Of the four units tested, two achieved zero reduction, one left 87% of the mold spores remaining and another left 27% of the mold spores remaining. As such, the CWA unit left the air 27 times cleaner than the best competitive unit tested.

See attached chart.



5. UVA/UVB AIR PURIFIERS, also referred to as PHOTOCATALYTIC PURIFIERS, PHOTOCHEMICAL PURIFIERS, PHOTO-OXIDATION PURIFIERS, ETC. Unlike UVC, which is deadly to most microbes, UVA/UVB does not harm airborne microbial organisms. At best, it will give them a tan. As such, UVA/UVB air purifiers operate on an entirely different principal, called photocatalysis. Photocatalysis occurs when a photocatalyst, such as titanium dioxide (TiO<sub>2</sub>) is irradiated by UVA or UVB ultraviolet light. At that time, the photocatalytic surface indeed becomes deadly to most microbes including mold spores, bacteria and viruses. However, the destruction only occurs where the organisms actually touch the irradiated titanium dioxide. Therein lies the great limitation of photocatalytic air purifiers. It is difficult, if not impossible; to create a UV irradiated photocatalytic structure that is touched by the majority of the air flowing through it.

In the ClearWave Air microbial kill chamber, all the air that passes through is irradiated with microbe-killing UVC light, whether it touches the surfaces of the chamber or not. CWA holds several patents that describe novel methods of achieving a large irradiated catalytic surface within the air purifier. However, CWA has not implemented any of these designs because none of them come close to the microbial reduction performance of its patented UV microbial kill chamber.

6. PRODUCT PERFORMANCE CLAIMS. Companies that produce UVA air purifiers often go to great lengths to explain the effectiveness of photocatalysis in the destruction of microbes, chemicals, etc., often quoting scientific research to support their claims. Indeed they are correct in describing the effectiveness of this process. However, they usually fail to tell the consumer that only a small percentage of the air passing through the purifier actually comes in touch with the photocatalyst. The only way a buyer can make a valid comparison between various air purifier technologies is by comparing test results of identical testing of various air purifiers by a recognized certified laboratory.

ClearWave Air has all its product testing and certification done by Intertek laboratories, a worldwide recognized organization. Attached is the 2015 Intertek Performance Test Report of the CWA200 air purifier against Penicillium citrinum mold spores. The CWA air purifier completely eliminated 1.7 billion mold spores in 240 minutes.



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**PERFORMANCE TEST REPORT**  
**102013047COL-002**

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Client		Blue Wave International Corp 1867 Ridgecrest Rd Prescott, AZ 86305
Project No.		G102013047
Sample	Product	Air Purifier
	Model	CWA-200/1
	Identification No.	COL1502121107-001
	Date Received	Feb 12, 2015
	Condition	New/Good
	Production or Prototype	Prototype
Procedural	Tested By	Nicholas Unger
	Reviewer	Lee MooMaw
	Dates Tested	3/24/2015- 3/26/2015
	Report Date	4/2/2015
Standard	Non-standardized Test Method: Microbial Reduction Rate	

**Test Method Summary:**

The test unit was placed in a test chamber and a microbial suspension was aspirated into the chamber. Air samples were taken from the test chamber once the unit was turned on and then at 15 minute intervals over a period of **4 hours**. The process was then repeated without the test unit in the chamber to provide the natural decay results

**Summary of Results:**

Organism	<i>Penicillium citrinum</i> (ATCC 9849)
Model	<b>CWA-200/1</b>
Percent Reduction as compared with Natural Decay Sample	99%


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Test Parameter		Test Result		Natural Decay Result	Units
Organism	Species	<i>Penicillium citrinum</i>			---
	ATCC No.	9849			---
	Challenge Concentration	1.7 x 10 <sup>9</sup>			CFU/mL
	Model	<b>CWA-200/1</b>	<b>Natural Decay</b>		---
Samples (15min.)	0	374	TNTC		CFU
	15	358	TNTC		CFU
	30	239	397		CFU
	45	138	384		CFU
	60	94	380		CFU
	75	67	388		CFU
	90	32	369		CFU
	105	29	331		CFU
	120	16	327		CFU
	135	21	256		CFU
	150	11	234		CFU
	165	7	221		CFU
	180	3	123		CFU
	195	2	136		CFU
	210	3	105		CFU
	225	2	71		CFU
240	0	68		CFU	
Percent Reduction	--	99%	---		CFU

\*TNTC = Too Numerous To Count and is considered a count of 400 CFU.

Test Performed by:

  
 Nicholas Unger  
 Engineer  
 Columbus Office

Report Approved by:

  
 Lee Moomaw  
 Engineer  
 Columbus Office

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