ZOO MED REPTISUN MEGA COMPACT UVB LAMP TESTS

An investigation into the 65W, 110V Mega Compact Fluorescent Lamp from Zoo Med

Thomas Griffiths, 2022
tom@tomaskas.co.uk
V 4.12.22

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DISCLAIMER

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The details provided in this document are based on sole use, and the document contains both scientific information as well as personal opinion. Other people may have different results. The tests have been performed to our best knowledge. Although, the tests do not substitute that of a laboratory test. There are uncontrollable variables when testing a single batch of any item. Different items of the same model number may differ due to their manufacturing batch or operating conditions.

This document may refer to the overall exotic animal keeping hobby as the “reptile hobby”, but this is a force of habit – Tomaskas Ltd. does in fact mean the keeping of the broader herpetological spectrum, including invertebrates, amphibians, and even birds.

REASONS FOR TEST

These tests were completed independently on behalf of Zoo Med Laboratories (Zoo Med). Zoo Med paid for a full version of this report and supplied multiple lamps for testing.

Zoo Med is a brand based in the USA, with products sold worldwide. They produce and sell products for the reptile and fishkeeping communities.

In order to provide the hobby with a base understanding of such products, it's important that impartial tests are conducted. We have a duty, as a community, to look out for each other and share appropriate good practice.

These tests aim to discover if products are suitable for the hobby, independent of the manufacturer's claims.

These tests aim to provide a better understanding of the product in question. The product is aimed at primarily providing a UVB provision.

This is the public version of the report.

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TERMINOLOGY USED

As with many things, there may be more than one correct or colloquial way to describe the same item. There may also be common terms used that may not be correct in everyday usage. I've tried to remain consistent throughout the document so that if I refer to a specific part of an item, you as the reader will know with confidence which part I'm referring to. I'm only human though, and there may be mistakes.

KIT

This refers to everything that comes in a box, including fittings and instructions.

LAMP/BULB

This refers to the main item in the kit. It is a fluorescent lamp with a spiral shape, tapering towards the lowest point. Inside the actual bulb

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are electronics to ensure that the lamp turns on and works as intended.

CFL/COMPACT FLUORESCENT

The term given to a lamp that uses fluorescent phosphor technology, and is considered "compact" in the sense that it generally has a small form factor.

UVI

This is shorthand for Ultra Violet Index. UVI is a standardised measurement for the appropriate wavelengths of radiation associated with essential biological processes involving the synthesis of Vitamin D3 – it is often used as a measure of solar UV radiation at the Earth's surface in terms of potential damage to the skin and the eye. The higher the UVI, less time it takes for harm to occur. This document does not aim to educate about this biological process specifically, and further reading is readily available online. By continuing, it is presumed that you have an understanding of UVI and its relevance to these tests. UVI is not to be confused with UVB. UVI is not to be confused with the Ferguson Zones.

UVB

UVB is the term for part of the electromagnetic spectrum on certain wavelengths, generally between 280 and 320nm. This document does not aim to educate about this specifically, and further reading is readily available online. By continuing, it is presumed that you have an understanding of UVB – including the differences between terrestrial (solar) UVB, which is around 295-320nm, and the more dangerous

non-terrestrial (non-solar) UVB, which is from 280nm to around 295nm.

FERGUSON ZONE(S)

The Ferguson Zones are classification markers for different exposure levels to different UVI. There are 4 Zones. Animals that expose themselves naturally to lower UVI are classified as Ferguson Zone 1, and animals that naturally expose themselves to high UVI are classified as Ferguson Zone 4. This document does not aim to educate about this specifically, and further reading is readily available online. By continuing, it is presumed that you have an understanding of Ferguson Zones – including the differences between the different Zones.

COLOUR TEMPERATURE (AND CORRECTED COLOUR TEMPERATURE)

Colour temperature, or CT, is widely used to define the colour appearance of a light source. Colour temperature is technically only used for "true" light sources – defined as a black body that reads close enough to the Planckian locus.

Corrected Colour Temperature, or CCT, is used on a light source that doesn't read close to the Planckian locus.

Both are defined in degrees Kelvin where a Warm White is around 2700K moving to Neutral White at around 4000K to Cool White, 5000K or more. Note that Colour Temperature and CCT do not tell you anything about the colour rendering ability of a light.

This document does not aim to educate about this specifically, and further reading is readily available online. By continuing, it is

presumed that you have an understanding of CT/CCT – including the differences and similarities.

COLOUR RENDERING (INDEX)/CRI

Broadly defined as an indication of how well a light source can provide wavelengths that allow for certain colours to be visible to the human eye. This is defined by the CIE in greater detail, along with standardisations on measuring the level of colour rendering capability – referred to as the "index" of colour rendering.

Light with a low CRI is less effective as one with a high CRI. The CRI of unobstructed sunlight is 100.

This document does not aim to educate about this specifically, and further reading is readily available online. By continuing, it is presumed that you have an understanding of CRI.

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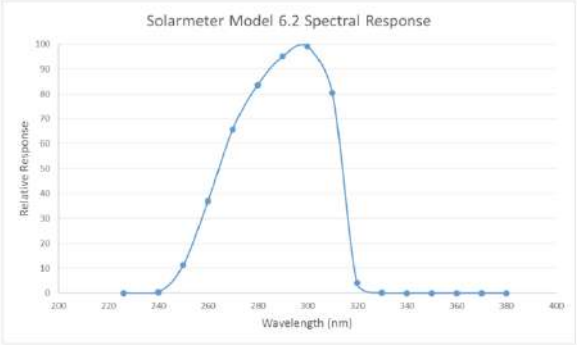
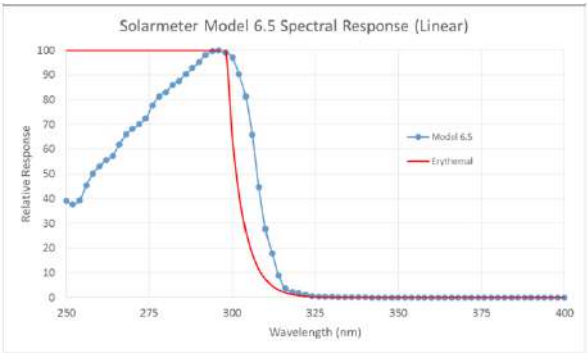
TESTING METHODS

EQUIPMENT

In order to ensure that results are as true and comparable as possible, I have used standardised measuring devices for the tests. I have used a SolarMeter 6.5 for measuring UVI, and a SolarMeter 6.2 for measuring UV in μW/cm².

The spectral response of these broadband meters is shown below.





To allow for full spectrometry, a calibrated FLAME Spectrometer from Ocean Optics was used alongside their flagship software – OceanView.

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Room temperature measurements were taken with an Inkbird branded digital thermometer, with part number IBS-TH2. The manufacturer claims the device to have an accuracy of ±0.3°C.

A drywipe backboard was used for the "manual" portions of the tests. The backboard was pre-marked with a grid pattern. The grid used is 2.5cm squares. The board is approx. 2mx2m in total.

The distance from the unit was determined using a Stanley tape measure, with points marked on the backboard.

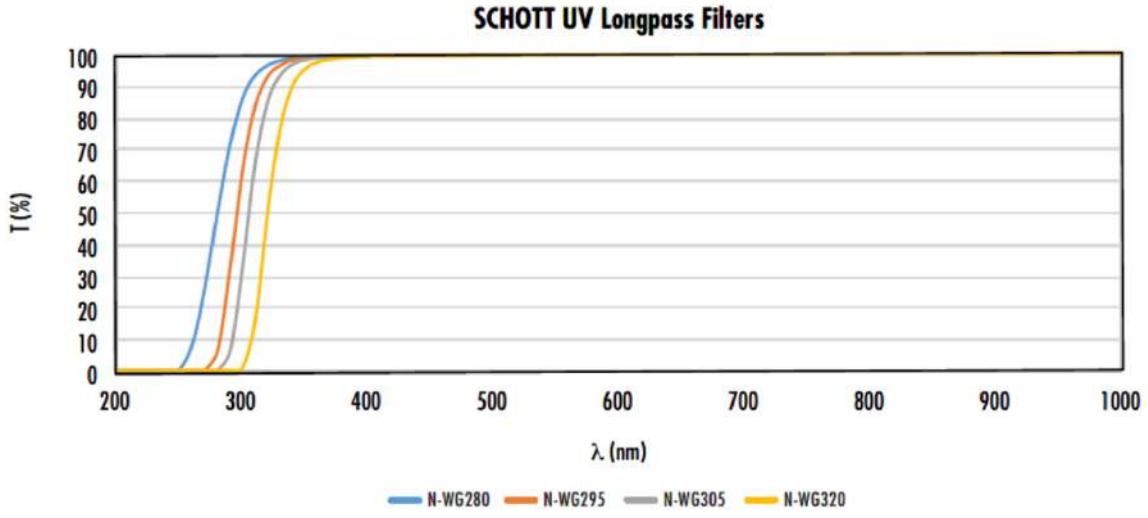
A Windows 10 PC with Microsoft Office and Adobe Photoshop CC 2015 was used to digitise the results and write up this report.

A power meter was used, model KWE-PM01, to monitor power usage.

A Dr Meter LX1330B was used to manually determine LUX values.

The lamps are 110V. I used a voltage transformer to correctly power the lamps.

SCHOTT N-WG295 Long Pass Glass (WG295 Glass) was used where appropriate to monitor for UVC vs noise on the spectrometer.



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For some of the irradiance measurements, I paired the lamp with common Zoo Med products that are recommended on packaging for use with this lamp. I utilised the Zoo Med Deep Dome Lamp Fixture and the Zoo Med Combo Deep Dome Dual Lamp Fixture, both pictured below.

When utilising the Combo Deep Dome Dual Lamp Fixture, a 150W Zoo Med Repti-Basking lamp was also placed in situ, to replicate how it would be utilised in every day use. Below is an image showing how the CFL sits in relation to the heat lamp.

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METHODS

Precaution was taken with all tests, as there should be when dealing with UVB-emitting devices. "Factor 50" UV protection sun cream was used on skin, with care taken not to spread any onto the equipment or lamps.

The method for creating ISO Irradiance charts is very close to the method documented by UV Guide. I have made comparisons with my results and those of the UV Guide, and the results are within tolerances – this means that the results are comparable to those of the UV Guide.
Info here: (http://www.uvguide.co.uk/makingspreadcharts.htm)

Before every test took place, a dry microfibre towel was used to wipe the lamp to ensure that the lamp was clean.

UVI was measured in the testing room before each test to ensure that results were only measuring the lamps and not any other sources.

Spectrometer readings were taken in line with standard processes.

The Reptile Lamp Database was utilised for some technical analysis.

The lamps were given 30 – 60 minutes to "warm up" before each individual test, unless otherwise noted.

The lamps had between 100 – 150 hours of "burn-in" before the tests began, unless otherwise noted.

PRODUCTS TESTED

The following product was tested.

65W REPTISUN MEGA COMPACT UVB LAMP

Multiple lamps were tested for Zoo Med. Each lamp was assigned a number. This public report is showing just one of the lamps, for the sake of easier analysis. Each lamp produced very similar results.

To ensure this report was both fair and accessible, I wanted to select a random lamp to show the results of. This way the lamp shown was not the "best" or "preferred" lamp. The lamp selected was not influenced by data or by Zoo Med. I decided to input the total number of lamps tested into www.random.org to select a random lamp to for the public report. The generator selected "Lamp 3".

INITIAL OBSERVATIONS

DESCRIPTION AND BUILD QUALITY

The lamps are – as expected for any glass lamp – delicate.

The lamps are an E26 fitting.

The lamps are 120mm in diameter at their widest point.

The ballast portion of the lamps, typical for CFLs, are approximately 80mm wide and 79mm tall. The ballast is made from white plastic.

The lamps are branded with the Zoo Med logo.

The lamps show markings for their wattage and voltage.

There are safety markings on the lamps for Mercury (Hg), and a convenient spot to write the date of installation so that a user can keep track of the 12-month lifespan. There are no CE or UKCA markings.

There is a grammatical error on the lamps, with a missing space where it says “radiationfor” instead of “radiation for”.

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BOX/PACKAGING

The box looks and feels high quality in general, there is no blurry printing or any off colours. The product's name is clearly visible on every main face of the box.

The box has brown/bronze accents with black areas, and the design is maintained throughout.

The lamp is made in China, according to the box. The box does not contain a Hg mark but warns that the product contains Mercury and the possible side effects of exposure. The box is very clear about the dangers of misuse of the lamp and where a user can find further information before purchasing.

The front of the box has a high-quality image of a tortoise, it appears to be a Redfoot Tortoise (Chelonoidis carbonarius). The sides of the box contain further images of some kind of agamid lizard (presumably a Frilled Dragon, Chlamydosaurus kingii) and a Monitor Lizard (possibly a juvenile Nile Monitor, but certainly of family Varanidae).

The box lists that the lamp is useful for larger animals, or groups of smaller animals.

There are different configurations provided, with different dome products being recommended, and different distances being recommended for different species.

The box boasts that the lamp has a 12-month lifespan. This is common for T5HO lamps, but not often advertised in CFLs.

The lamp is packaged inside a polystyrene protector – making it very well protected in transit.

There is a double-sided sheet of instructions included in the box.

The instructions provide some clear advice on how best to use the lamp, as well as showing some basic details on the use of the lamp above a mesh screen.

ACCESSORIES

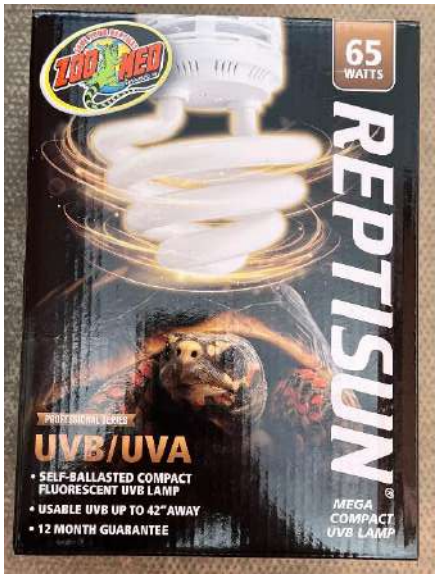
No accessories are included.

PRESUMPTIONS AND GENERAL OBSERVATIONS

The lamp is much larger than a standard CFL. It has a peculiar "cone-like" shape which is unique in the main hobby. I have seen some "no-name" brands use a similar design – such products are available from various sellers on Amazon. Those lamps are not tested here.

PHOTOGRAPHS

Here are some images of the lamp, and box etc. Descriptions are provided where appropriate.



C

Box in different orientations.

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ZOO MED

REPTISUN®

MEGA COMPACT UVB LAMP

ITEM# FS-C65

INSTRUCTIONS

Congratulations on your purchase of Zoo Med's **ReptiSun® Mega Compact UVB Lamp**; your reptiles will thank you! The following instructions will assist you in determining the correct set-up for your application. Zoo Med's **ReptiSun® Mega Compact UVB Lamp** is made for large enclosures where the basking site is at least 11" (28 cm) away from the bulb and for use with animals such as adult bearded dragons, tegus, monitors, uromastyx, tortoises, etc. The unique shape of this bulb produces a wide beam to ensure your pet's entire body is allowed to soak up the UVB rays they need while they bask. Use the UV Index Chart available at zoomed.com/uvichart for the recommended species specific operating distance.

WARNING: Do not allow your pet to get closer than 11" (28 cm) to the bulb.

For use on 40 gallon terrariums or larger.

LAMP FIXTURES AND APPLICATIONS:

This lamp will screw into a standard screw-base lamp fixture. Use the chart below to determine the correct set-up for your reptile.

- **Zoo Med's Deep Dome Lamp Fixture:** Zoo Med's Deep Dome Lamp Fixtures are compatible with your **ReptiSun® Mega Compact UVB Lamp**. The **Deep Dome** Lamp Fixture must be securely suspended above your terrarium by the metal hanger attached to the fixture near the ceramic socket. Zoo Med's adjustable **Reptile Lamp Stand (Item LF-20)** is recommended for safely suspending this fixture above your terrarium. Use Zoo Med's **36" Lamp Stand Extension Pole (Item LF-20X)** for extra-tall enclosures.

Deep Dome Lamp Fixture
Item LF-17

Reptile Lamp Stand
Item LF-20

Combo Deep Dome Lamp Fixture
Item LF-25

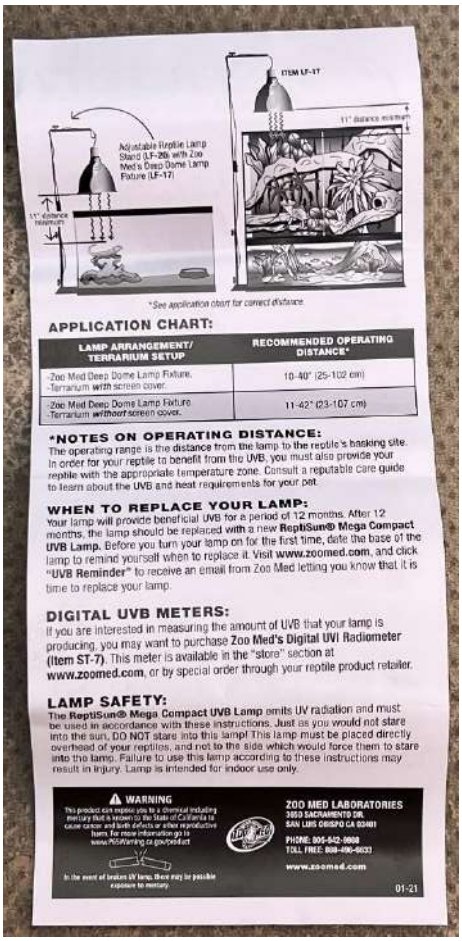
Lamp Stand Extension – 36" Height
Item LF-20X
(Available for purchase at zoomed.com/where-to-buy)

CAUTION: Be sure that the lamp fixture is securely suspended above the enclosure in a manner that will prevent the lamp and fixture from falling into the enclosure.

CAUTION:

- LAMP EMITS ULTRAVIOLET RADIATION FOR REPTILE USE ONLY.
- NOT FOR EMERGENCY LIGHTING.
- FOR INDOOR USE ONLY.
- ANIMALS MUST BE A MINIMUM OF 11" (28 CM) AWAY FROM LAMP SURFACE.
- LAMP CONTAINS MERCURY, FOR MORE ON CLEANUP AND SAFE DISPOSAL, VISIT EPA.GOV/CFL

Please email or call us with any questions you may have.
Phone: 805-542-9988 Email: zoomed@zoomed.com



ITEM LF-17

11" distance minimum

Adjustable Reptile Lamp Stand (LF-20) with Zoo Med's Deep Dome Lamp Fixture (LF-17)

11" distance minimum

*See application chart for correct distance.

APPLICATION CHART:

LAMP ARRANGEMENT/ TERRARIUM SETUP	RECOMMENDED OPERATING DISTANCE*
-Zoo Med Deep Dome Lamp Fixture. -Terrarium with screen cover.	10-40" (25-102 cm)
-Zoo Med Deep Dome Lamp Fixture. -Terrarium without screen cover.	11-42" (23-107 cm)

*NOTES ON OPERATING DISTANCE:

The operating range is the distance from the lamp to the reptile's basking site. In order for your reptile to benefit from the UVB, you must also provide your reptile with the appropriate temperature zone. Consult a reputable care guide to learn about the UVB and heat requirements for your pet.

WHEN TO REPLACE YOUR LAMP:

Your lamp will provide beneficial UVB for a period of 12 months. After 12 months, the lamp should be replaced with a new **ReptiSun® Mega Compact UVB Lamp.** Before you turn your lamp on for the first time, date the base of the lamp to remind yourself when to replace it. Visit **www.zoomed.com**, and click **"UVB Reminder"** to receive an email from Zoo Med letting you know that it is time to replace your lamp.

DIGITAL UVB METERS:

If you are interested in measuring the amount of UVB that your lamp is producing, you may want to purchase **Zoo Med's Digital UVI Radiometer (Item ST-7)**. This meter is available in the "store" section at **www.zoomed.com**, or by special order through your reptile product retailer.

LAMP SAFETY:

The **ReptiSun® Mega Compact UVB Lamp** emits UV radiation and must be used in accordance with these instructions. Just as you would not stare into the sun, DO NOT stare into this lamp! This lamp must be placed directly overhead of your reptiles, and not to the side which would force them to stare into the lamp. Failure to use this lamp according to these instructions may result in injury. Lamp is intended for indoor use only.

⚠ WARNING

This product can expose you to a chemical including mercury that is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warning.ca.gov/product

In the event of broken UV lamp, there may be possible exposure to mercury.

ZOO MED LABORATORIES
3650 SACRAMENTO DR.
SAN LUIS OBISPO CA 93401
PHONE: 805-542-9988
TOLL FREE: 800-[illegible]
www.zoomed.com

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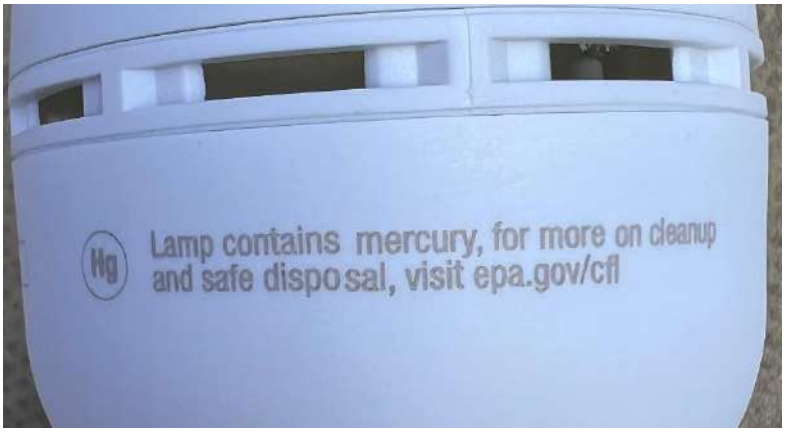
Instructions included in box.

Lamp packaged in protective polystyrene.



Grammatical error

Lamp and markings. Note the grammatical error.

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UV PERFORMANCE

The instructions state that this lamp is only supposed to be used overhead.

As it can be presumed that most average consumers will not burn-in their lamp (there is no instruction to do so on the box), I have measured the UV as it degrades over the first 100 hours of use.

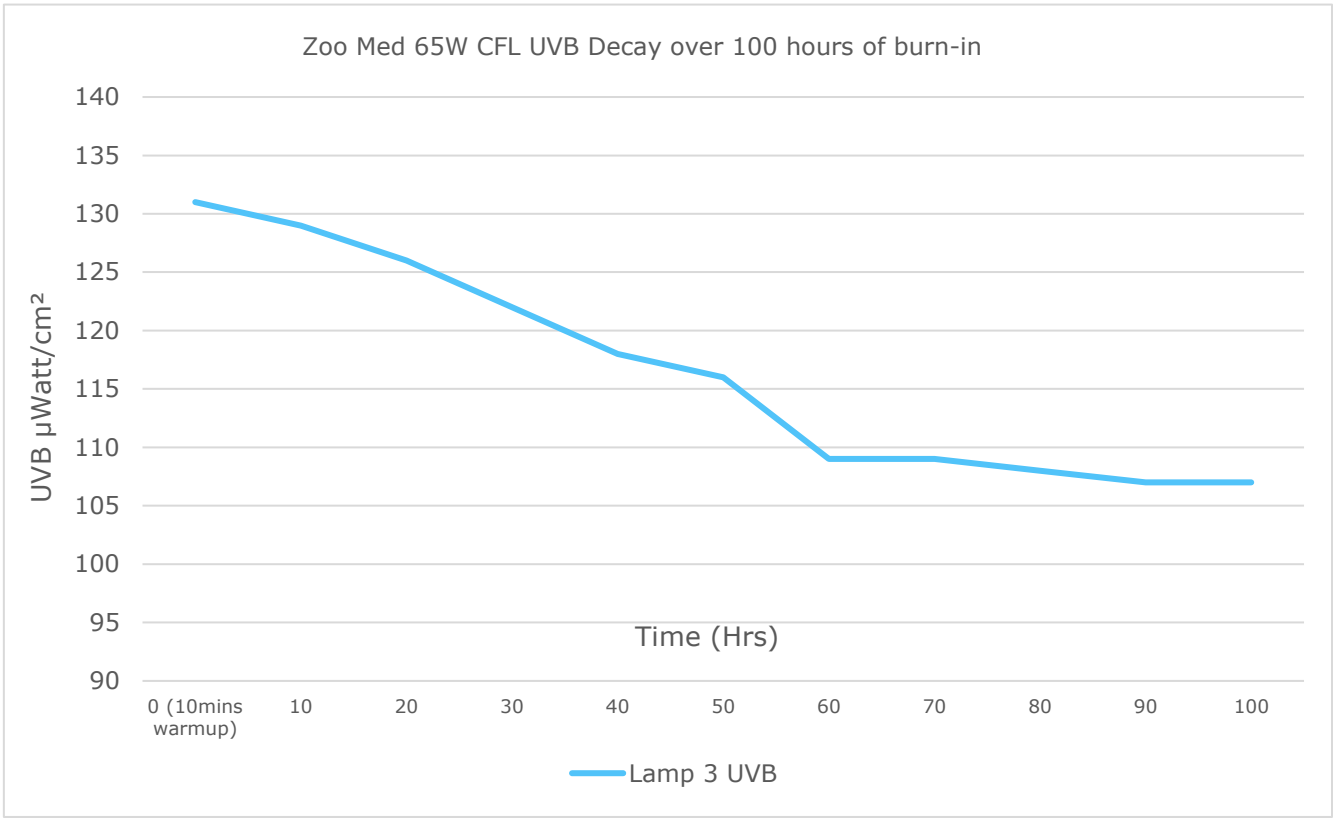
I have measured the UVI (Solarmeter 6.5), and the UVB in μW/cm² (Solarmeter 6.2) at 30cm (approx. 12”) from the centre point of the lamp every 10 hours for the first 100 hours of use.

BURN-IN AND DEGREDATION

The below measurements were taken at 30cm (approx. 12 inches) from the centre point of the lamps over the first 100 hours of burn-in. No reflector or dome is used for this test.

Age (hrs)		0 (10 mins warmup)	10	20	30	40	50	60	70	80	90	100
Lamp 3	UVB	131	129	126	122	118	116	109	109	108	107	107
	UVI	5.5	5.4	5.1	4.9	4.9	4.8	4.7	4.7	4.6	4.6	4.6

The following is a graph of the above data, showing how the UVB decays over time at 30cm.



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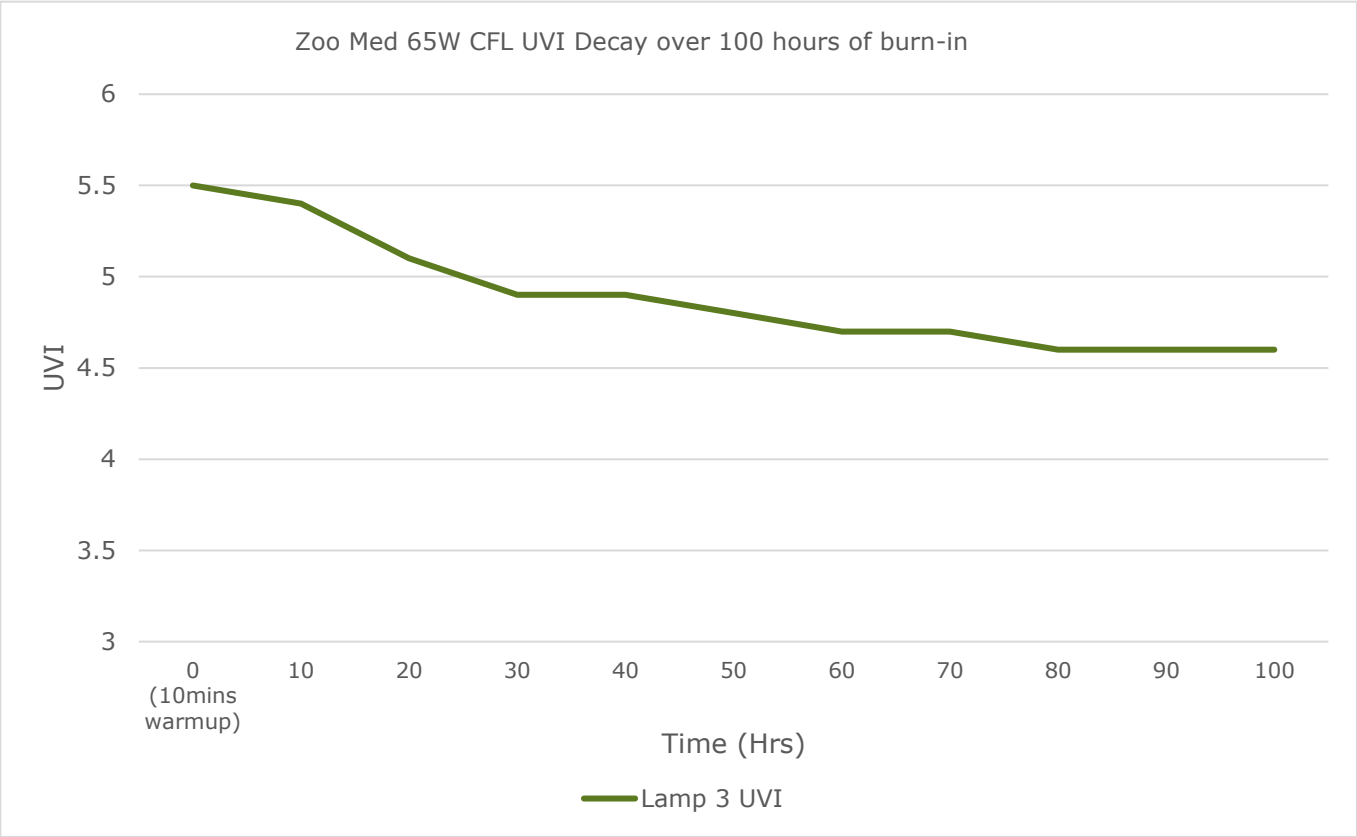
The following is a graph of the same data, showing how the UVI decays over time at 30cm.



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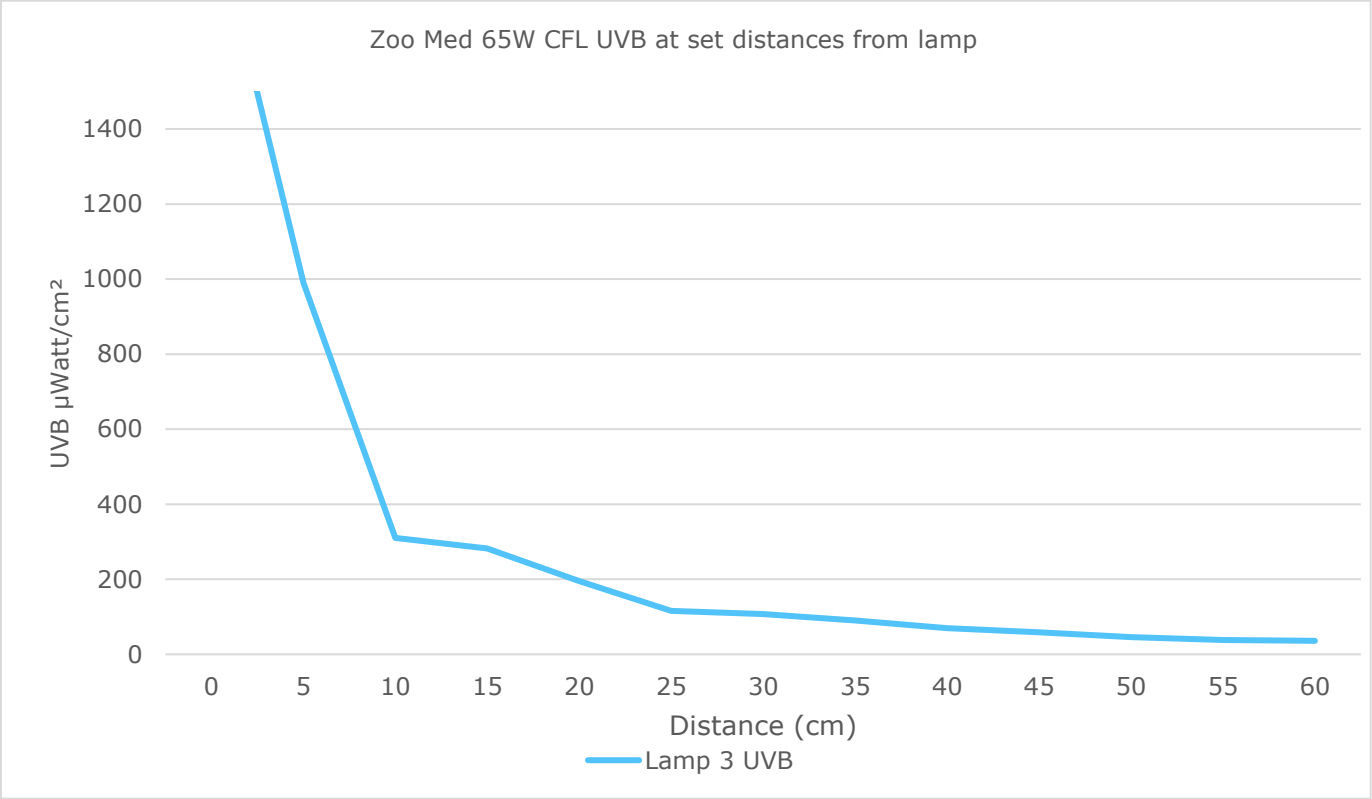
CENTRE POINT AFTER BURN-IN

The below measurements were taken at set distances from the centre point of the lamps after a 105-hour burn-in. No reflector or dome is used for this test.

Distance (cm)		0	5	10	15	20	25	30	35	40	45	50	55	60
Lamp 3	UVB	2000	990	310	282	195	116	107	90	70	59	46	38	36
	UVI	195.0	52.0	22.0	13.0	8.2	6.1	4.6	3.5	2.8	2.3	1.9	1.8	1.4

The following is a graph of the above data, showing how the UVB changes over distance.



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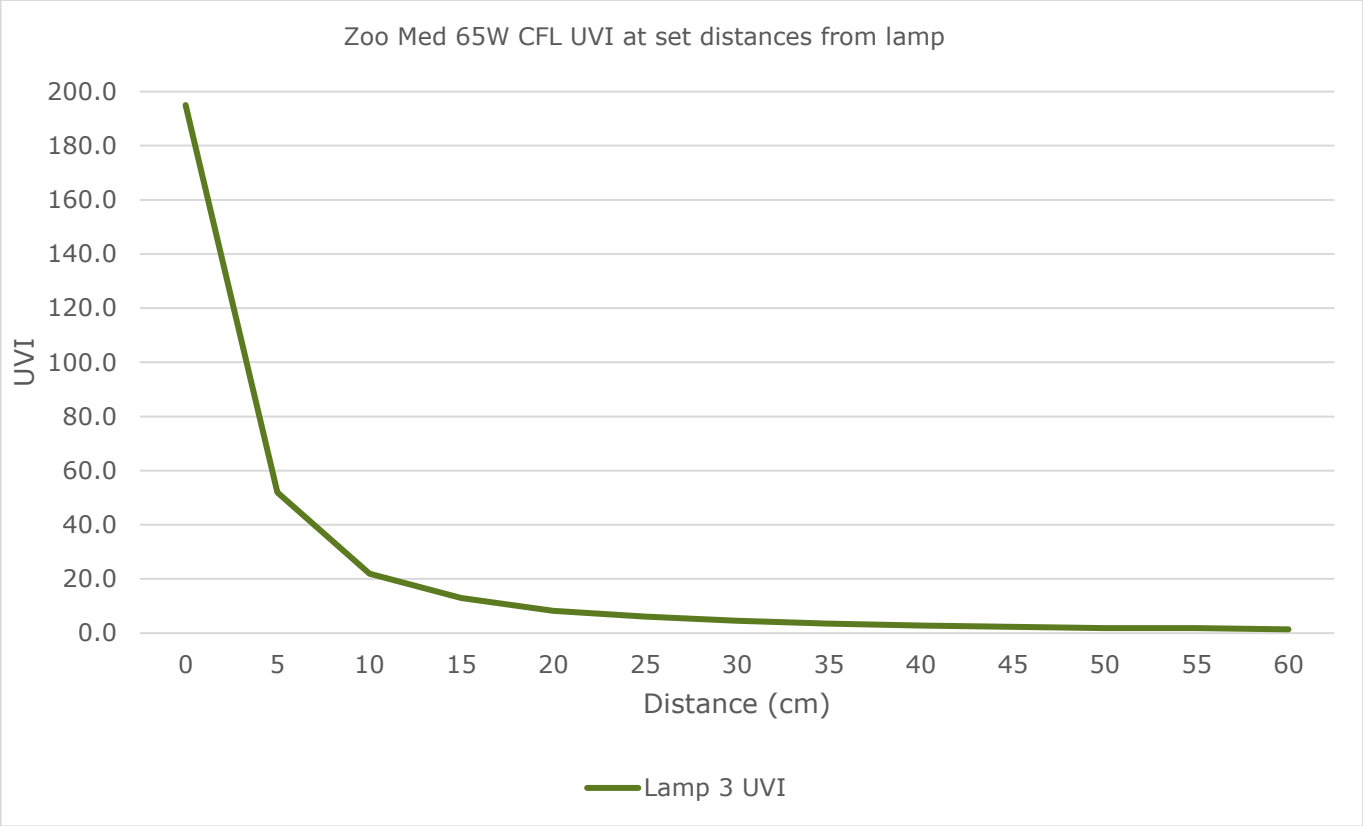
The following is a graph of the same data, showing how the UVI changes over distance.



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IRRADIANCE CHARTS

PURPOSE

The charts in this chapter are an indication of UVI output from the lamps at set distances.

It is possible to visualise how the lamps emit UVB as a whole, using UVI as a figure.

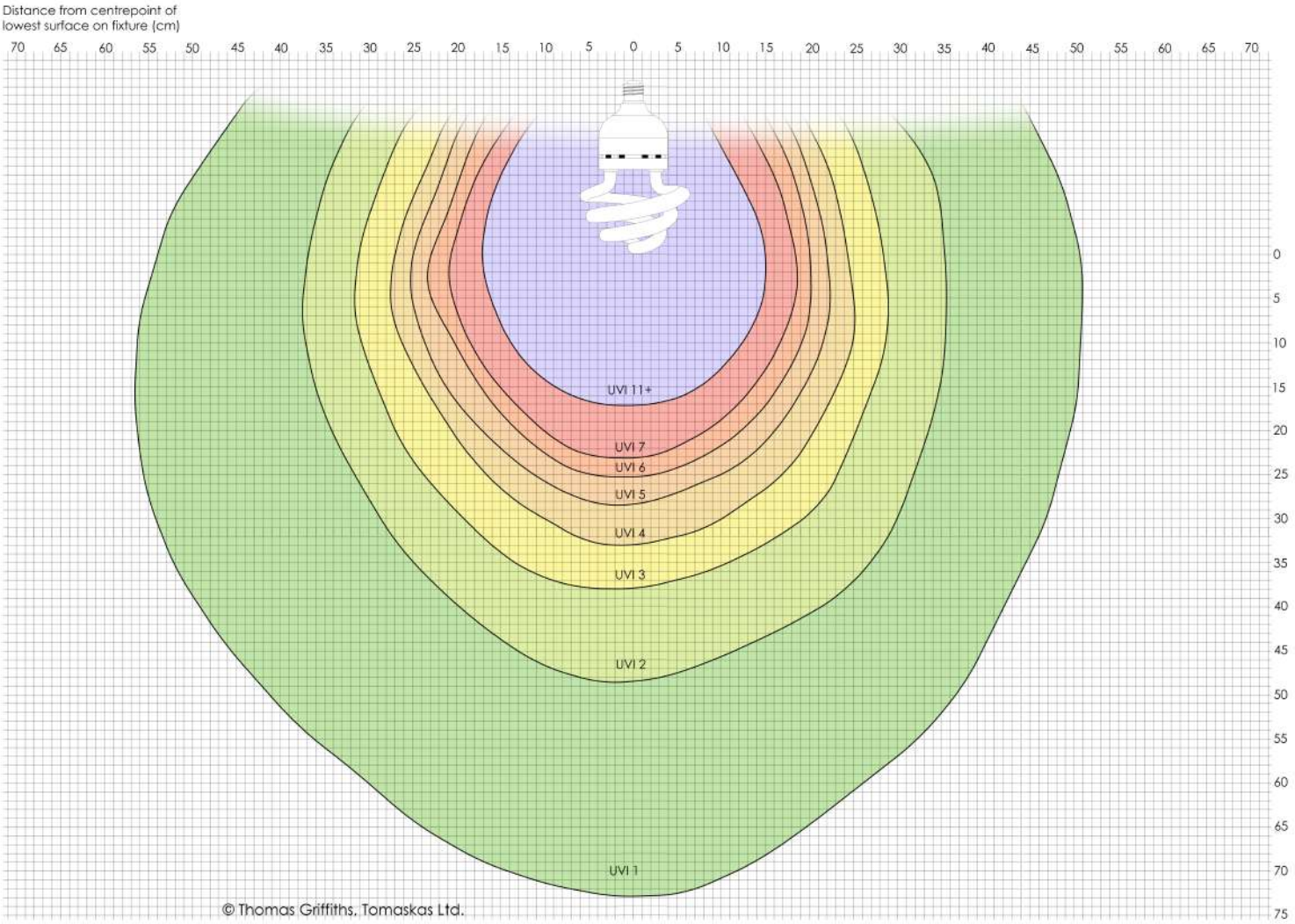
DISCLAIMER

The charts do not make claim to the safety of the lamps, as there is no data on the spectrum included in the charts. The charts are a guide only.

The charts are to scale.

LAMP 3 – NO REFLECTOR

This is the ISO Irradiance Chart for Lamp 3 without a reflector or "dome". Commentary is on a later section.



ISO IRRADIANCE CHART (Spread pattern diargram)
Zoo Med Reptisun Mega Compact UVB Lamp 65W
Tested after 105 hour burn-in and after 1 hour warm up

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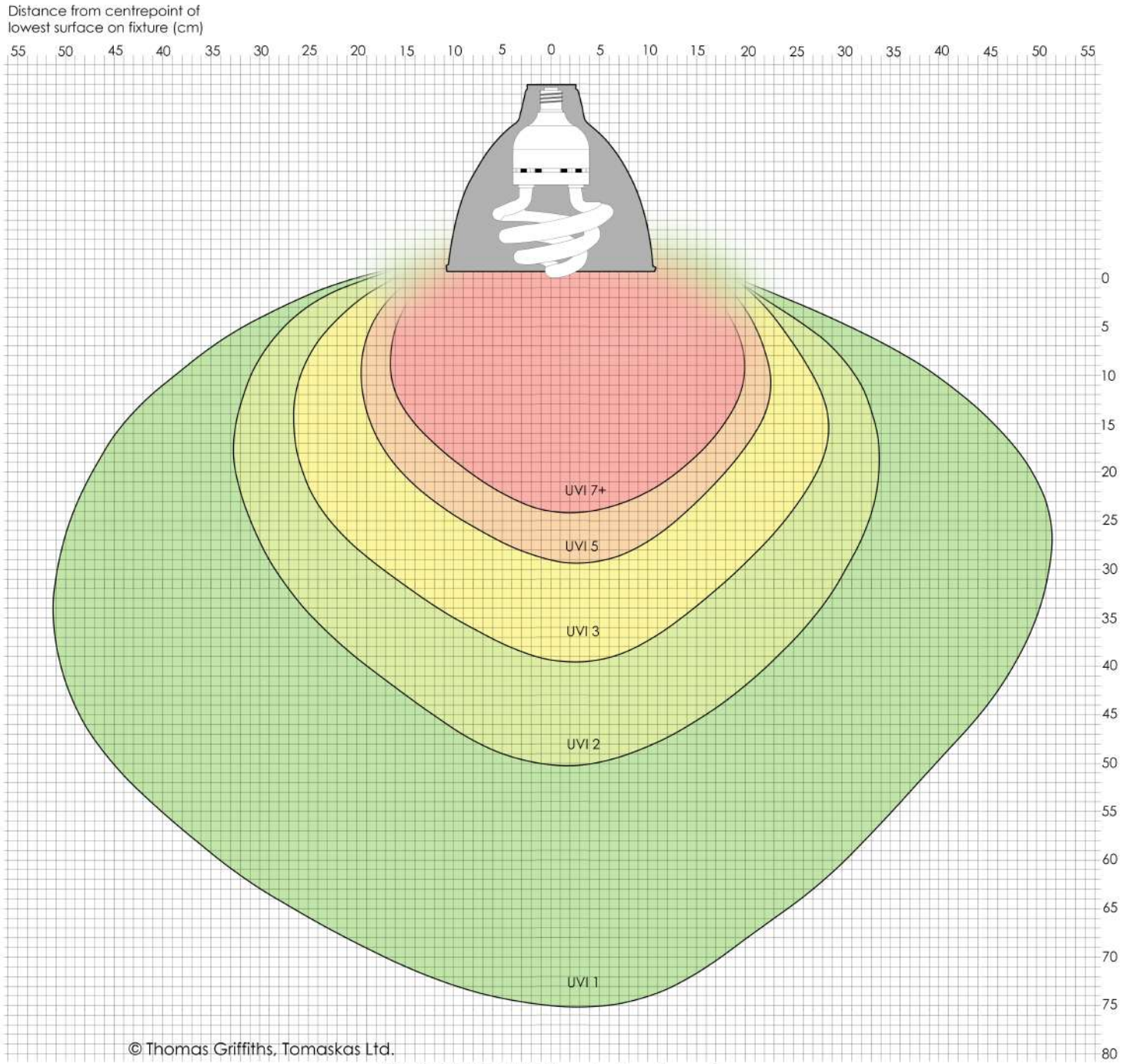
LAMP 3 – WITH DEEP DOME FIXTURE

This is the ISO Irradiance Chart for Lamp 3 with the Zoo Med Deep Dome. Commentary is on a later section.



ISO IRRADIANCE CHART (Spread pattern diargram)
Zoo Med Reptisun Mega Compact UVB Lamp 65W in Zoo Med Deep Dome Lamp Fixture
Tested after 106 hour burn-in and after 1 hour warm up

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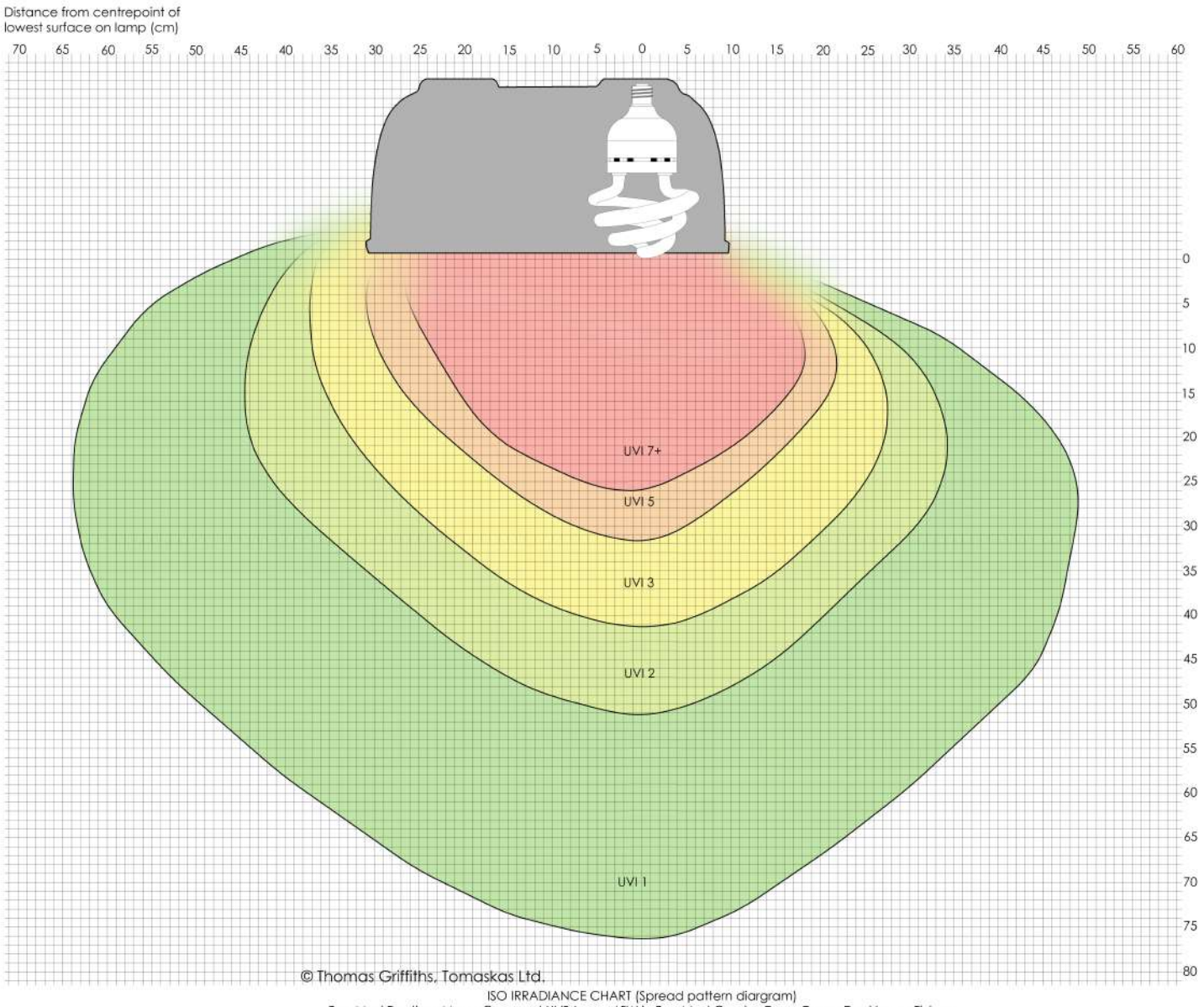
LAMP 3 – WITH COMBO DEEP DOME FIXTURE

This is the ISO Irradiance Chart for Lamp 3 with the Zoo Med Combo Deep Dome reflector, there was also a heat lamp in situ to replicate real life use. Commentary is on a later section.



ISO IRRADIANCE CHART (Spread pattern diargram)
Zoo Med Reptisun Mega Compact UVB Lamp 65W in Zoo Med Combo Deep Dome Dual Lamp Fixture
Tested after 107 hour burn-in and after 1 hour warm up

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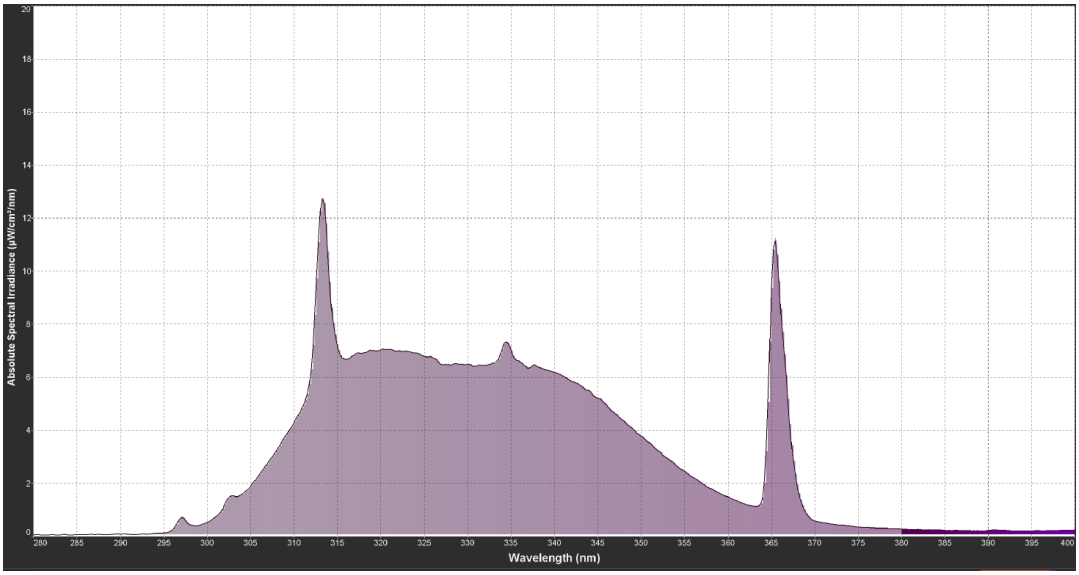
SPECTRAL MEASUREMENTS

280 – 400NM

Reading taken at 30cm away from the lamp. Lamp warm-up was 30 minutes each. This reading was taken **after** the lamp had burned-in for 105 hours.



Full page graph is on the next page. Commentary is in a later section.

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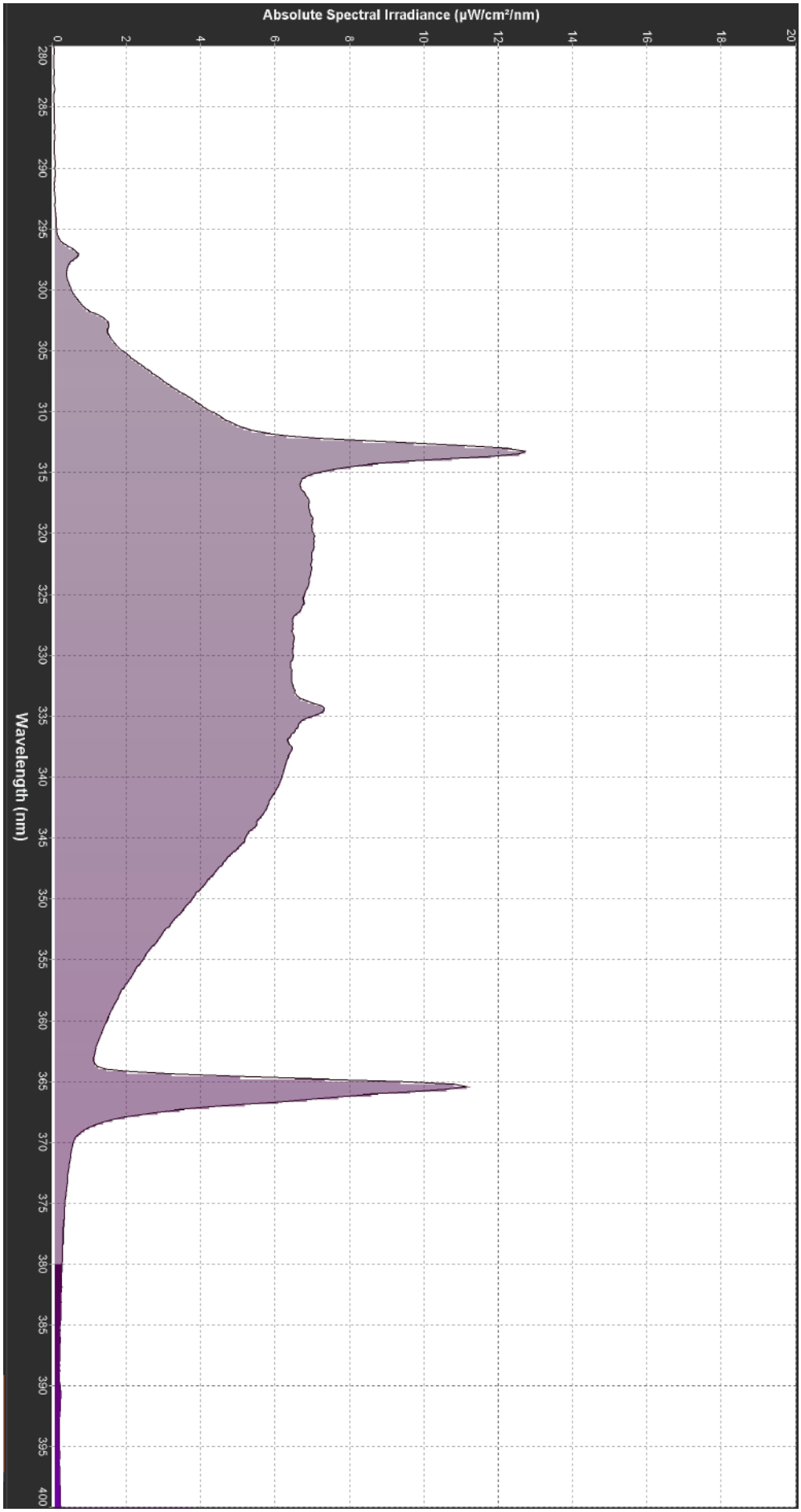

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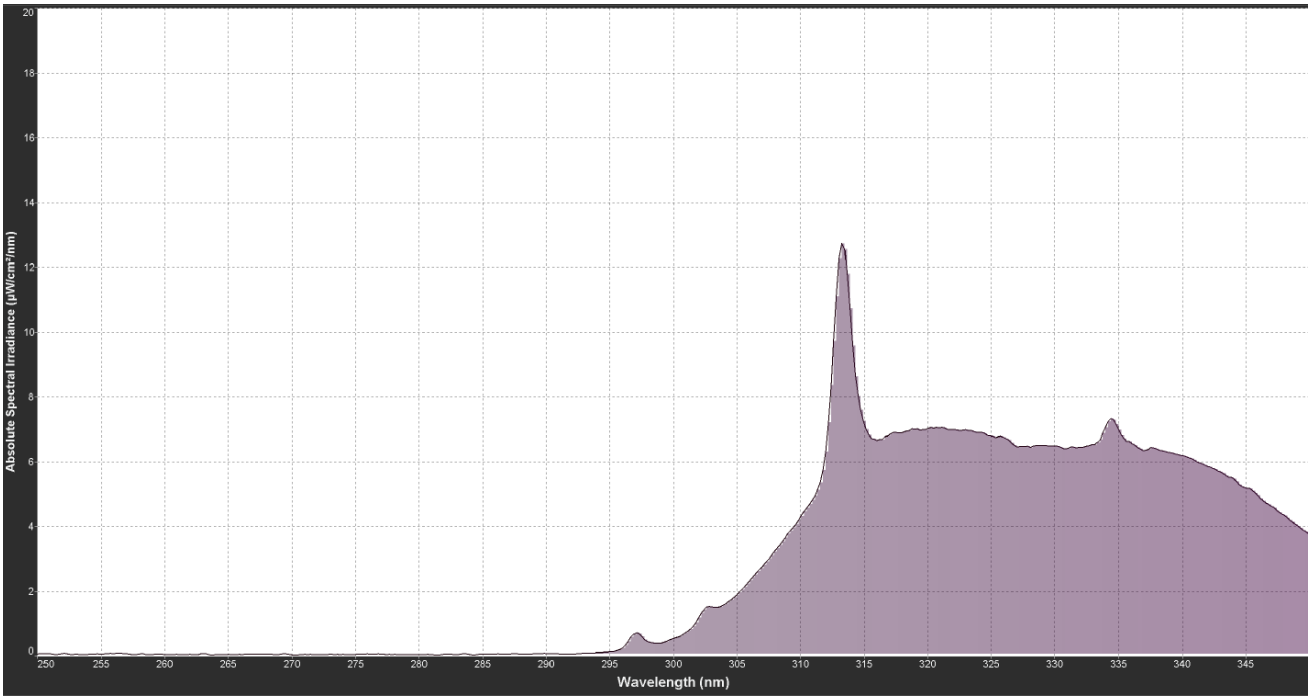
250 – 350NM

Reading taken at 30cm away from the lamp. Lamp warm-up was 30 minutes each. This reading was taken **after** the lamp had burned-in for 105 hours.



Full page graph is on the next page. Commentary is in a later section.

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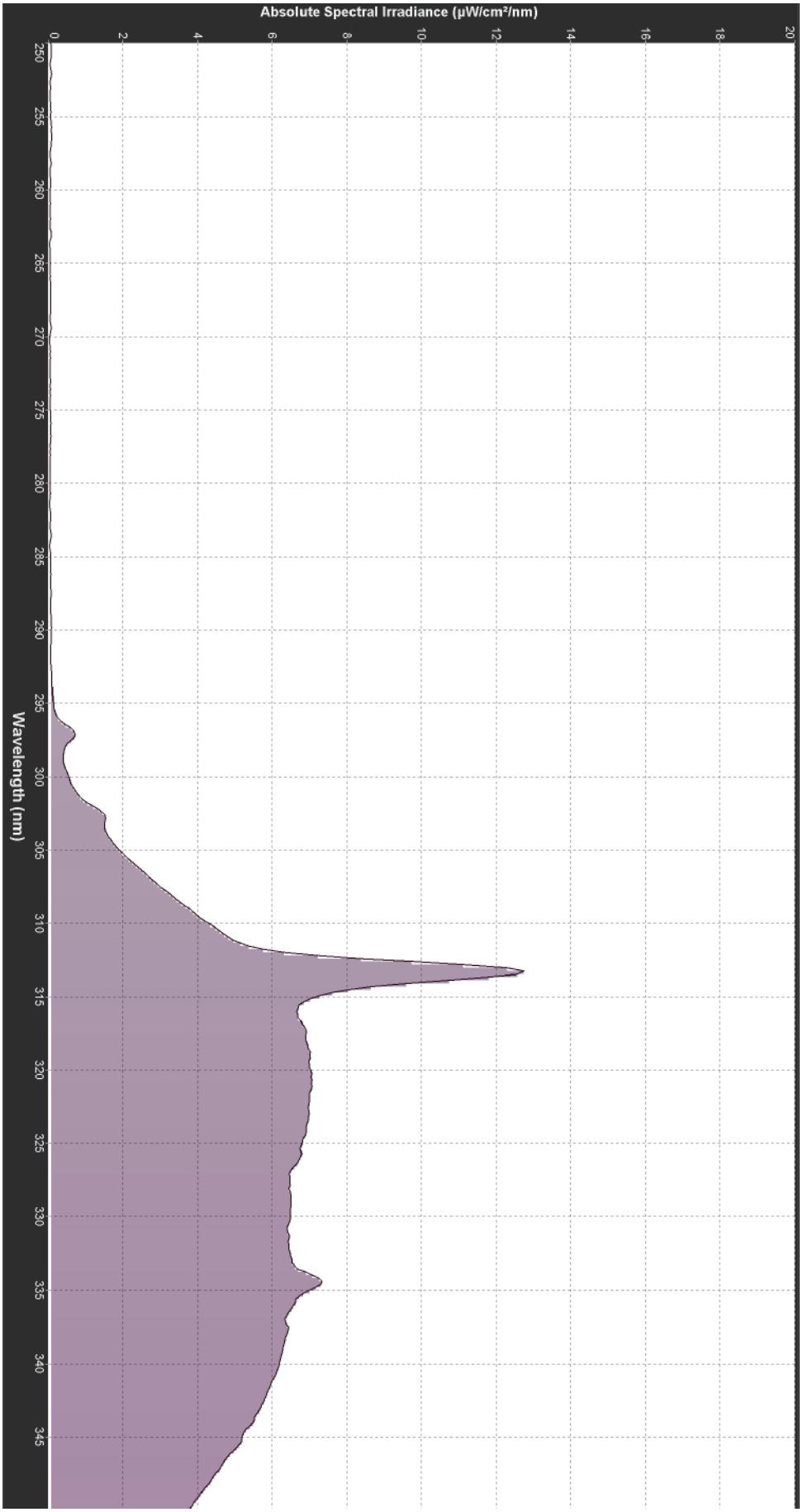

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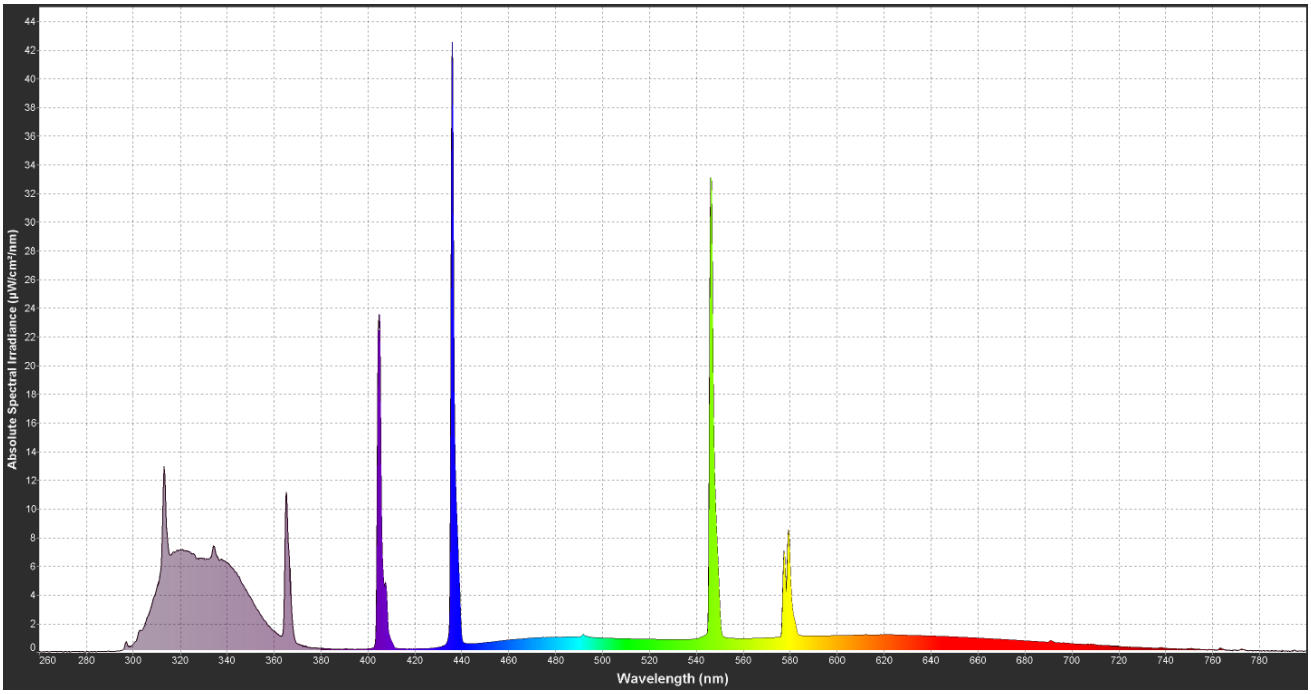
260 – 800NM

Reading taken at 30cm away from the lamp. Lamp warm-up was 30 minutes each. This reading was taken **after** the lamp had burned-in for 105 hours.



Full page graph is on the next page. Commentary is in a later section.

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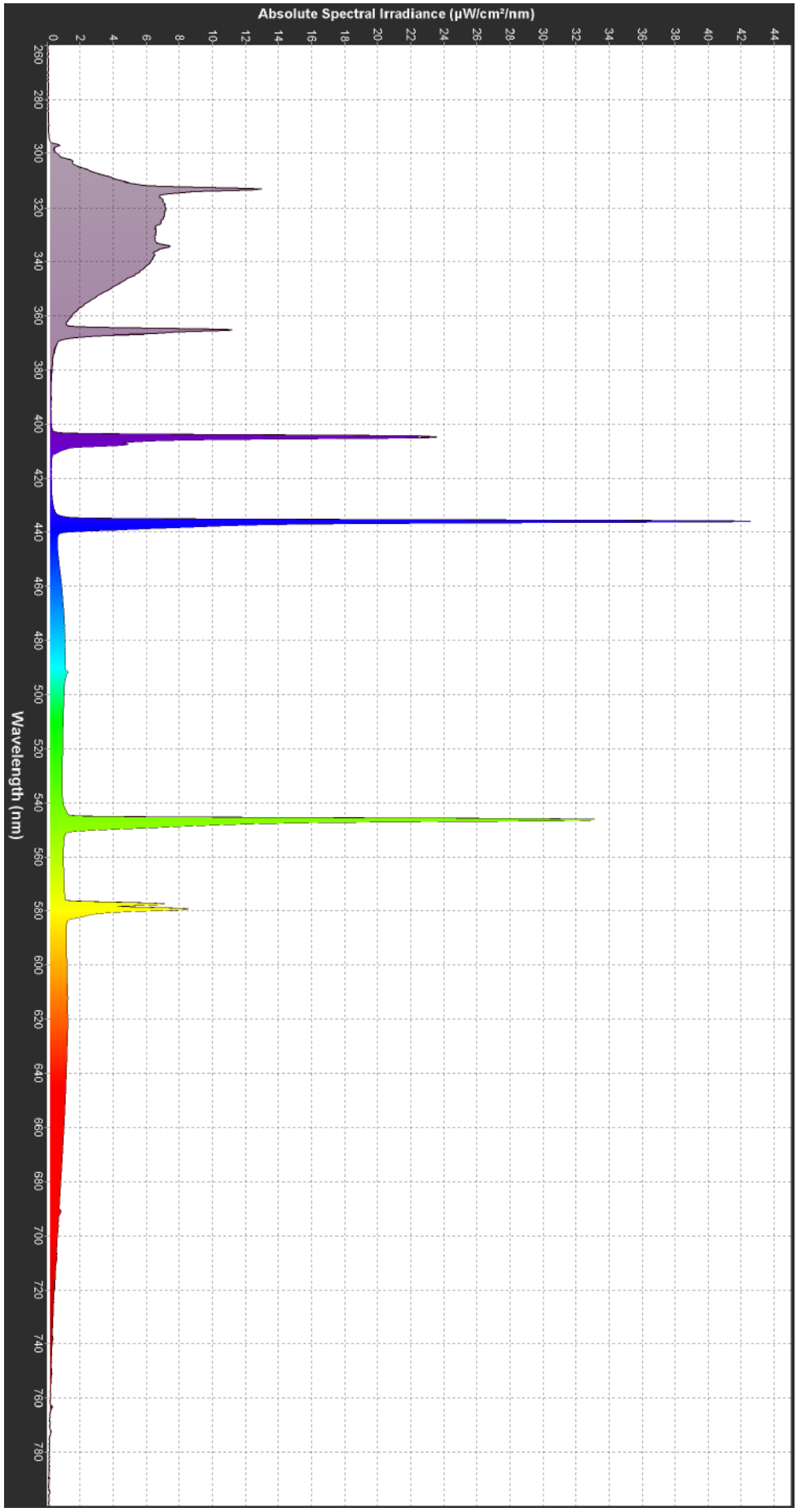

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COLOUR MEASUREMENTS

OVERVIEW

The spectrometer software is able to calculate colour values based on the readings from the lamps.

The range of wavelengths used to generate these values is dictated by the CIE. The range defined is 380nm to 850nm.

These standards are defined as such for human vision only, and they do not take into consideration reptile vision in the UVA range.

I have also used a wider range (350nm to 800nm) to allow analysis of typical reptile photoreceptor excitation by software.

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COLOUR VALUES

The lamps each had their colour values checked. Data is below.

Category	Ref	Lamp 3 Value
CCT (Kelvin)		6618K
CRI(a)		5.0
R1		18.2
R2		12.4
R3		10.1
R4		-10.2
R5		-8.7
R6		-3.8
R7		9.4
R8		12.3
R9		90.8
R10		-0.2
R11		0.8
R12		40.4
R13		-15.9
R14		41.4
R15		11.4
DC<5.4E-3		True

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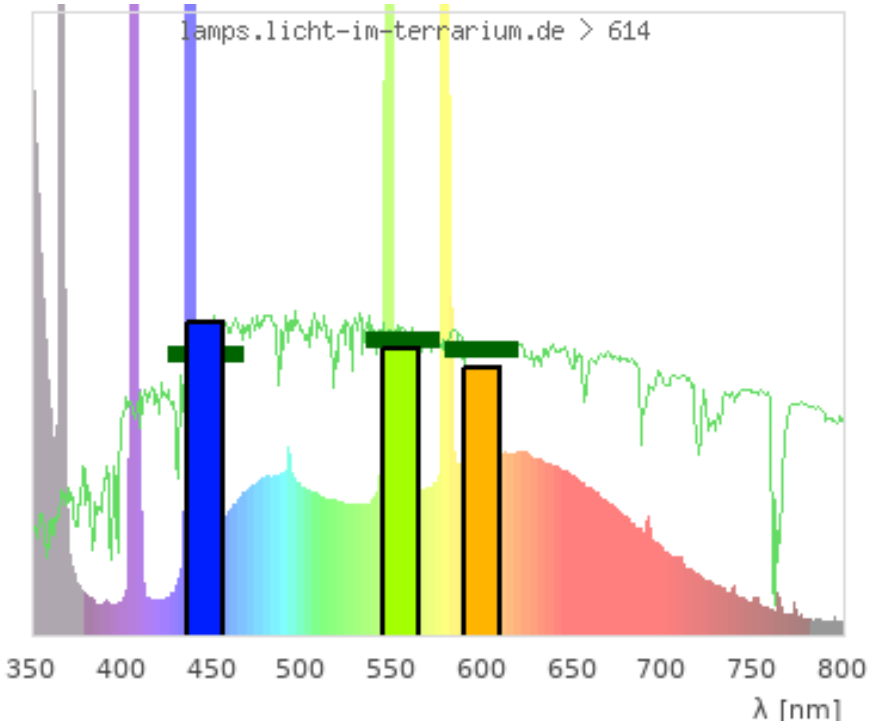
Below is a chart showing excitation of the 3 “cone” visual photoreceptors used in human vision, as they would be stimulated by the spectrum in this enclosure. The coloured vertical bars show the cone stimulation level; the short green horizontal bars show the equivalent stimulation by natural sunlight. The chart gives a visual representation of how well colour is rendered by humans.



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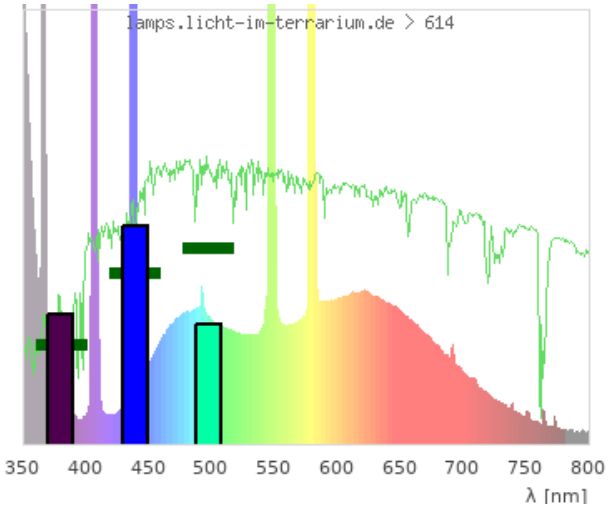
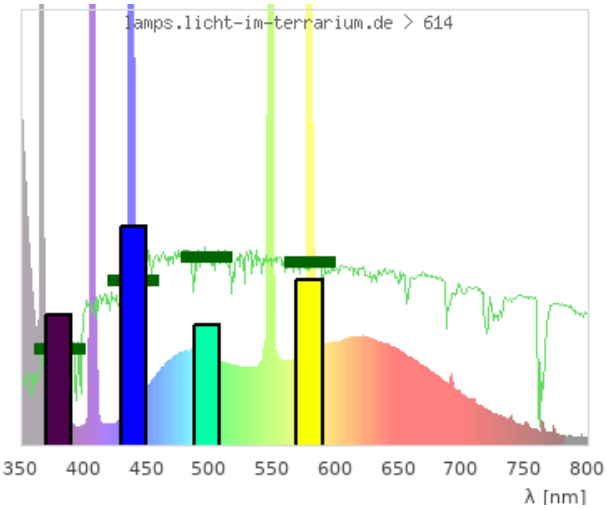
Reptiles have different photoreceptors to humans. And most species are also different to each other. This makes it difficult to quantify and analyse light for reptile vision. Basic assumptions can be made though.

Below are the same charts showing excitation of the 3 “cone” visual photoreceptors used by some reptiles and birds (top), and the same for “4 cone” visual photoreceptors used by other species of reptile and birds (bottom), as they would be stimulated by the spectrum in this enclosure. The coloured vertical bars show the cone stimulation level; the short green horizontal bars show the equivalent stimulation by natural sunlight. The chart gives a visual representation of how well colour is rendered by different species of reptile or bird.





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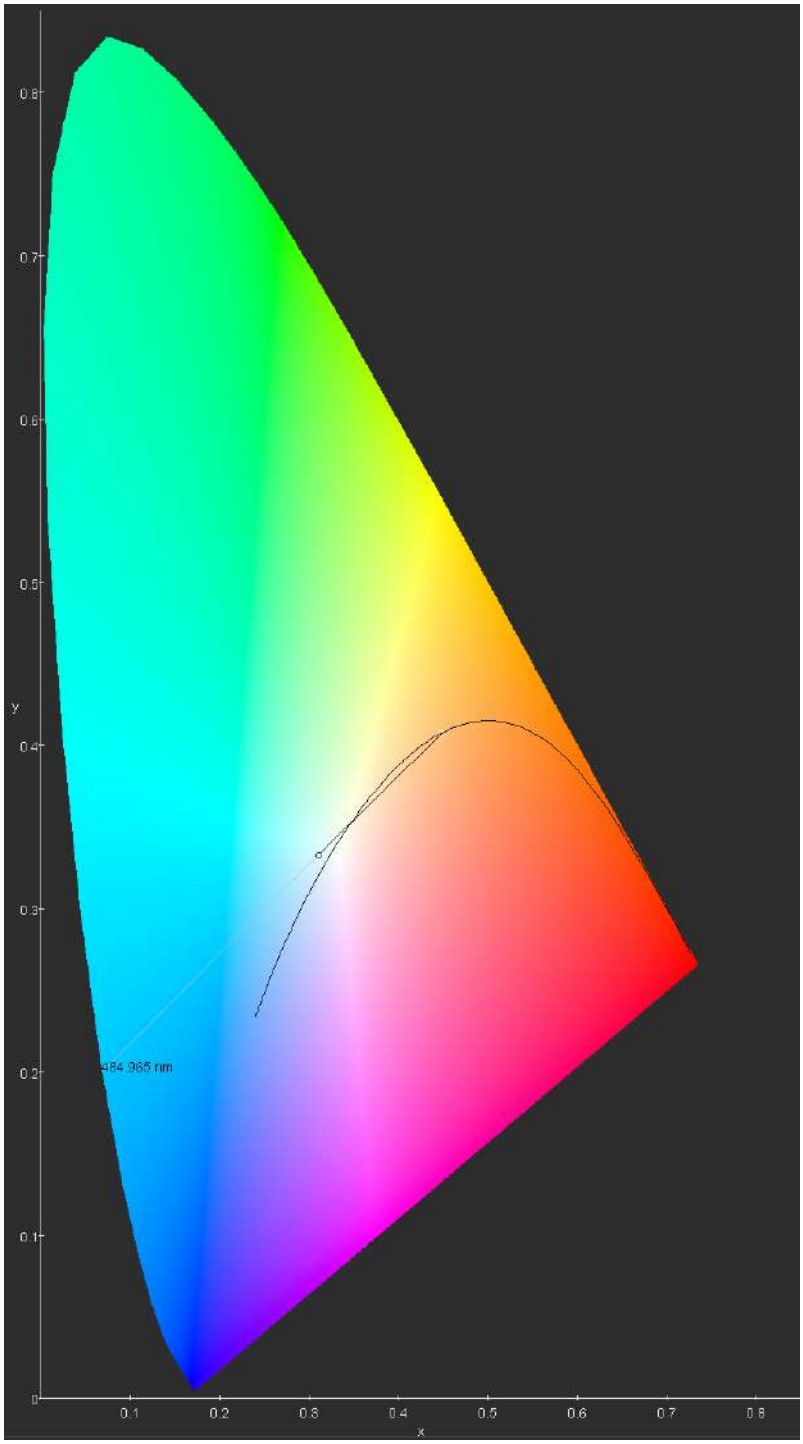
Many reptiles see the range 350nm - 800nm and have an additional UV photoreceptor in their retina. On the left is a representation of a typical “3-cone” reptile’s cone excitation. On the right is the same for a typical “4-cone” reptile.

The lamp colour space graph is below.



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OTHER MEASUREMENTS

OVERVIEW

The spectrometer software is able to ascertain certain values based on the readings from the lamps. Each reading was taken at 30cm where appropriate. The lamp was given 30 minutes to warm up before each test.

I have listed the Illuminance (Lux), Luminous intensity (Candela), Power Density (μWatt/cm²), UVB density (250-320nm in μWatt/cm² using SolarMeter 6.2), UVI (SolarMeter 6.5), SolarMeter Ratio, Power Factor, and average wattage values.

Integration began at 280nm and ended at 850nm for measurements, excluding the tests done with the Solarmeter 6.2 and Solarmeter 6.5. This encompasses the range of UV, Visible Light, and the very shortest Infrared Wavelengths. Simpson's rule was used for integration.

This section also contains light spread and thermal imaging.

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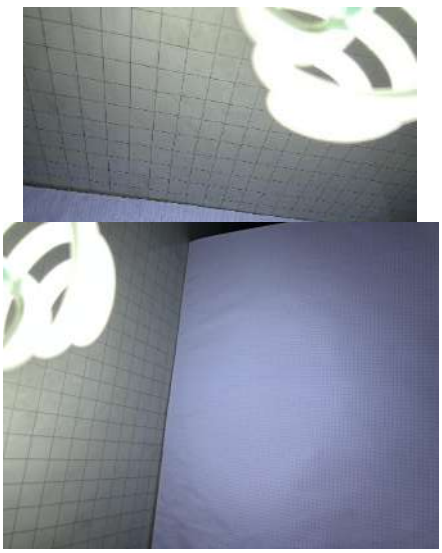
MEASURMENTS (AFTER BURN-IN)

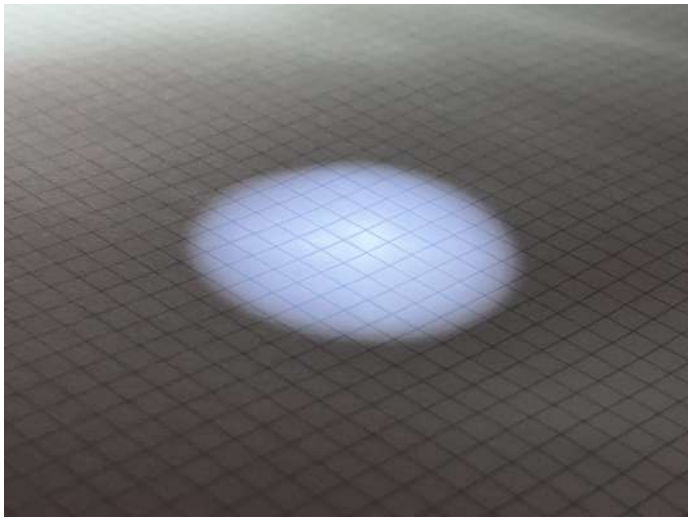
The following are readings taken from the lamp after a 105-hour burn-in period. No reflector used.

Category	Lamp 3 Value
Lux	1320.2
Candela	0.015771
PD µWatt/cm²	843.65
(SM6.2) UVB	107
(SM6.5) UVI	4.6
SolarMeter Ratio	23.2 : 1
Power Factor	0.62
Average Wattage	35.1

LIGHT SPREAD

The spread of light can be seen as homogenous in the below images. One image is direct spread, and the other is through a 16mm circular hole. Both are at 30cm distance from the lamp.





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THERMAL IMAGING (AFTER BURN-IN)

The following thermal image was taken of the lamp after a 105-hour burn-in period. The ambient room temperature was approx. 22.5°C.

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COMMENTARY ON FINDINGS

OVERALL

The lamp worked without any faults during the tests.

The lamp shows no European standard safety markings, but as the product is not for sale in Europe at the time of writing, this should not be a problem.

UVI AND UVB

The UVB output from the lamps is impressive for a CFL.

The UVI measured from the lamp was 4.4 at 30cm. This rivals some T5HO lamps used in high quality reflective fixtures.

The Solarmeter ratio can be used as a way of estimating the biologically-appropriate UV from a light source. By comparing the ratio to that of the sun, we can discern how similar or different a light source is to sunlight in the UV wavelengths. Sunlight is generally

shown to have a ratio of 50-55:1 at "full strength". The average Solarmeter ratio was 23.7. This is fairly low. A low ratio implies a significant amount of short-wavelength UVB compared to longer wavelengths. However, this is normal for a fluorescent lamp.

If we consider what is shown on the box, as discussed in an earlier section, the UVI at 30cm could be considered too high for many species. However, I feel that there is sufficient data on the box and in the packaging to give consumers the insight and ability to make their own informed choice.

The spread of the UV (in UVI) was similar across the lamps. The small differences are probably down to the orientation that the lamp was at when screwed in. The spread is enough to comfortably cater for an animal with Ferguson Zone 3 UV requirements, down to Ferguson Zone 1 requirements.

Below are the advertised "zones" (The box doesn't explicitly state that these are Ferguson Zones, so they could be Zoo Med's own equivalents) vs the average measured Ferguson Zones based on all of the lamps in the different setups. Combi Dome measurements were measured from centre of the lamp, not the centre of the whole fixture.

Distance from lamp (inches approx., cm actual)		Advertised Zone	No Dome Actual Reading (UVI) and Zone	Deep Dome Actual Reading (UVI) and Zone	Dual Dome Actual Reading (UVI) and Zone
2"	**5cm**	Not safe	47.5 - Not safe	47.5 - Not safe	62.1 - Not safe
4"	**10cm**	Not safe	20.7 - Not safe	22.7 - Not safe	28.1 - Not safe
6"	**15cm**	Not safe	12.6 - Not safe	13.6 - Not safe	16.1 - Not safe
8"	**20cm**	Not safe	8.1 - Not safe	9.0 - Not safe	10.4 - Not safe
10"	**25cm**	Not safe	5.9 - Zone 4	6.4 - Zone 4	7.1 - Not safe
12"	**30cm**	Zone 4	4.4 - Zone 3/4	4.7 - Zone 3/4	5.2 - Zone 3/4
14"	**35cm**	Zone 4	3.3 - Zone 3	3.6 - Zone 3	3.9 - Zone 3
16"	**40cm**	Zone 4	2.7 - Zone 2	2.9 - Zone 2	3.1 - Zone 3
18"	**45cm**	Zone 4	2.2 - Zone 2	2.3 - Zone 2	2.5 - Zone 2
20"	**50cm**	Zone 3	1.8 - Zone 2	2.0 - Zone 2	2.1 - Zone 2
22"	**55cm**	Zone 3	1.8 - Zone 2	1.8 - Zone 2	1.9 - Zone 2
24"	**60cm**	Zone 3	1.3 - Zone 1	1.4 - Zone 1	1.5 - Zone 1

The actual readings show Ferguson Zones that are lower than that on the box, even with the use of the reflective fixtures.

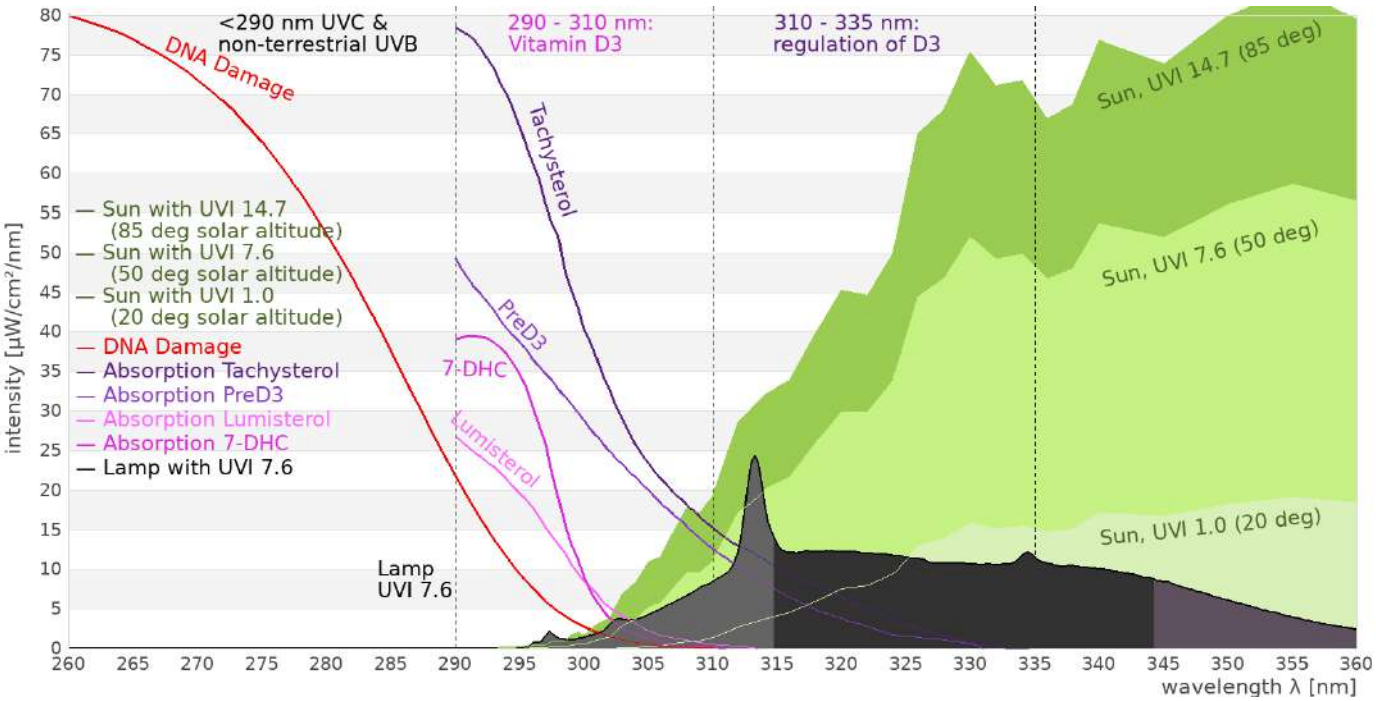
In these tests, I also found that the fixtures don't reflect much UVB, with the Deep Dome increasing readings by approximately 7% and the Dual Dome increasing readings by approximately 20%.

The Dual Dome did produce a significantly wider spread of UV.

SPECTRUM AND VITAMIN D3 SYNTHESIS

Below is a graph showing the lamp spectrum compared to biological processes associated with certain wavelengths of UVB and UVA.

Also included is the solar spectrum at different UVI, for reference. The spectral plot of the lamp has been displayed at UVI 7.6 for analysis purposes.



Graph made using Reptile Lamp Database software, Courtesy of Dr Sarina Wunderlich

In the graph, the lamp's spectral output can be clearly seen. The graph shows the following:

1. *The lamp does not emit dangerously short-wavelength UVB.*

2. *The lamp does not emit UVC.*

3. *There is activity in the wavelengths associated with the synthesis of Vitamin D3 and regulation of Vitamin D3.*

In practical terms, this tells us that the lamp will cause the skin to synthesise Vitamin D3 safely. It will also allow the safe regulation of Vitamin D3 in the body. This lamp should not cause an overdose of Vitamin D3, as there is sufficient activity in the wavelengths associated with the regulation of Vitamin D3.

There is some activity in the UVA range of wavelengths, however this is primarily short-wavelength UVA. There is little to no activity between approximately 370nm and 400nm. This is typical for a fluorescent lamp.

There isn't much activity in the visual spectrum, or in the infrared spectrum. This lamp is not designed to accommodate those wavelengths significantly, and this is typical of a fluorescent lamp.

The light emitted from the can be broken down as follows. The measured range for these readings is 280nm to 780nm:

Grouping	W/m2	Percentage of total Measured Range
UVB (280-320nm)	1.06	13.22%
UVA (320-400nm)	2.3	28.68%
Visible (400-780nm)	4.66	58.10%

COLOUR RENDERING AND VISION

The colour, to my eyes, is fairly white with a slight tint towards blue. However, the lamp doesn't render colours very well. The skin on my hands appeared pale when illuminated by the lamp.

The light is homogenous. This is to be expected, as there is just one source and the phosphor coating acts as a frosting.

For a reptile, the lamp would appear close to white. It may have a slight tint towards "UVA-colour" due to the spike in activity at 365nm (a known Mercury Emission Spike).

OTHER COMMENTS

The lamp is not very bright considering the wattage. This is expected from a fluorescent lamp. The Power Factor of the lamp is approximately 0.62. This is very low and considered poor.

The lamp's glass was fairly hot when in use, this is to be expected. The plastic housing for the electronics/ballast also became warm. Taking into consideration emissivity, it is sometimes best to consider the temperature of the ceramic socket. The socket did not get unjustly hot considering the wattage being used.

When used with the respective Zoo Med domes, the lamp protruded from the base of the domes slightly. Images below show this.

At the time thermal images were taken, the lamp was using an average of approximately 35W, which is significantly lower than the advertised 65W. This lower energy consumption isn't necessarily a bad thing. The lamp showed significant photodegradation (aka "yellowing") on the plastic housing. This is normal for CFL lamps, but is unsightly and could be mistaken for burns by some users. Below is an example.

Zoo Med could utilise cardboard (recycled) for packaging on the inside of the box, this would be a more environment conscious choice of packaging material.

I feel that this lamp will suffer from "compact lamp syndrome" in the hobby. In circa 2007, many compact lamps were sold and found to be dangerous – emitting significant amounts of unnaturally-short-wavelength UVB. This caused health problems with reptiles across the hobby. This has somewhat tainted the reputation of compact lamps as far as keepers are concerned. Although most modern compact lamps are perfectly safe if used properly, they are still often touted as being associated with health problems in reptiles.

The Zoo Med 65W Mega Compact Lamp is safe, and if used properly should not cause eye problems or other health issues in reptiles.

FURTHER TESTS

LONGEVITY AND DEGRIDATION

Zoo Med states that the lamps will emit UVB for 12 months. This was not tested, although such a test is doable if time was put aside for the test.

TEARDOWN

At this point I have not conducted a teardown of the lamp. This could involve reviewing electronics inside, although I may seek further counsel on this first as I don’t want to break any laws regarding intellectual property.

These types of lamps are widely used, so I don’t suspect there is any ground-breaking technology inside to warrant a teardown.

SPECIAL THANKS

Special thanks are in order for many friends, colleagues, and partners. I'd like to give a thank you to the following, but there are undoubtedly more that have not been named.

COLLEAGUES

Dr Sarina Wunderlich has kindly allowed me to utilise her Reptile Lamp Database system to generate some technical graphs and datasets. She has also acted as a point of consultation.

Andrew Elston at Zoo Med has acted as a point of contact from Zoo Med, and answered all my questions with commendable speed.

COPY

Rebecca Baines MA conducted spellchecks and ensured that I was making sense. She also provided much needed coffee.

LITERATURE AND FURTHER READING

In this paper, I have made comments supported by scientific literature, both peer-reviewed and not. Here is a list of literature that I have either directly referenced, or used in support of points and claims that I've made. The list is not extensive.

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