# Tungsten Halogen “Dichroic” Lighting: Unsuitable for Supplying UVB light to Reptiles.

## Introduction.

Ordinary incandescent lamps (with a tungsten filament) produce no ultraviolet light. Recently a range of lamps which do emit significant and useful amounts of UV light have become available. Specialist fluorescent tubes, compact fluorescent lamps and mercury vapour lamps, all designed to emit UVA and UVB light in varying amounts, are now on sale worldwide. Over the last year, those of us writing for UVGuideUK (www.uvguide.co.uk) have tested 109 lamps of 24 different brands/types – mainly focusing upon their UVB output, since it is UVB light of wavelengths between 280 – 315nm that enables cells in the skin to synthesise vitamin D from a natural cholesterol. UVA is also of great importance to reptiles since they need it for normal vision, as well as for providing cues on day and night and seasonal changes.

These UV-emitting lamps all utilise mercury vapour in one way or another, to generate UV light which is transmitted through quartz glass. Production of lamps emitting quality UV light in the correct wavelengths is comparatively expensive, however, and so these lamps are not cheap. As a result, hobbyists are often tempted to find other, cheaper sources of UV light, and over the years many experiments have been conducted in the search for “cheap UV”.

Recently, we have seen several reports claiming that tungsten halogen lamps might be used to supply reptiles with UV light.

## TUNGSTEN HALOGEN LAMPS

Tungsten halogen lamps are the now-familiar, inexpensive household “dichroic lamps” or “halogen” lamps used widely, for example, in “recessed lighting” fitments. They are available in low voltage (12 volt) or mains voltage versions, in a range of wattages. The actual lamp consists of a tungsten filament sealed in a small quartz bulb; this is filled with an inert gas mixture containing a halogen, under pressure. This gas allows the tungsten filament to be heated to far higher temperatures than in a normal incandescent light bulb, (over 2,700°C), resulting in a much brighter light with a fuller spectrum. The extreme heat which is also produced means that quartz must be used, rather than ordinary glass, which would melt. If the bulb breaks, because of the high pressure within, it usually explodes. For this reason these bulbs (except for very small low-voltage ones) are usually sold in sealed units with a secondary safety cover, made of ordinary glass.

The reports we have seen claim that useful amounts of UV light are emitted by the bulbs, but blocked by the safety cover glass. They suggest that the cover glass be removed, and the naked bulbs can then be used in the vivarium, providing a very cheap source of UV light. We have now investigated these claims carefully, and we are concerned by our findings.

Some of the reports, which have appeared on several internet discussion forums, appear to have arisen from a misinterpretation of the results of measurements of the UVA, UVB and infra-red (heat) output of a wide range of lamps, published in a paper entitled *Ultraviolet Lighting for Captive Reptiles – a review (testing the conventional wisdom and advertising)* by Greg Fyfe, Senior Curator of Reptiles at Alice Springs Desert Park(1). We are all concerned that reptile keepers may misinterpret, or fail to understand the results of the tests described in this paper, and infer that halogen

lamps are a worthwhile source of UVA and UVB, and moreover, that it is worthwhile taking the risk of removing the safety cover glass to obtain the UVA and UVB rays.

We believe that halogen lamps are an excellent source of ***heat and visible light*** when properly used, with the safety covers in place, but we also believe that they do not have any place in the vivarium as suppliers of UVB light, and in fact we consider the practice of removing the covers, and attempting to use the naked lamps to supply UVB, frankly dangerous.

**REASONS WHY HALOGEN LAMPS ARE UNSUITABLE FOR SUPPLYING ULTRAVIOLET LIGHT**

We consider using halogen lamps without covers an unsuitable and dangerous practice because:

**1. These lamps produce a great deal of heat, and at the distance needed for safe basking temperatures, UVB levels will be inadequate.** If anyone decided to site one of these lamps in a vivarium so as to obtain adequate UVB light, there would be a serious risk of burning the reptile. The results of the tests in the above-mentioned paper show this clearly. All of the 240-volt lamps which were reported as producing “significant” levels of UV light with the safety glass removed also produce, ***at that same distance***, far too great a heat for basking. One of the best UVB emitters (with glass removed) for example, produces in this study a UVB output of 40uW/cm2 at 20cms...but at that distance the temperature is **137.9°C (280°F)**! If the distance is increased until these lamps are producing a basking spot temperature of under 40°C (104°F), in every case the UVB is reduced to below levels which the meter could detect. And of all the 12v dichroics tested, only two produced barely measurable levels of UVB at distances at which the temperature does not exceed 40°C. There are a very few reptiles which tolerate basking spots hotter than 40°C. The author of the paper, Greg Fyfe, states (in personal correspondence) that at the Alice Springs Desert Park, in the centre of Australia, basking spot temperatures for some desert lizards may reach temperatures as high as 45 - 55°C (113 -131°F); but these are zoo exhibits in large enclosures, in which the animals can easily move away from the extreme heat. Those temperatures are well above the critical thermal maximum for many species. Eastern Bearded Dragons (Pogona barbata), for example, have a mean survival time of ten minutes if unable to escape temperatures of 46°C(2). We do not believe such high temperatures have a place in the vivarium.

**2. These lamps do not produce useful amounts of UVB light.** In this paper, the author states that these lamps “emit very useful amounts of UV light”, but we assume he is referring to the UVA output. Unfortunately, the broadband meter used for these experiments –a Spectroline DRC-100X radiometer with a DIX-300A UVB sensor (http://www.spectroline.com/laboratory/lab_digitalradiometers.html) was not designed for measuring low levels of UVB light - it has a resolution of 10uW/cm2, meaning that this is the lowest reading the machine can make before it reads zero. (The Solarmeter 6.2 radiometer we use, for example, has a resolution of 1uW/cm2) If we look at the solar recordings, in the same paper, we see that at 2pm in July – Australian midwinter – the reading was 60uW/cm2. The only recording as low as 10uW/cm2 occurred at 9.20am on a winter's morning in August. How much higher a recording at this location would have been in midsummer at noon, we do not know - but our own solar recordings(3) suggest it would be considerably higher.
However, in this study, as we have commented already, of all the 12v dichroics tested, only two produced measurable levels of UVB at what we consider “safe distances” (basking spot under 40°C), and the readings in both cases were only 10uW/cm2. It was not possible to obtain a reading for UVB from any of the 240-volt halogen lights at safe basking distances.
There are now a number of safe, tried and tested UVB-emitting lamps designed for use in the vivarium which produce levels of UVB which are indeed far more "significant" and some mercury vapour lamps which can even match the output of the summer sun, at distances where the basking temperatures are a comfortable 30 - 35°C.

**3. The purpose of the safety glass is primarily to protect the user from red-hot glass shards if the bulb explodes.** This is clearly stated in the

above-mentioned paper by Greg Fyfe. It is not quite as unlikely as it sounds - the technical manual issued by Osram, one of the manufacturers of tungsten halogen lamps(4) states that because the bulbs are filled with gas at positive pressure, if the bulb breaks it may indeed explode. This is, according to this manual, a particular hazard with lamps over 24v, which have an increased risk of exploding as a result of a simple internal short circuit at the end of a filament's life. Removing the safety glass not only removes the protection from the exploding bulb, but also increases the risk of that explosion by exposing the bulb to the environment. We are concerned that although this might well be a rare occurrence, it does pose a risk to a basking reptile under such a lamp. Whilst we can say that a lamp might be placed at a “safe basking distance” with regard to the temperature, we cannot say that this would be a safe distance to avoid burns and injury from searing hot glass shards.

4. It is true that tungsten halogen lamps produce small amounts of UV light. This is not because they are designed to do so, like the specialist fluorescent tubes or mercury vapour lamps, but because the extremely hot filament used in these lamps emits radiation similar to "black body radiation" - **radiation at every wavelength from ultraviolet to infra-red.** It will even include traces of UVC. The proportion of UV light is very small – less than 0.2% of the lamp energy output is below 380nm according to the lighting manufacturers’ manual. The theoretical maximum output from such Tungsten lamps can in fact easily be calculated. Such black body radiation calculations indicate that the UV-B intensity at 300nm would be about 1/10th the UVA intensity at 380nm and that in turn is approximately 1/10th the level of visible light at 600nm. Such lamps can therefore only be an extremely inefficient producer of UVA and ten times worse than this at producing UVB. 99.8% of the lamp’s output is heat and visible light - approximately two-thirds heat, one-third light.

5. Dichroic lamps are also not a particularly good choice as a heat source because the whole point of a dichroic reflector is that it is able to reflect selected wavelengths of visible light forwards, whilst allowing other wavelengths to pass through the back. The type of dichroic reflector used in household lamps is called a cold-light reflector - it reflects only visible light from about 400 - 700nm and allows the UV, and the heat, to pass unhindered through the reflector to the rear. So over half the already-tiny amount of UV which is emitted by these lamps is lost through the back. (This property of dichroics also means that the lamp housing and the surface behind the lamp can get very hot. Great care must be taken when these are used in confined spaces, as there is a fire risk.)

6. Only two models of dichroic lamp, both from one manufacturer, were discovered to be emitting detectable amounts of UVB at "safe basking distances" in this study. Variations in the amount of UVB emitted may be due to differences in the temperature reached by the filament (the higher the temperature, the more short-wave radiation emitted) or due to differences in the quality of quartz glass used, which will alter the amount of UVB passing through. There is of course nothing on the packaging of any of these lamps to indicate which brands emit measurable UVB if their safety covers are removed! Manufacturers are constantly marketing new models and changing the specifications of existing ones; there is absolutely no way of knowing whether the UVB output of one batch of 12v household dichroic lamps will be the same as the next batch. Unless a reptile keeper owns a UVB meter to measure the output of every single lamp he breaks open, there is no way that he can know whether he is supplying any UVB at all to his reptiles. The evidence suggests that even those bulbs which do produce a little UVB do not produce enough, given the heat that they also emit in plenty.
Contrast this with the purchase of a product actually manufactured to supply UVB light. As long as the manufacturers are truthful about their product (and this is what, in part, our own survey at www.uvguide.co.uk was set up to find out) the purchaser can rest assured that it is quite likely that his reptile is getting what he has paid for. And what we have discovered includes the fact that one does indeed get what one pays for. Quality UVB is not cheap. But various high quality products are available which are suitable for all types of reptile and which are a bargain in the long run, since they are long lasting, safe when used properly, and beneficial to health. Vitamin D, produced in the skin, does not merely protect against metabolic bone disorder; it is important in keeping the heart, blood vessels and immune system healthy. It enables absorption of calcium from the diet and this in turn is needed for muscles, as well as bone, to remain in good shape. Vitamin D, and ultraviolet light itself, may also play a role in ensuring the mental well-being of animals although this aspect is not yet well understood.

## OUR OWN TESTS ON HALOGEN LIGHTS

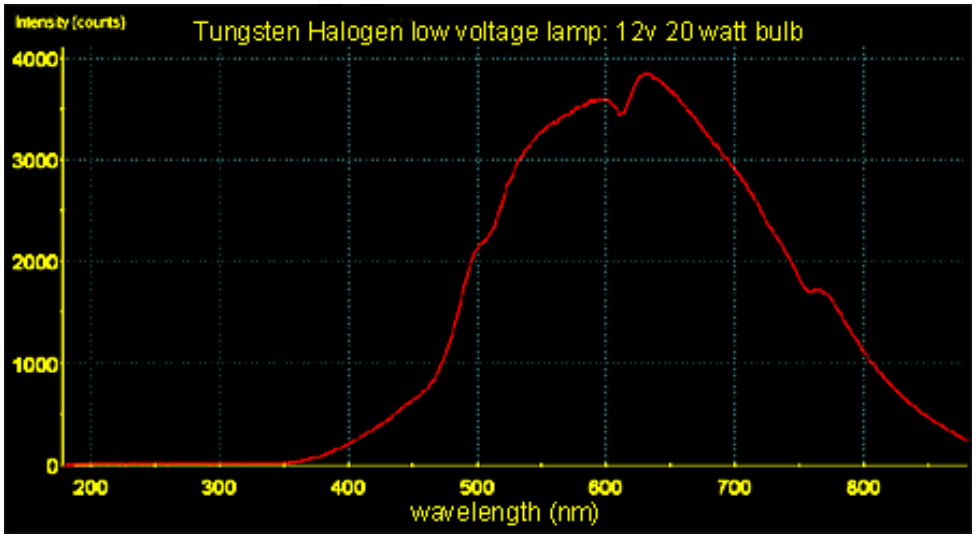
Until the last few weeks, we have not seriously considered testing these lamps for their UV output. We are now collecting what data we already have, and obtaining new lamps for testing – we will publish our findings shortly.

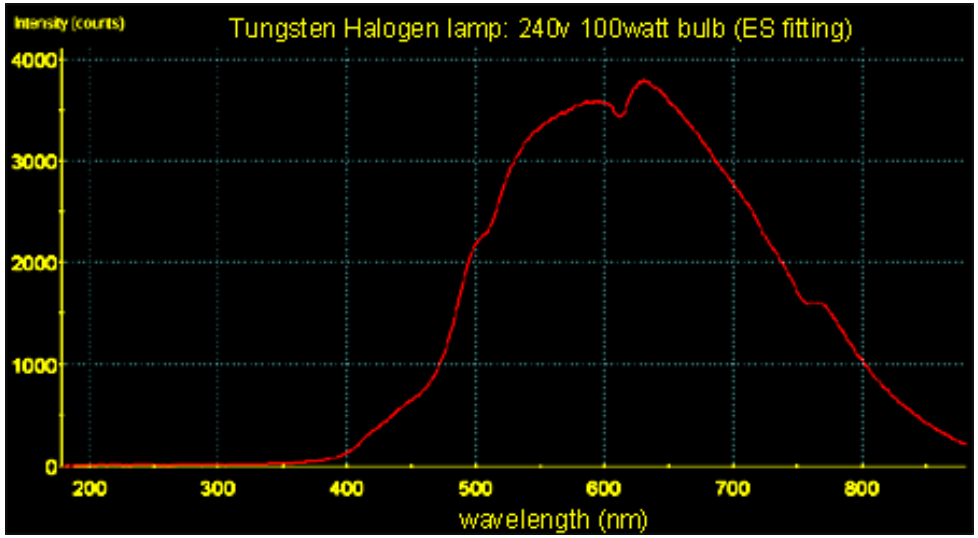
We are so far able to make the following observations.

**Bob MacCargar:** I have been testing halogen lamps for five years. Work lamps *(in the automobile industry)* that have an easily removable lens have shown some UVB and UVC at distances too close to use before thermal burns would kill the critter anyway. I have measured both UVB and C from 250watt halogen lamps with the face plate removed and small amounts of UVB from the 100watt globe type halogen lamps. I have somewhere a spectro showing wavelengths in the UVB-C spectrum, though it wasn't much.

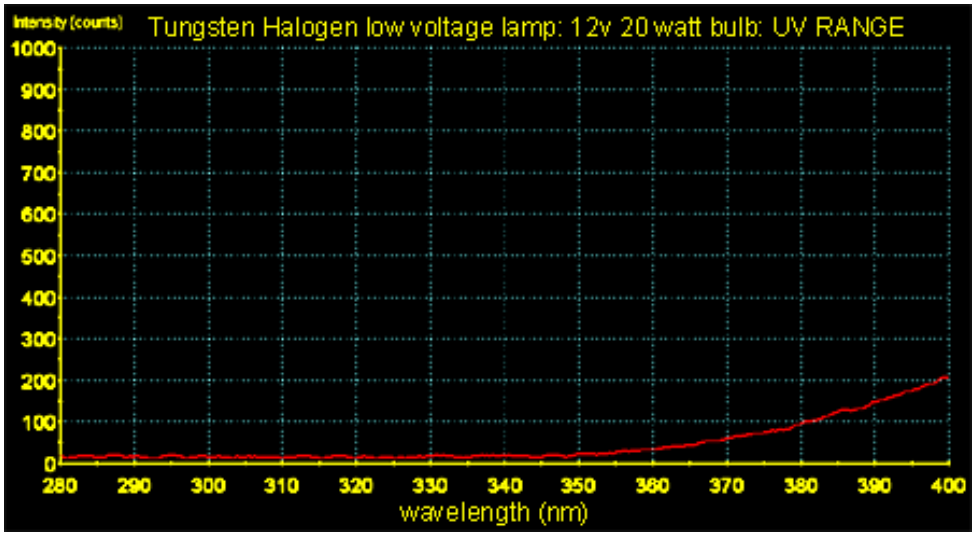
**Rob Lane:** I have tested several 12v halogens this evening without glass and none produce any UVB at any distance apart from an inch or so from the bulb. I have previously tested several makes of both 240v and 12 v halogens and none have shown any reading on our Solarmeter 6.2. I have removed the glass and the readings are still nil.

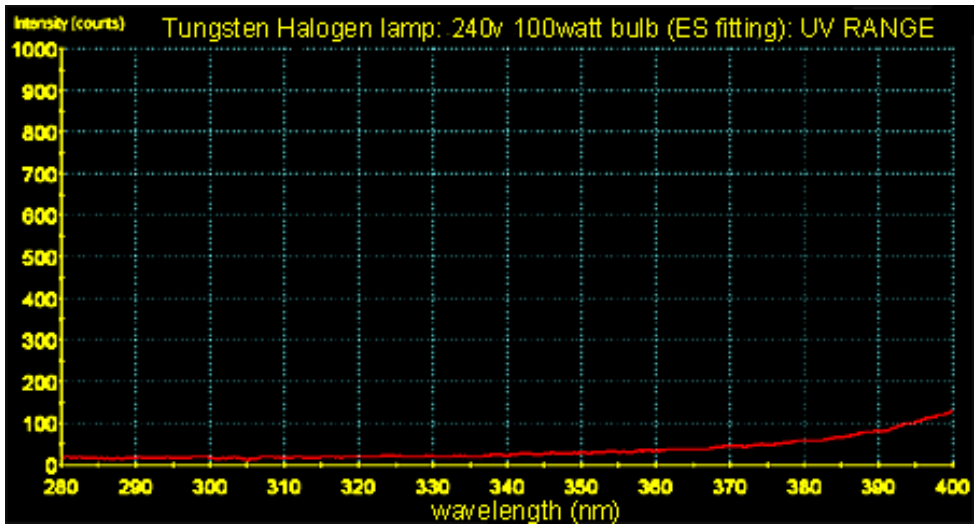
**Andy Beveridge:** I got similar results when I tried this a while ago. I have a 12V desk lamp here that uses a 20W plain bulb. It did have a glass "UV protection" cover but I removed it -still no significant UV though. You can also get a version with reflector that fits into an ordinary ES light fitting. *(Here are)* some very old example spectra for these (although it's with the covers on):




*You can see that the spectra for both bulbs are essentially identical- this is simply the emission spectrum from white-hot tungsten. The curve tapers quite smoothly into the UVA range but there appears to be very little below 400nm. Zooming in to the UV range of the spectrogram clarifies the situation: there is no detectable UVB (280 – 320nm) from either bulb.*




**Some final comments.**

**Rob Lane:** They do produce a nice white light and my chams show positive attraction to halogens BUT and it's a big BUT, I think any heliothermic lizard shows positive reaction to halogens in the short term, as they do with MV lamps made of glass. *(for human use- the glass blocks all the UVB)* The better light quality and intensity probably positively affects the pineal gland and the animal appears brighter, more active, better coloured etc. After a while the calcium/D3 deficiency kicks in and the few I have seen kept using only MV (glass, not reptile) and halogens then go down hill quickly. On the two occasions I have seen animals that have survived under non UV-producing lamps (glass MV in this case) they were obtaining their D3 from their diet, albeit the keepers were unaware of this. Fish food was used as gutload *(for the insects)*, which contains vitamin D. Some makes contain very high levels.

**Bob MacCargar:** I love halogen lamps. I can heat my 16 and 25 pound iguanas at a 4 foot distance with very little wattage ..but it requires a MegaRay *(a mercury vapour lamp designed for reptiles)* for the UVB.

**References:**

(1) Fyfe, G. 2004. Ultraviolet Lighting for Captive Reptiles – a review (testing the conventional wisdom and advertising) in: Proceedings of the 2004 C.A.R.A. (Care of Australian Reptiles and Amphibians) Conference, Wild Australia Expos Pty Ltd, Turramurra, NSW 2074, Australia.

(2) Heatwole, H., and Taylor, J. 1987. Ecology of Reptiles. Surrey Beatty & Sons, Chipping Norton, NSW Australia.

(3) UV Light in Nature: Solar Ultraviolet Light. 2005. http://www.uvguide.co.uk/uvinnature.htm

(4) Tungsten Halogen Low Voltage Lamps Photo Optics. 2000. Osram Sylvania Inc.

This report was compiled by Frances Baines, with Andy Beveridge, Rob Lane and Bob MacCargar. October 2005.