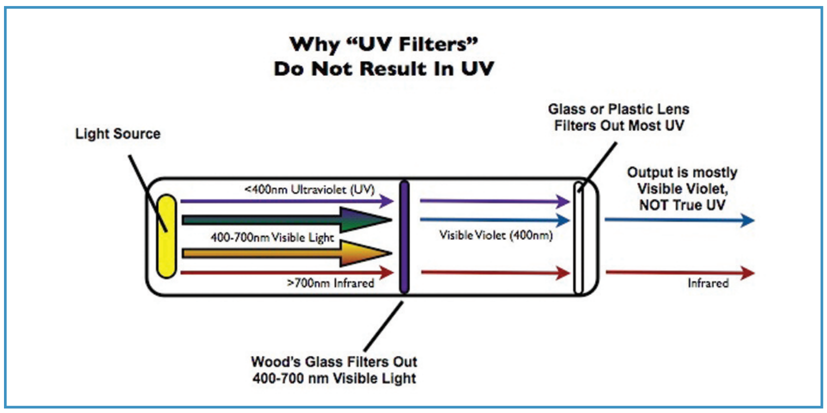
The Truth About UV Filters

By: John Berardi

Many moving lights feature UV filters, but are they the real thing?

Recently, some name-brand moving light manufacturers have begun including a "UV filter"—typically on one of the gobo wheels—that is said to produce black light effects.

Having been in the UV effects business for over 12 years, I was a bit skeptical. So I decided to put the claim to the test and find out how well they actually work. The results were not surprising to me, as will soon become apparent. But they may come as a surprise to the



large number of lighting designers who don't fully understand how the effect works.

Before I reveal the methodology and results of the test, I'll explain very briefly some black light basics...

In order for fluorescence to happen, you need two things: UV-sensitive material (such as black light paint), and a good source of UV light. In fact, for the best and most spectacular results, you need a source of pure UV light with a peak wavelength at around 365nm.

If the UV light is truly pure, there will be very little visible light present (and certainly no "purple wash" of color). The primary source of visible light will be the fluorescing object itself—not the fixture.

The key to producing a pure source of UV is Wood's glass, a special lens that filters out pretty much every wavelength between 400nm and 700nm—which is the entire visible light spectrum. (Wood's glass is named after its creator, Professor Robert Wood, who developed it during World War I as a means for covert communication.) Because of the nature of the technology, there is a small amount of high-energy violet light left over at around 400nm—hence the "purple" color produced by black lights.

In a typical dedicated high-quality UV fixture, the light source is a mercury-halide lamp that produces a broad spectrum of visible, ultraviolet, and infrared light. This light is passed through Wood's glass to produce a pure source of UV with a bit of infrared (heat) mixed in.

The moving lights produced by name-brand manufacturers operate in a similar way (with one critical difference): The light source is a high-output discharge type lamp (which produces a broad spectrum of light). The light is then filtered through a UV filter (Wood's glass), then passes through one or more additional lenses before leaving the fixture. Herein lies the problem—and the source of my skepticism.

Glass and plastic lenses naturally filter out UV light. A case in point: Have you ever tried to get a sun tan in a greenhouse? It doesn't work. The glass panes in the greenhouse filter out most of the UV light.

Consider what's happening inside these fixtures: As the accompanying diagram illustrates, the broad spectrum of light is filtered through Wood's glass, leaving UV, infrared, and a narrow band of visible violet around 400nm. This remaining light is filtered through a normal glass or plastic lens, which filters out most of the UV. All that's left is infrared (heat), and some high-energy visible violet light at 400nm—certainly not the pure source of UV necessary for producing powerful UV effects.

Are these fixtures producing adequate amounts of 365nm UV to produce a powerful UV effect? Are they capable of revealing invisible fluorescent images made with invisible paint? Are they suitable for producing professional-quality black light effects? My guess was no.

To test my hypothesis, I compared three popular name-brand fixtures from leading manufacturers, each of which included a so-called UV filter. I chose a 1,200W low-priced fixture, a 1,200W mid-range fixture, and a 2,000W premium fixture, and tested their UV outputs against a dedicated high-quality UV fixture.

Using a UVX digital radiometer with the UVX-36 sensor, cosine-corrected, I measured the irradiance at 365nm at a distance of 5'. This wavelength is an appropriate measure of the amount of UV produced by the fixture.

In addition, I set up a fluorescent white nylon fabric at a distance of 5' in front of the fixture to test the amount of visible light coming off the fabric. The optical brightener in the fabric reacts to the entire range of UV, even up to 400nm—the dividing line between high-energy visible violet and ultraviolet light.

I then took a spot reading at a distance of 5' from the fabric using a Sekonic L-508 Cine Meter. This is simply a measure of the visible light coming off the fabric. It gauges either fluorescence (if the light source is pure UV) or reflection (if the light source contains visible light).

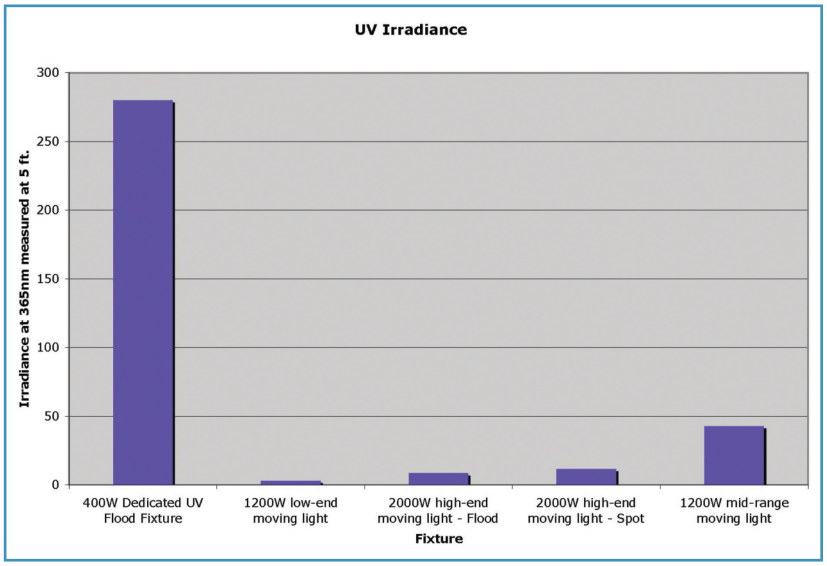
Finally, I tested various fluorescent paint colors (visible and invisible) from several different manufacturers, to gauge their reaction. Since paints typically react at a much narrower UV range than the white fabric, this gives an indication of the effectiveness of the fixture in producing a quality UV effect.

Here are my results:

The dedicated UV long-throw flood (400W): Irradiance at 365nm measures 280mW/cm2 at a distance of 5'. The spot meter in front of the fluorescent fabric read 28 foot-lamberts (FL) at a distance of 5'. All fluorescent paint colors performed exactly as they are supposed to.

The 1,200W low-price range unit: The UV filter was found on Position 4 on the color gobo wheel. In the spot configuration, the UV irradiance is just 2.8 mW/cm2 at 5'. The spot meter gave a reading of 20FL at 5' off the fabric.

All nine visible paint colors reacted with a noticeable shift toward blue. Optical White was visibly blue and Invisible Yellow appeared white. Invisible Blue, Blue Clear, and Glow Green performed as intended. Invisible Red and Invisible Orange did not respond at all.



The 1,200W mid-price range unit: The UV filter was found on Position 4 on the color gobo wheel. The UV output of this fixture was much better than the previous. Irradiance at 365nm is 42.7mW/cm2. The spot meter read 45FL at 5'.

All nine visible paint colors reacted with a noticeable shift toward blue. Some of the darker colors, like Deep Violet, reacted only minimally. Optical White appeared visibly blue, and Invisible Yellow appeared white. Invisible Blue, Blue Clear and Glow Green performed as expected. Invisible Red and Invisible Orange did not respond at all.

The 2,000W upper-price-range unit: The UV filter was found on Position 5 on the litho wheel. This fixture, despite its higher wattage and price, did not perform as well as the mid-range 1,200W fixture. It had a UV irradiance of 8.4mW/cm2 in the full flood position, and 11.5mW/cm2 in the full spot position with a hard edge focus. The spot meter read 79 to 105FL, depending on the focus and zoom settings.

The fluorescent paint reacted the same as the other two fixtures. All nine visible paint colors reacted with a noticeable shift toward blue. Optical White was visibly blue and Invisible Yellow appeared white. Invisible Blue, Blue Clear, and Glow Green performed as expected. Invisible Red and Invisible Orange did not respond at all.

The data appear to confirm my hypothesis. Although each of the moving fixtures are at least 1,200W, their UV output is much lower than the 400W dedicated UV fixture, as the accompanying chart illustrates.

Because of the lower UV readings, the larger reading on the spot meter for the 2,000W fixture and the mid-range 1,200W fixture appears to be more a phenomenon of reflection rather than true fluorescence.

None of the moving fixtures were effective at producing a quality UV effect. The "UV filter" then, is more appropriate for a generic wash of violet color—not as a source of sufficiently pure UV for creating fluorescent effects. It's important that lighting designers understand this distinction when specifying fixtures for shows that incorporate a UV effect.

A dedicated UV fixture will create much more powerful and awe-inspiring fluorescence, it will not cause a "blue shift" in fluorescent paint colors, and all invisible colors will respond as expected.

John Berardi is the president of Wildfire Lighting & Visual Effects, and is the author of The Ultimate How-To Guide to Creating Spectacular, Ultra-Bright UV Effects, *available as a free download at www.TheWildfireReport.com.*