Claypaky Xtylos

By Mike Wood

In February 2011, I reviewed a product that became an icon of its time, introducing the mass usage of very narrow beam aerial effect projectors that aren't lasers. The product, of course, was the Claypaky Sharpy. This month, I'm looking at Claypaky's newest entry in the same market: the Xtylos. This time, it uses LED lasers as its light source. Is it an LED lighting product or a laser product? It isn't clear and the difficulty in classification is pointed up by the way the product is treated in different countries around the world.

In Europe, Claypaky's home turf, the Xtylos is treated as a very bright light in Risk Group 3 and a Class 1 laser. There are no special regulations or precautions for its use, over and above that of any light in Risk Group 3: Hazard distances are defined but it is up to the user to ensure that it is operated correctly and not shone directly into anyone's eyes long enough to cause damage. In fact, the blink-and-aversion response of viewers would normally be sufficient to make the light safe to use in entertainment situations. You wouldn't want to shine it directly at the audience from a short throw, but that's true of many lights. Although the internal light source in the Xtylos is a Class 3B laser (obtained from three Class 4 lasers; one each in red, green, and blue), it passes through beam expanders and color homogenizers before exiting the fixture; the light emitted is not so tightly collimated, making it much less hazardous than native lasers. US authorities see it differently. Although standards and definitions for laser classifications and risk groups are the same as in Europe, they don't give full dispensation with the variance for the Class 1 RG3 classification and beam expanders; instead, they require that it be treated as an intermediate style of product—not with full laser regulations, but not for free use, either. The US does allow free use of products using powerful lasers when that light cannot escape, such as those used in DVD or Blu-ray players; however, if the light is emitted in any form, it's regulated. It's a tricky one: Is the Xtylos using a Class 3B laser source? Yes. Does light exit the unit? Yes. Then, according to the US regulations, it must be treated as if it were a laser. Use of the Xtylos in the US is regulated, and a variance issued by the FDA is required.

Depending on where you are or might tour with the Xtylos, you need to be aware of these important differences. In Europe, you are free to use it like any other RG3 light; in the US, you must have trained staff and apply for an FDA variance to purchase, rent, or use the product. Furthermore, a variance is needed for each time it is used. I live in the US, so I took the training course, applying for, and receiving, the FDA variance. I'm now allowed to use the Xtylos in light shows for the remainder of 2020, with the ability to renew as long as I submit an annual report of the shows for which I used it. You can see all the issued FDA variances, including mine, by searching for Xtylos on www.regulations.gov. It's clearly a bit of a chore, but, having been through the process, I can report that it's all very simple and shouldn't be a barrier. Will it put off some people from using the Xtylos? Yes, of course, but for large venues where it is likely to be used, and the companies that will be involved, it shouldn't be a concern. This is not a light you will use in a small nightclub! Claypaky US has curated an online process in which the training is given, and you can apply for the variance. There is no cost to the user for the training, which takes an hour to complete, or the variance. Once a person in a company has completed this training, he or she can train other employees. One caveat: The variance applies to a company and its full-time employees only, not to contracted or part-time workers.

As I did with that Sharpy review 11 years ago, I've tried to do my usual measurements, but bear in mind that this is a tight beam unit, not a light for illuminating people or scenery, and the requirements are very different. Color ren-

Figure 1: As tested.

dering, for example, is irrelevant as, to a great extent, is lumen output. All that matters is how well the beam shows up in the air and the effects it can produce. All tests were run on a nominal 115V 60Hz supply; however, the Xtylos is rated to run on voltages from 100-240V 50/60Hz (Figure 1).

Light source

As mentioned, the Xtylos uses three semiconductor lasers—one each in red, green, and blue—rated at 10,000 hours of life. These are enclosed in a custom-sealed light module made by Claypaky's parent company, Osram. The module aligns and combines the three beams into one, which, in turn, passes through a homogenizer tube—I'm inferring that this is a hexagonal light pipe or tube, from the native beam shape—and, finally, through a micro lens array on the end of the exit tube. Figure 2 shows the sealed light engine at the rear of the unit. The semiconductor lasers are enclosed in this die-cast enclosure with sets of heat pipes leading out into fan-cooled heat sink fins. In addition to the need for safety, I'm sure there is some critical alignment of the components within that enclosure and I understand why this should not be opened by the user. Figure 3 shows the exit aperture of the light engine as it enters the main body of the luminaire. The cylindrical tube contains, I believe, a homogenizing light pipe or light tube with a beam expander lens at the end. Finally, the rectangular exit window at the top is capped with a glass micro lens array or engineered holographic lens—I'm not sure which. The light exiting this aperture is a very tight light source, but no longer a coherent fully collimated beam. (Note: sometimes our old enemy etendue can be our friend. A laser beam is extremely narrow but does have some slight beam divergence. The use of beam expanders to enlarge the beam diameter can also decrease the beam divergence.)

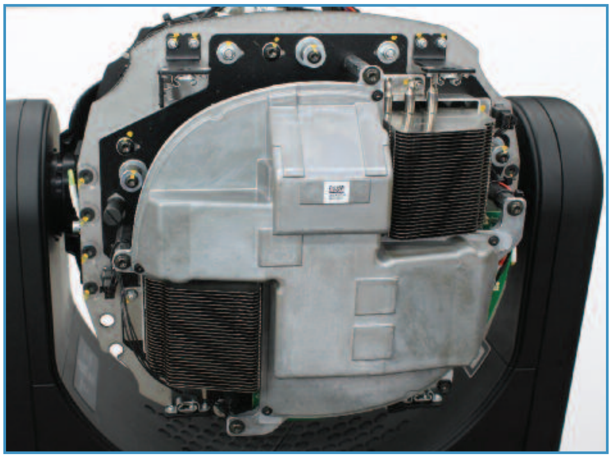

Figure 2: Light engine.

Figure 3: Light engine exit aperture.

Gobo wheel

Right in line after the light engine are the two gobo wheels. The first is a fixed gobo wheel fabricated as a single piece with 11 patterns primarily consisting of a range of different-sized apertures to provide images for the very tightest beams. As with the Sharpy, the smallest apertures are tiny, down to around 1mm in diameter. Figure 4 shows a section of the fixed gobo wheel with the three smallest apertures visible. I included my pinky in the photograph to give some idea of scale. These apertures are very, very small!

This lightweight wheel moves quickly, with snappy change times.

GOBO WHEEL

Gobo change time – adjacent apertures	< 0.1 sec
Gobo change time – max (Gobo 0 - 6)	0.4 sec
Maximum wheel spin speed	1.4 sec/rev = 43 rpm
Minimum wheel spin speed	27 sec/rev = 2.2 rpm

Figure 4: Fixed gobo.

The way the Xtylos' optics work to produce tight beams (more on this later) means that it's the very center of the beam where the best focus is achieved and where most light is concentrated. Thus, the patterns on this fixed wheel are sharp and bright. These are the heart of what makes the Xtylos an aerial beam projector.

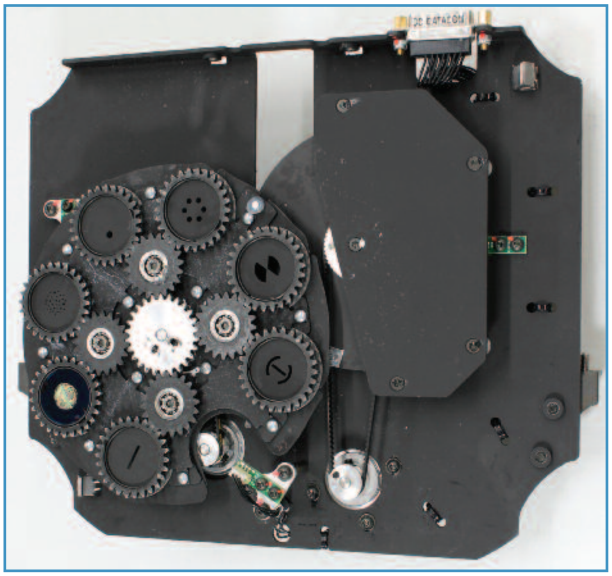

Figure 5: Rotating gobo.

Mounted back-to-back with the fixed wheel is a rotating gobo wheel with seven user-changeable patterns. Figure 5 shows the arrangement. This is normal for an automated spot. Interestingly, the images on the rotating wheel are much larger than those on the fixed; they also extend further out from the sweet spot in the middle of the beam. To deal with this, when a gobo from the rotating wheel is selected (and if the fixed wheel is in nominally open position), the fixed wheel automatically moves to gobo 11, which has a much larger aperture to let light through to the larger rotating wheel images. Effectively, the fixed wheel has two open positions—one for itself, and a second, larger, one for when the rotating wheel is in use.

ROTATING GOBO SPEEDS

Gobo change speed – adjacent	0.2 sec
Gobo change speed – worst case	0.4 sec
Maximum gobo spin speed	0.0625 sec/rev = 960 rpm
Minimum gobo spin speed	2566 sec/rev = 0.23 rpm

The Xtylos rotating gobo wheel has an extremely fast gobo spin, faster than anything else I've measured, providing laser tunnel-like effects from the patterns, in particular the gobo with an off-center aperture.

Although the standard gobo load is monochrome and consists of simple linear art, the user can use grayscale images and colored glass in the rotating wheel. You can see a sample colored gobo, supplied by Inlight Gobos, in Figure 5; Figure 6 shows what this looks like when projected. Again, as with the Sharpy and similar units from other manufacturers, the focus quality on the larger gobos is of good quality in the center but with quite a big falloff from center to edge. Figure 7 shows this in more detail using a monochrome dot pattern. The unit's optics are optimized for small, tight beams and anything inside the center third of the image. Small images within that center portion are sharp. It's useful that you can use larger gobos like this, but it isn't the primary strength of the Xtylos.

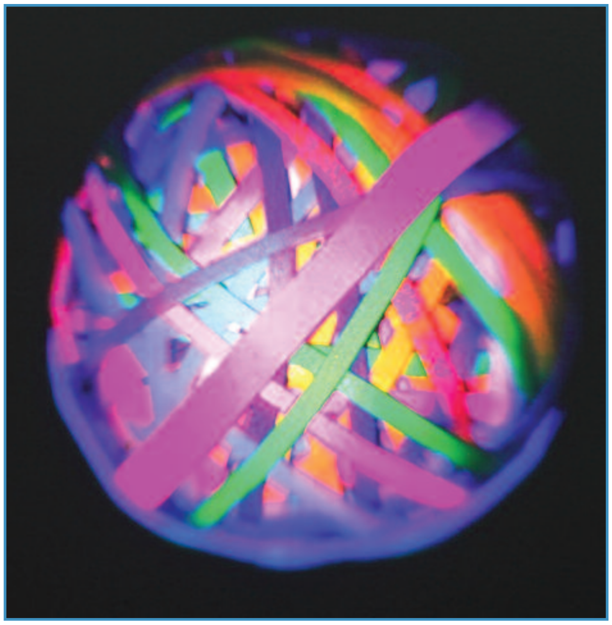

Figure 6: Gobo projection.

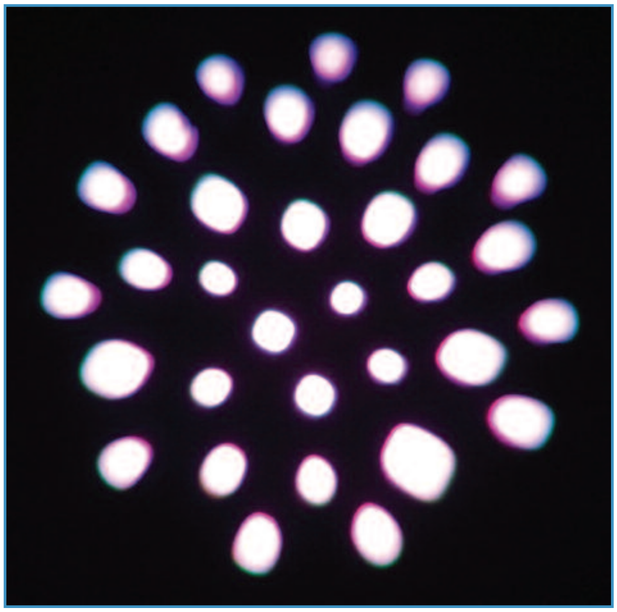

Figure 7: Gobo focus.

Figure 8: Prism wheel.

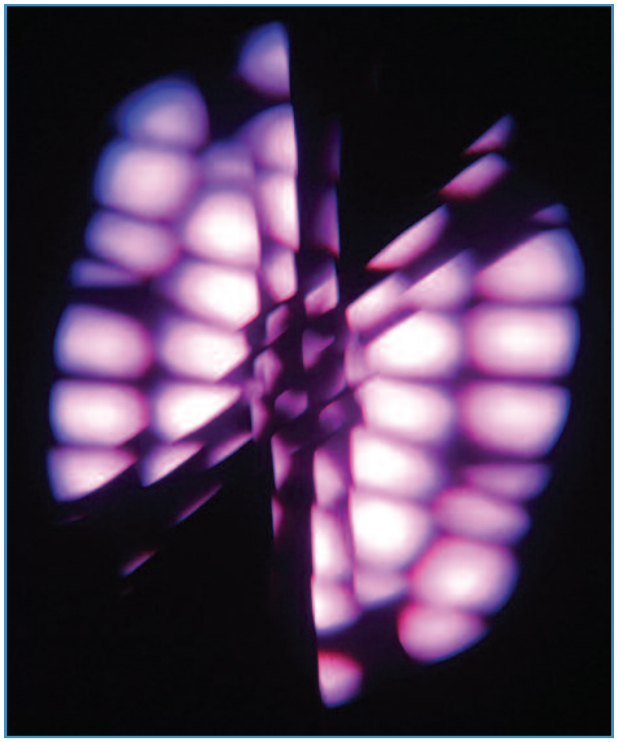

Figure 10: Prism overlays.

Prisms

That covers the first removable optical module. The second contains two sets of effect prisms and a frost filter. Figure 8 shows the first set of four effects, three prisms, and a frost, which are mounted in a wheel. The three standard prisms on this wheel are a six-facet circular, a linear barrel, and a six-facet linear. All give good separation of individual beams. Any of these can be overlaid with the second, rotatable, 16-facet prism (two concentric rings of eight facets each) mounted on the other side of the module as shown in Figure 9. I measured the prism insertion/removal time for either set at around 0.5 seconds; once in place, any prism can be rotated at a range of rotation speeds up to 17rpm. The effects when the two prisms are combined, along with a suitable gobo pattern, can be quite interesting. Figure 10 shows an example.

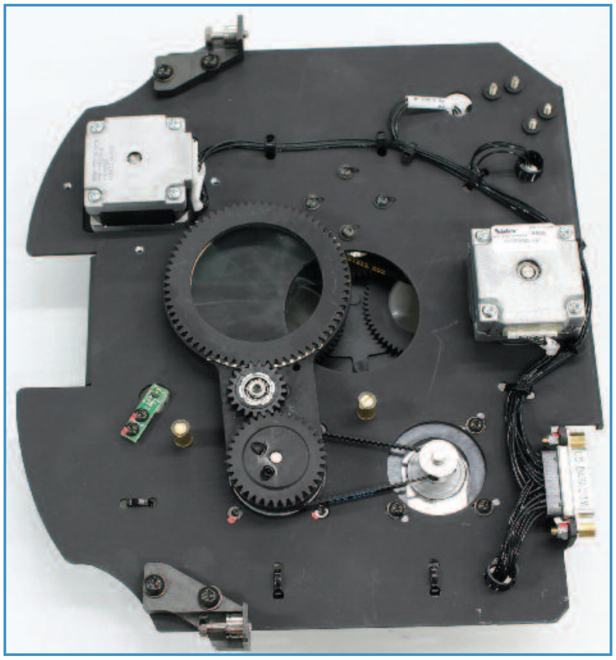

Figure 9: Prism arm.

Lenses

The final optical elements are the projection lenses, a single movable lens that provides focus control and a final fixed output lens. These can be seen in Figure 11. The focus lens is large and can be moved from one end of its range to the other in about 3.4 seconds. The optics are much simpler than a typical automated spotlight. Again, the goal is very bright tight beams, and everything is done to maximize that.

Figure 11: Focus lens.

Color, dimming, and strobe

I've combined these three typically separate features in additive fixtures such as the Xtylos; they are all boil down to the same thing: control of the LEDs or semiconductor lasers. The Xtylos is a simple, three-color, RGB additive color-mixing unit. It's not what you would use for lighting faces, as I mentioned above, but all you need for aerial beams and projection.

(Note: Why is this? It's the same reason that a video screen or a movie projector only needs RGB to produce any hue within its range. You aren't concerned about how that light bounces off colored objects and how it interacts with and thus renders their colors. All you care about is projecting on a white screen, or straight into the eye. The light from a video screen never bounces off anything colored. Color rendering only comes in to play when light interacts with a colored object.)

On the plus side, what the narrow bandwidth of the laser sources gives us is very high color saturation. Because of this, the primary colors of the Xtylos are going to be just about the highest saturation reds, greens, and blues that you can get from any light—much higher than the original Sharpy.

Figure 12 shows the measured spectral distribution and extremely narrow peaks from the laser diodes. In reality, the peaks are even narrower than shown here. Looking at the Osram datasheets for the laser diodes, the bandwidth is more like 2 — 4nm. The spectrometer I used, a Sekonic C7000, has an 11nm wide bandwidth sensor, so the narrowest peaks it can show are 11nm (more likely 22nm) wide. The output of each of the three colors and their simple additive mixes breaks down as follows:

COLOR MIXING

Color	Red	Green	Blue	Cyan	Magenta	Yellow	White
Output	27%	45%	7.9%	77%	36%	72%	100%

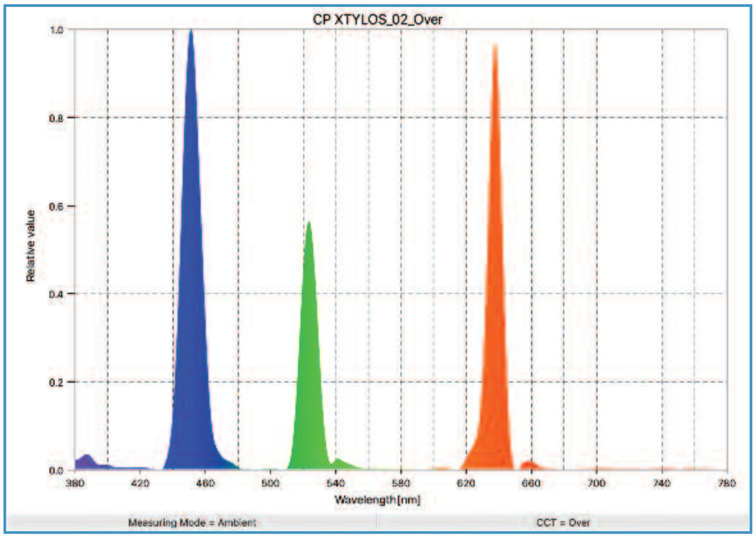

Figure 12: Spectral distribution.

That looks a bit odd doesn't it? How can blue at 7.9% plus green at 45% add up to cyan at 77%? Well, they don't. This, I'm afraid, is more a function of the poor response of light meters to the extremely narrow wavelengths emitted by laser LEDs. I own about six light meters; I tried them all and each gave completely different results for the blue emitter by a factor of nearly 10:1! Not only do these meters have problems with the very narrow bandwidths of the lasers (light meters are designed for broadband white light) but also the definition of lumens is tied to human eye response and is poorly defined at the blue end. A very small movement in wavelength of a narrow band emitter can make a huge, disproportionate (and, frankly, wrong) difference to the output seen on the meter that doesn't reflect what the eye

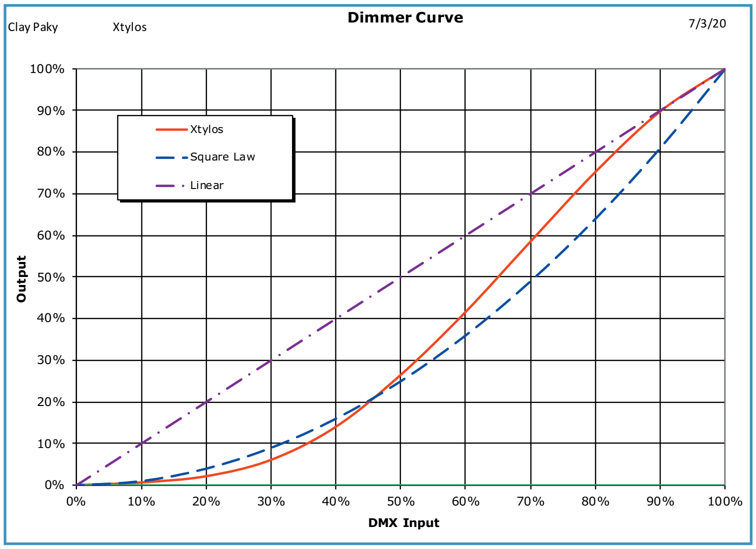

Figure 13: Dimmer curve.

actually sees. With that in mind, take the figures above for the blue with a large pinch of salt. Instead, trust your eyes and/or the video camera you are using; that's all that matters. I ended up going with values from my Sekonic spectrometer-based meter, as it pretty much agreed with the Minolta. However, they both suffer from our poor definition of lumens at the blue end of the spectrum. It's not the fault of the meter; it's our definition that is to blame. Blue is much brighter to our eye than the meter shows. Dimming and strobing were as expected. When using the default settings, the Xtylos dimming is smooth and follows a curve similar to a square law. Figure 13 shows that curve. Strobe is adjustable up to 25Hz and includes the usual options of strobe type and random effects.

As is often the case with LED-based units (laser LEDs behave the same), the output dropped with the temperature as the unit warmed up. I measured a 14% drop over 15 minutes when running at full power.

The Xtylos offers a wide range of user-adjustable PWM frequencies, with the possibility of going up to 40kHz or more. Actually, it offers two different means of dinning. The overall maximum brightness, used in the safety zones, is set by reducing the drive current. The user dimming is done with PWM.

Output

As I mentioned earlier, measuring the output of a beam unit like the Xtylos is tricky. It was tricky back when I measured Sharpy, and it hasn't got any easier. On the face of it, the Sharpy had a higher lumen output than Xtylos, but it's clear from looking at the units that the Xtylos has hugely brighter beams than Sharpy ever did. It's all down to that beam size and how much power you can get into that small aperture.

rotating gobos wheel is used), the beam increased to about 5.5° with a lumen output around 5,300 and had an output distribution more of what you might expect when you aren't restricted to the beam center. Figure 15 shows that curve.

Finally, with the very smallest gobo aperture selected on the fixed wheel, the beam angle dropped down to a tiny, almost parallel, 0.17°. Even with a gobo selected, only a portion of the original beam is allowed to pass through; there's still a lot of energy there. It would be easy to damage scenery or fabrics if you had too short a throw. At 5m, I was easily melting plastics. Care is essential. Don't just turn this on without checking where it's pointing first. This is a fixture for large venues and long throws.

As with the Sharpy before it, it's interesting using the Xtylos focus control at these narrow angles. The beam has

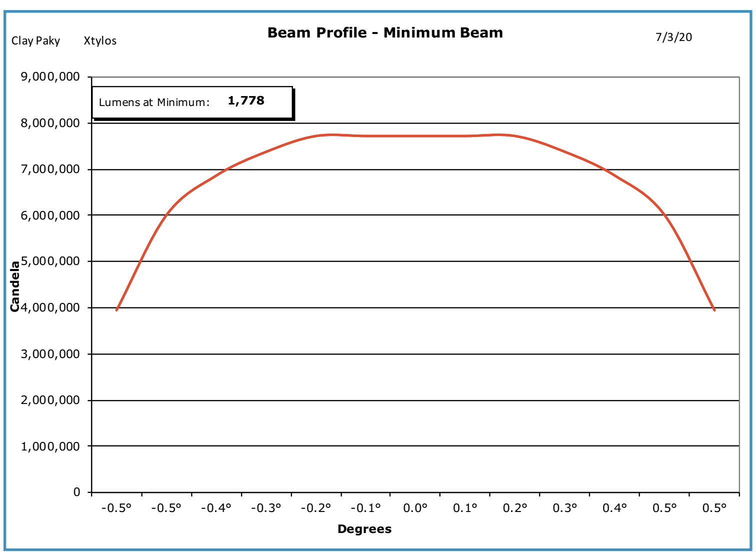

Figure 14: Output at minimum beam size.

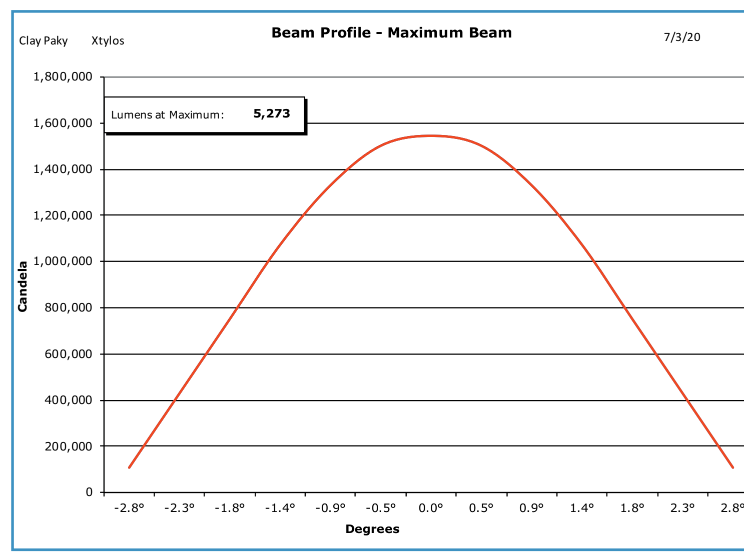

Figure 15: Output at maximum beam size.

We know that the tiny laser pointer we use to annoy the cat can produce an impressive beam in a hazy atmosphere, and it's only a few milliwatts; the same applies here: The Xtylos has a much smaller beam than the Sharpy and concentrates a lot of energy into that small area. That's what we see rather than the total light in a diffused beam. In the case of the Xtylos, your light meter isn't much use. What matters is what your eye, or the camera, sees. It's also likely that different cameras with different sensors will see the Xtylos in different ways. It's important to test with the cameras you intend to use.

With both gobo wheels set on the open hole, I measured the output at 1.1° angle with intensity at 4m of around 485,000 lux (That's 45,000fc at 13'). This is, perhaps, around 2,000 lumens, but who cares? The open hole position isn't actually open. Instead, it clips the beam to its bright center, as can be seen in the beam plot in Figure 14. With the fixed gobo wheel set to Gobo 11 (the open hole for when the

an external crossover point where it necks in and spreads out again. By carefully adjusting the focus control, you can visibly move that crossover back and forth along the beam.

Pan and tilt

The Xtylos has full pan and tilt ranges of 540° and 250° respectively. I measured pan speed over the full 540° at 2.7 seconds and 1.5 seconds for 180°. In tilt, the figures were 2.3 seconds for the 250° and 1.7 seconds for 180. Hysteresis, or repeatability, was measured at 0.08° for both pan and tilt, which is about 0.3" at a 20' throw (14mm at 10m).

Noise

The Xtylos isn't a silent light. The cooling fans for the laser emitters provide a steady background noise with that very high-speed gobo spin adding to it.

SOUND LEVELS

Ambient	<35 dBA at 1m
Stationary	52.7 dBA at 1m
Homing/Initialization	58.1 dBA at 1m
Pan	53.2 dBA at 1m
Tilt	54.0 dBA at 1m
Prism	53.4 dBA at 1m
Gobo select	53.0 dBA at 1m
Gobo spin	55.2 dBA at 1m
Focus	52.8 dBA at 1m

Homing/initialization time

The Xtylos took 59 seconds to complete a full initialization from first powering up and 45 seconds to perform a system reset while running. The unit was well-behaved on reset: It faded the output to black, performed the reset, then faded it back in again

Power, electronics, and control

In operation on a nominal 115V 60Hz supply, the Xtylos consumed 2.45A when stationary but with emitters at full power. Power consumption was 287W at a power factor of 0.99. Quiescent load was around 1.24A, 146W.

The Xtylos has a dot matrix LCD screen, buttons, and menuing system to allow setting all the usual parameters and options. This can be accessed using an internal rechargeable battery for power when the unit is being prepared for use (Figure 16).

The connector panel (Figure 17) provides five-pin DMX512 XLRs as well as power in and through via PowerCon and Ethernet via an EtherCon.

Construction and serviceability

Construction follows the current standard: a rigid aluminum chassis backbone and optical modules with data connectors that can be slid in and out for service. As previously mentioned, the laser engine is sealed and shouldn't be touched by the user. The yoke arms and motor control are also very familiar, as shown in Figure 18. The novelty in the Xtylos is not in these features, nor in the types of effect it produces; it's in the light source that it uses to create those effects.

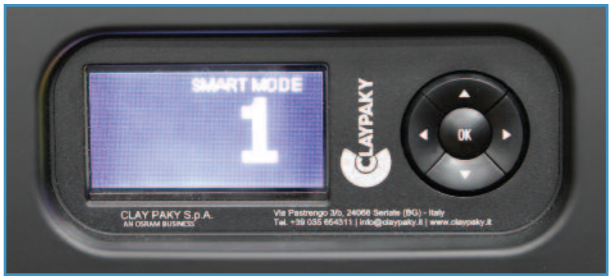

Figure 16: Menu.

Figure 17: Connectors.

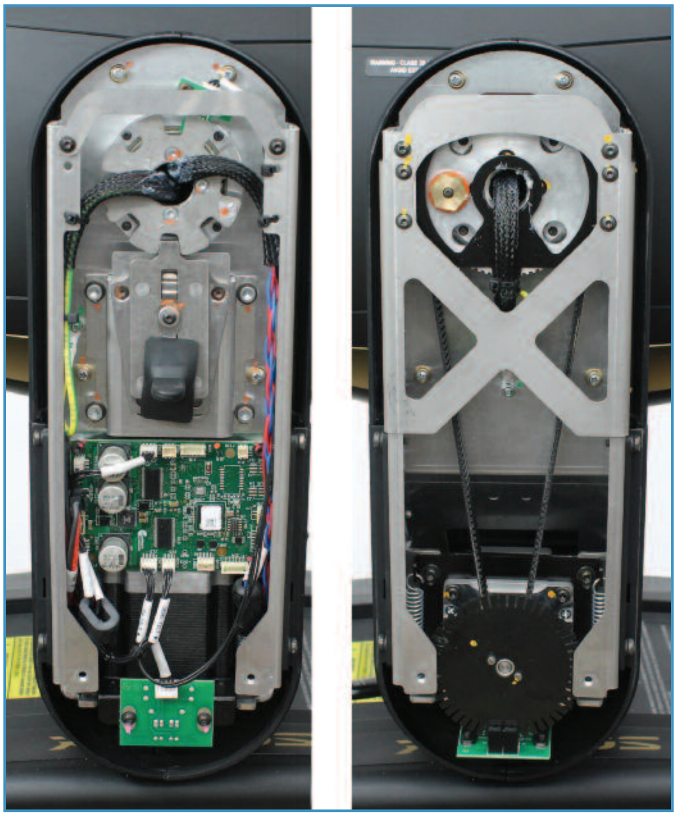

Figure 18: Yoke arms.

Safety

There is an entirely new set of parameters to be aware of when setting up and using the Xtylos. This is particularly relevant in the US, where the use of these features is mandatory, although they are available to everyone. The Xtylos has a system, Smart Mode, that allows you to program safe zones where the light will automatically operate at reduced or zero power. For example, you might set zones where the light, shining directly at nearby audience or band members, would be off; areas where the audience can be scanned at a distance to a reduced power level; and overhead areas, where there are no people, at full power. This is done through dedicated control channels from the desk and is relatively straightforward once you've got your head around it! As DMX itself is not a reliable transmission protocol for safety-related functions, these safety zones are stored within the Xtylos itself in permanent memory and, once set, no external combination of DMX pan-and-tilt values can override them. In practice, as a programmer using the Xtylos, these would be the first things you set up. Once you've done it, you can forget about it; the units will prevent you from doing anything you shouldn't. The concepts of safety zones and hazard distances won't be unusual to those of you with experience of operating lasers, but controlling them in a light through DMX is likely new to everyone. One final safety-related point: If you want to use Xtylos outdoors in the US, you also need to check with and inform the FAA, as the beams could be a hazard to aircraft.

Conclusion

That's about all I can measure with the Claypaky Xtylos. Is it bright? Yes, it is. Does it produce well-defined laser-like beams? Yes, it does. If you are trying to get Sharpy-like effects in very large venues or stadium shows, the Xtylos will likely do it for you. This is a light, like all beam projectors, where the way you use the unit, the setup, positioning, and the use of haze or atmosphere are all as important as the light itself. Is the Claypaky Xtylos for you? If anything I've written here seems interesting, I encourage you to get a demonstration and see for yourself.

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