Martin Stagebar 54

By: Mike Wood

Fig. 1: Fixture as tested

The time has come—it was inevitable that I would have to review an LED-based fixture. Their use is becoming ubiquitous in certain sectors of the entertainment technology industry, and there's no doubt in my mind that this is just the beginning of a powerful and unstoppable trend.

For no particular reason, just the luck of the draw (and you can decide if it's good luck or bad luck), the first LED fixture to be reviewed is one from a company extremely well-known for its moving lights and other products, and which is taking its first steps into the LED arena: The Stagebar 54 from Martin Professional. I find it particularly interesting to look at how Martin has addressed the design issues and reconciled the differences between LED fixtures and its other units.

How do we review an LED-based fixture? Do we judge it using the same criteria as we use elsewhere? Unless a fixture is being sold as a direct replacement for an existing luminaire with a more conventional light source, it is perhaps not correct to use the same criteria. On the other hand, they are being used side-by-side with conventional units and such comparisons may be valid.

It's been an interesting process, and I've taken a few different measurements than I usually would, but have also tried to draw comparisons where it seems sensible to do so. I would appreciate any feedback on how this worked out and welcome suggestions for how I might improve the process. I'm quite sure I'll be reviewing more LED products in the future.

The Stagebar 54 is marketed as "a modular, LED-based color changer and pixel display fixture." My focus in this review is primarily to cover the lighting-based color-changer component of that description, rather than the video/display-based portion. However, there is clearly an overlap between the two functions. For this review, I was supplied with the 54S version (S for short). Martin also manufactures an L version, where the cells are more widely spaced. The distinction is, if the L version units are stacked, both the vertical and horizontal cell spacing will be the same, making it more appropriate for video applications.

Let's start out by considering this to be a color-changing wash light and measure some of the same things we would for conventionally sourced competitive products. The first difference is obvious—instead of three subtractive colored CMY dichroic glasses, the Stagebar 54 uses additive mixing from five differently colored LEDs—red, green, blue, amber, and white. Can this system provide the range of colors needed, from deep saturated color washes through theatrical pastels? (Figure 1.)

The Stagebar 54 is fitted with a universal power supply input; however, for all my tests, the unit was run from a nominal 115V 60Hz supply.

Light source

We normally start with the light source in these reviews. Here, of

course, it's the same five colors of LEDs that provide our color mixing. As can be seen in Figure 1, the unit comprises six "cells" or pixels, each of which contains nine LEDs; two each of red (1.2W), blue (2.9W), green (2.9W), and amber (1.2W) and a single central white (2.9W), for a total cell power of 19.3W per cell, or a grand total of 116W (Figure 2: LED layout). All devices are the well-known Lumileds Luxeon K2, rated at 50,000 hours life.

Optics

Each of the six cells is fitted as standard, with a removable molded plastic lens sheet containing nine individual identical optical elements. These focus the wide-angle Lambertian output of the K2 emitters down to a more manageable and useful rated 29° beam angle. Figure 3 shows a view of the cells both with and without the lenses installed. (Note: All fasteners on this fixture are Torx-style heads. Personally, I like Torx; it has a very good grip and is not prone to stripping out; however, not everyone has the drivers yet. Now is the time to buy them.)

The Stagebar 54 also allows the fitting of optional diffusers in front of the LEDs. Various effects can be achieved by combining these with and without the lens sheet fitted. Figure 4 shows the fixture with the front diffuser fitted. The left three cells have had the lens sheet removed to give a smooth, diffuse output while the right three still have their lenses. When used without the lenses, the cells can be treated as single large pixels for low-res video applications. Figure 4 shows the unit dimmed right down to aid the photography, while Figure 5 shows the same three diffused pixels, but at a more realistic light level.

Output

To get a symmetrical light output that's simpler to calculate, I measured the output from a single cell set to peak 5,500K white output. Note: Peak white output is not the same as setting all the LEDs to full; the use of additive color mixing means that some LEDs are below full output when white is mixed. Therefore, it's probable that a higher output than this is achievable when not in white. However, measuring peak white output seemed to me a reasonable figure that would be comparable with other units. Figure 6 shows the output curve and the single cell output of 249 lumens. Multiplying this by the number of cells (six) gives 1,494 lumens as the total field lumen

Fig. 2: LED layout

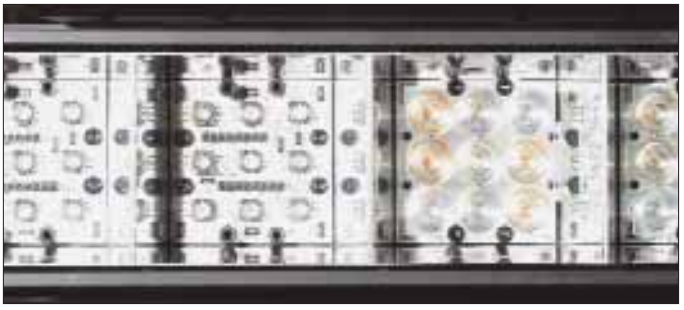

Fig. 3: Lensing

Fig. 4: Diffusing screen

Fig. 5: Diffusing screen 2

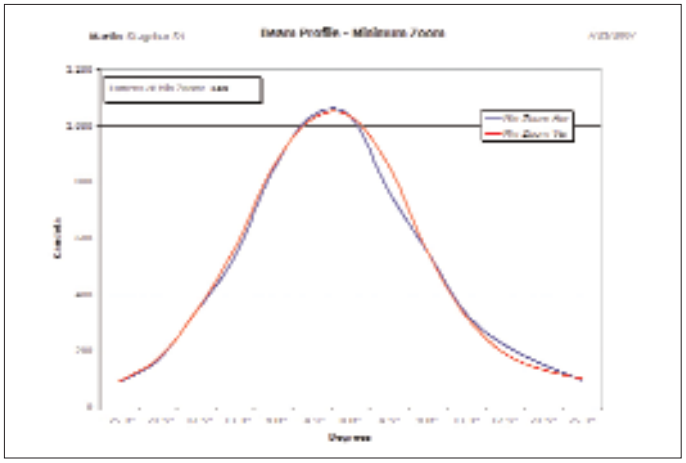

Fig. 6: Output from one cell

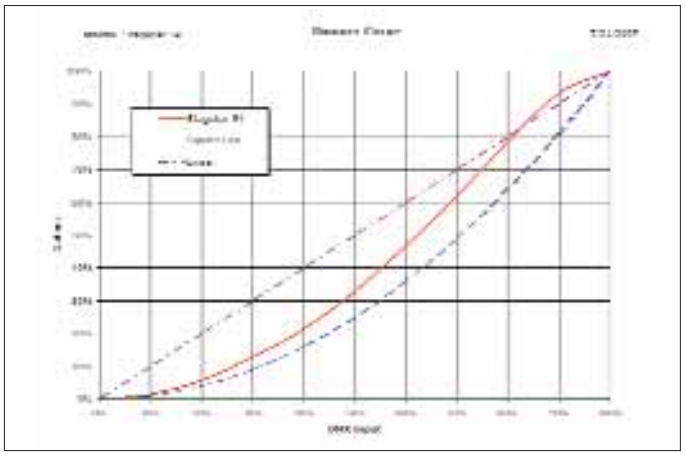

Fig. 7: Dimmer curve

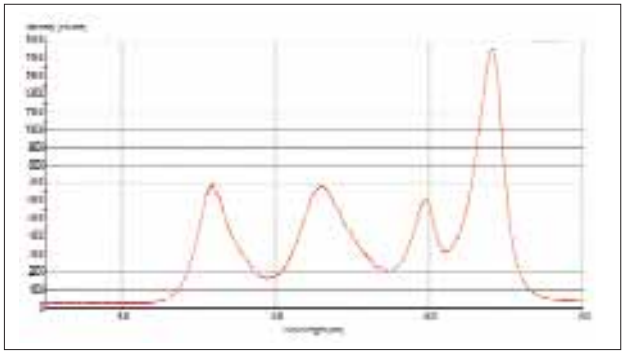

Fig. 8: All LEDs at full

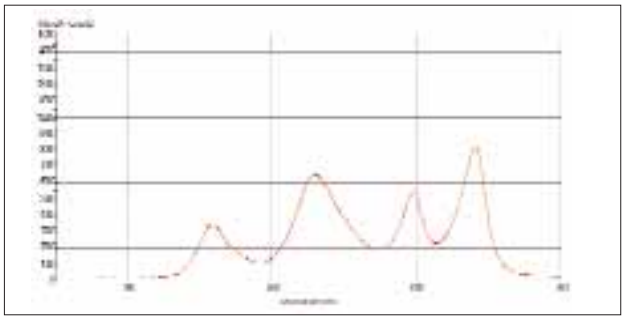

Fig. 9: Mixed white

figure for the unit. The field angle was measured at 51° when fitted with the standard lens sheets.

The output curves show a good, smooth, highly symmetrical light distribution, which should blend well.

So, how did the output actually look? Actually, pretty good. Get too close and you start to see uneven mixing and multi-colored shadows from all those LEDs. However, keep more than 6-10' away, and it all merges nicely. With multiple cells illuminated, there is significant overlap and most unevenness is smoothed out.

Dimming

Figure 7 shows the dimming curve; it's a very nice smooth curve with no discontinuities. A minor issue is that, as with many LED fixtures, you can see the DMX512 steps when you get down to low levels. Unlike an incandescent light source or a mechanical dimmer, an LED has absolutely no inherent thermal inertia or lag, so any change in input is instantly reflected in the output light level. At low DMX512 levels—less than 25%—each step can be a large percentage of the light output at that point, and thus can be very noticeable. For example, when you are at 10%, one DMX512 step dim is actually around 4% of the current light level—and you can see 4% if it happens in a step. Martin might consider adding some optional dampening or smoothing to the fixture for use when it is operating as a light. It's not so necessary when using it with video.

Color system

As you would expect from a unit of this type, the real strength of the Stagebar 54 is in its color production. With five colors, rather than the more common RGB triad, it should be possible to both produce a larger gamut of colors and to have improved color rendering over that gamut. From a subjective point of view, I think that's certainly the case here. I was able to mix just about every color I wanted; using the output on skin tones produced pleasing results. I'm not a big fan of RGB LED color mixing; I always feel something is missing—particularly in pale pastel colors—and the Stagebar 54 did a noticeably better job in those areas. Although there is only a single white LED, it does a good job of filling in some of the holes in the spectrum and giving a much more complete feel to the light.

Color is also the area where LED fixtures can excel in output. They may not be able to compete in white light output yet, but, when it comes to deep colors, they really put up a fight.

Color mixing

Color	Cyan	Magenta	Yellow	Red	Green	Blue
Output	89%	53%	32%	32%	41%	52%

The figures in the table above show what I mean. Output in deep blue of 52% of the white output is outstanding. A conventional fixture with dichroic color mixing would normally achieve around 5% here, so the LEDs are perhaps ten times as efficient. This means that, although the white output is perhaps only 10% of that from a 700W discharge lamp-based

moving light; the output in deep blue is very comparable with that same fixture. Other colors aren't quite so dramatic, but, in every case, we see a significant narrowing of the gap between the Stagebar 54 and more conventional fixtures the deeper the color used.

Here's where the review diverges somewhat from the previous format. With LED-based fixtures, I think it is worthwhile to show the spectrum of the emitted light at some key points. Figure 8 shows the output when all the LEDs are set to full. You can clearly see the four distinct peaks for the four main colors of LED—blue on the left at about 460nm, green at 530nm, amber at just under 600nm, and, finally, red at 640nm. The white LED isn't visible as a separate peak; rather, it provides a broad-band "lift" to all these values and helps fill in the gaps between the other discrete colors.

Figure 9 shows the same, but for a standard 5,500K white output. You can see that both the red and blue LEDs have had to be reduced in output to get the right mix to produce a clean white. With all LEDs at full, you do indeed see a pale rose tint showing there is too much red and blue.

I'm pleased that Martin has implemented an HSI (hue, saturation, intensity) control model in the Stagebar 54. To my mind, this is by far the easiest way to find the color you want. It's tough enough to mix accurate colors with just RGB as discrete channels, but trying to find the optimum mix with RGBAW is even more difficult. HSI hides all complexity from you and allows you to get on with the task of picking the color you like.

The Stagebar 54 does an excellent job of matrixing and controlling the color mixing in the HSI modeling, and I saw little-to-no color shift as the intensity channel was dimmed, while keeping the hue and saturation channels constant.

Fig. 10: LED electronics

One downside of the HSI mode, though, is that it can really show up the effect mentioned above, where single DMX512 steps produce a large change in output. The hue channel is a single, 256-step, DMX512 channel, which runs through all hues starting with red at 0, passing through oranges, yellows, greens, cyans, blues, and magentas back to red again at 255. As it passes through this range, various colors of LED are being dimmed up and down—sometimes in as few as 10 steps. This leads to a few points on the curve where the difference between adjacent steps is big enough to give a visible jump in the output. Once again, some artificial "inertia" or smoothing could really help. This is the same problem as you sometimes see with moving lights when trying to accurately position an eight-bit resolution wheel. Similar predictive algorithms as used there could perhaps be utilized to minimize this issue.

Noise

No motors and very few moving parts—just a couple of fans—make for a pretty quiet unit. I measured a peak level of 41dBA at 1m, as compared with the 35dBA of my test room's ambient floor noise.

Electrical parameters

The Stagebar 54 uses an internal, fully power-factor-corrected auto-ranging (100-24V 50/60Hz) power supply.

Power consumption as tested at 115V

	Current, Power	Power Factor
Electronics only, no LEDs	0.18A, 19W	0.87
All LEDs illuminated	1.89A, 226W	0.99

The initialization time from power up was a surprising 14 seconds. With no motors to move to their "home" position, I was expecting something much less. Martin tells me this is the time to initialize and address each of the six internal LED modules

Electronics and control

The electronics are very modular, with each LED cell having its own identical circuit board. Figure 10 shows the rear of a single board, with its power and data connectors. Heat management is critical in LED fixtures. The individual LED dies have to be normally kept at around 70°C or less for optimum performance and life. Figure 11 shows the main heatsink, which is formed in a U-shaped channel along the entire fixture length. You can also see one of the two fans (here shown folded back) which blow air along this channel. The hot air then exits through the vents at the top and bottom of the heatsink. I ran the fixture at full power for an extended period and had no problems.

Martin tells me that the unit continuously monitors the currents

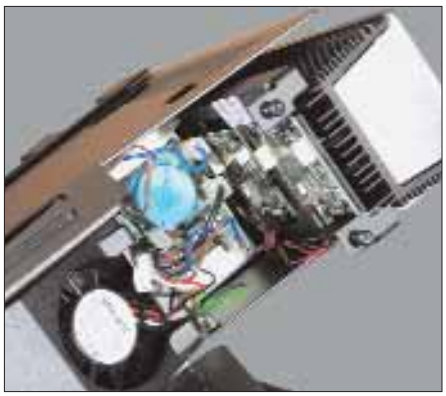

Fig. 11: Cooling and electronics

Fig. 12: Menu

Fig. 13: Power and data input

Fig. 14: Power and data output

to each LED as well as its temperature. These readings are used by the processor to adjust the current on the LEDS so as to minimize color shifts as the temperature changes.

The Stagebar 54 has a good, simple, LCD-based menu system (Figure 12), which allows the setting of DMX addresses as well as the control mode. As mentioned above, the unit offers HSI control but you can also use RGB, RGBAW (direct control of all LEDs), and HSIC (HSI + color temperature) as you prefer. In each of these modes, you can choose to address each cell independently or in groups of two, three, or six. Thus, the number of channels needed varies from a minimum of three—where you are using RGB control with all cells ganged together—up to a maximum of 30 channels when using RGBAW mode with every cell separately controlled. This is a very flexible arrangement and should meet everyone's needs. As a bonus, the menuing system uses battery-backed power, so you can access menu settings before powering up.

Martin has chosen not to use standard DMX512 connectors for the Stagebar 54, and instead uses Ethercon RJ45 connectors wired in a non-standard manner. This worries me: These look, feel, and smell like Ethernet connectors, but aren't, and I think it's highly likely that somebody will plug an ArtNet or ACN network cable into these units by mistake. Ethernet on lighting bars in becoming more common each day, and it seems an odd decision to use the same connector but for different signals. Martin doesn't call the connectors DMX512—it labels them "serial data links" and mentions in the manual that they use DMX512A protocol. That's probably true, but using DMX512A protocol is not the same as meeting the DMX512A standard.

With the fixture, Martin provides an adaptor for the input side to a standard DMX512A five-pin XLR male connector—but not for the output side, although they are available from Martin. So be aware that you'll have to obtain some non-standard jumper cables to run the DMX512 signal down the line from fixture to fixture. Your standard cables won't do the job. This seems like an odd decision for a lighting product.

To balance this review, I asked Martin about this choice and the response was that the company has plans for many software features down the road that would not be possible through a DMX512 cable and connector. These will include color calibration and other maintenance functions. Thus the decision to choose the RJ45 and non-standard wiring, as the Ethercon is a reliable connector and has enough pins for Martin's needs. The company agrees that it is using the DMX512A protocol but not the DMX512A standard.

On a more positive note, you can also daisy-chain power down the line, as the Stagebar 54 has male and female Powercon connectors on each unit. Figures 13 and 14 show the input and output sides, respectively.

Construction

Mechanical construction is clean and tidy, with various options for rigging the unit on either a bar or floor. Figure 1 shows the unit using its floor stand. There are also grooves in the fixture's outer case, to facilitate alignment when used in an array. As shown in Figure 11, both ends of the unit swing open for access to the lenses and diffusing filter, as well as the main electrical connections and fuses. Maintenance should be simple.

Conclusions

Did Martin win or lose by being the first LED fixture review in this series? Either way, the company has set the standard, and you can be sure that we'll be looking at more LED-based luminaires in the future. Again, I would appreciate any feedback or thoughts you might have about testing LED fixtures. You can contact me at the e-mail address below. For now, I hope I've provided some useful information that will help you decide if the Stagebar 54 is the right fixture for you.

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