

EQUINE BRIGHT™



ULTRA-TECH™ LIGHTING

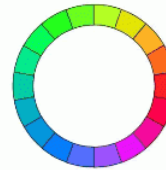
Save 85% in Electricity and up to 600% in Maintenance

Overview –

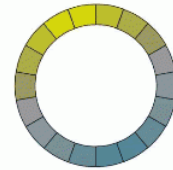
When we glance at a high intensity light like an LED and get lingering dots in our vision we say to ourselves, “Oh, I just looked directly at an LED... the dots will go away soon.” When a horse does the same thing, the reaction is fear and stress over the temporary visual impairment. Do you really want to subject these precious animals to such discomfort? This is only one of the many reasons

we developed Equine-Bright™ with our exclusive **BRIGHT-TECH®** system. Horses have highly unique vision that is particularly well suited for low light levels. Although horses can distinguish colors, their vision is dichromatic, meaning they only have two types of cone cells in the retina. Human sight is trichromatic and in rare cases tetrachromatic. The difference in color differentiation capability is very dramatic and significant. Horses do not differentiate in the upper range of the visual spectrum associated with orange and red. At the same time, horses do not distinguish between shades of blue. This suggests that conventional lighting like metal halide, incandescent, fluorescent, and even new LEDs does not address the specific characteristics of equine vision.

Human Trichromatic
Color Vision



Horse Dichromatic
Color Vision



<http://www.horsetalk.co.nz/2012/11/21/vision-horses-more-than-meets-the-eye/#ixzz45cvUnvOj>

Like other ungulates, horses are active during all times of the day and night. This requires high and low light sensitivity. The biological emphasis upon rods within the retina gives horses the ability to distinguish objects at dusk and in the dark. This sensitivity makes horses susceptible to being startled and disturbed by extremely bright light. This is why recent use of LED lighting in equine settings has proven problematic, causing nervous reactions among horses from excessive glare.

Since human beings must interact with horses in equine venues, any artificial lighting should take the visual acuity of *horses and people* into consideration. Equine-Bright™ technology is the first lighting that addresses the combined visual requirements of the horse and rider. This dual purpose design is critical for the comfort of horses, riders, and workers. It is also a major safety factor that can prevent accidents and avoid stress.

Until the development of Equine-Bright™, facility managers, trainers, and riders were forced to compromise on light quality with generic fixtures like metal halide, halogen, high pressure sodium, and LEDs. None of these fixtures specifically address the unique nature of equine vision within the context of human interactions. Moreover, a lack of

understanding about how horses visualize the world has led to poor design decisions for stables, barns, and competition venues including race tracks.

This was the motivation behind developing Equine-Bright™ technology. It is well accepted and scientifically verified that a happy and comfortable horse is a more responsive and competitive horse.

Equine Vision Challenges –

6,500–9,500 K	LCD or CRT screen
15,000–27,000 K	Clear blue poleward sky
These temperatures are merely characteristic; considerable variation may be present.	

Studies using electroretinogram (ERG) flicker photometry have been used to measure spectral properties of cones in ungulates including horses. As it turns out, peak sensitivity of S-cones varied

from ~444nm to ~455nm while M/L-cones came in from ~552nm to ~555nm, relating to the shorter end of the visual spectrum. (Jacobs, Deegan, Neitz, 1997) Not coincidentally, these spectral ranges highly correspond to outdoor sunlight.

Based upon studies, horses should be treated to simulated sunlight with a spectral balance from 428nm through 539nm when indoors. Stables, barns, stalls, and common areas should maintain sufficient light intensities within the horse’s visual sensitivity to provide appropriate comfort and visual acuity. It is also important to note that proper lighting levels within a balanced spectrum can relieve stress and lead to happier animals. Light can directly influence mood and disposition.

The eyes of ungulates like horses, cows, sheep, goats, moose, and deer are

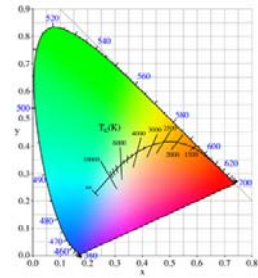
unique because they use a reflective membrane called the *taptum*



lucidum that intensifies low light levels. When designing an artificial light for these species, it is critical to *avoid high directional intensities* from a light source like LED elements. This can actually damage the retina. An LED’s high glare is inherently uncomfortable and stressful for these animals. Ultra-Tech™ Lighting has designed a set of industrial water resistant fixtures specifically for horses within indoor environments.

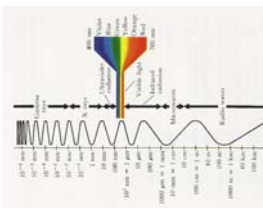
Temperature	Source
1,700 K	Match flame, low pressure sodium lamps (LPS/SOX)
1,850 K	Candle flame, sunset/sunrise
2,400 K	Standard Incandescent lamps
2,550 K	Soft White Incandescent lamps
2,700 K	"Soft White" compact fluorescent and LED lamps
3,000 K	Warm White compact fluorescent and LED lamps
3,200 K	Studio lamps, photofloods, etc.
3,350 K	Studio "CP" light
4,100–4,150 K	Moonlight ^[2]
5,000 K	Horizon daylight
5,000 K	Tubular fluorescent lamps or cool white/daylight compact fluorescent lamps (CFL)
5,500–6,000 K	Vertical daylight, electronic flash
6,200 K	Xenon short-arc lamp ^[3]
6,500 K	Daylight, overcast

Horses are more comfortable and happier under a full spectrum light that has enhanced intensities from 428nm to 600nm. The visual light spectrum is characterized by its color temperature measured in Kelvin (K); the higher the temperature, the “whiter” the light. The temperature is derived from the color of a “black-body radiator.” High color temperatures are called “cool” because of their white appearance while low temperatures are considered “warm” because they tend to be more yellow/orange like a sunset. The graph depicts a *Planckian locus* which represents the color hue associated with different temperatures. Bright sunlight ranges above 10,000K and is in the blue range. Very few lighting products emit temperatures above 5,000K. The color temperature chart lists the various light temperatures with corresponding sources. We see that daylight begins around 6,500K, representing an overcast day. Clear blue poleward sky which is often called “northern exposure” exceeds 15,000K.



Unfortunately, there have not been high color temperature fixtures that address equine environmental needs. Most often, facilities use generic fluorescent fixtures or incandescent lighting because it is simply readily available. To be sure, some equine facilities have adopted LEDs for energy efficiency, but without any consideration for the potential effects upon animals.

Moreover, the equine environment presents challenges of moisture, straw dust, soil dust, and positioning. Therefore, an indoor fixture must be moisture-proof (IP55 rating), washable, and durable. The luminary must accommodate the needs of horses, but also address the visual requirements of workers. Thus, there must be a balance of spectral output appropriate for both species.



Human vision carries from ~400nm to ~700nm. The highest acuity occurs from ~540nm to ~650nm. This provides an overlap in the 550nm range. By balancing spectral intensities for both workers and animals, Equine-Bright™ technology optimizes total performance.

The Science of Equine Venue Lighting –

The objectives for lighting indoor and outdoor equine facilities include:

- ◆ Optimal spectral output for horses and workers
- ◆ Increase animal health, safety, and performance
- ◆ Anti-bacterial, anti-viral, anti-fungal (indoors)
- ◆ Low glare
- ◆ Energy efficient
- ◆ Longevity
- ◆ Durability
- ◆ Environmentally friendly (recyclable)
- ◆ Cost effective

Equine-Bright™ features our unique **BRIGHT-TEC®** System that uses proprietary **LUMEN-TEC®** spectral tuning in conjunction with magnetic induction lighting (MIL) and nano-particle reflectors to precisely create light that matches visual profiles of horses, workers, and athletes. MIL was actually invented by world renowned Nikola Tesla back in the late 1800s and was patented in 1891. Tesla called his invention “Forever Bulbs” when they were presented at the 1893 Chicago World’s Fair because there are no filaments to burn out. Equine-Bright™ fixtures have a rated lifecycle of 100,000 hours which is 11 years operating 24 hours x 365 days per year. Thomas Edison thought such a long lasting bulb was a terrible business model and idea.

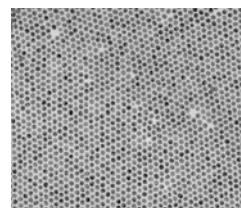


Large format light source



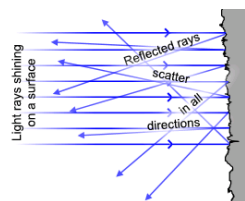
Focused Beam

As the above diagram illustrates, our **BRIGHT-TEC®** System uses a large format MIL bulb that evenly disperses light without the glare of LEDs, halogen, or metal halide. This makes the lamps safe for direct viewing, allowing them to be strategically placed where needed. Unlike standard lighting that emits a focused beam, Equine-Bright™ uses a specialized proprietary nano-reflector



Nano-particles

material with millions of highly reflective particles that evenly diffuse light into a “field.” The effect is similar to reflected sunlight for a more natural and safe effect. Light is dispersed in

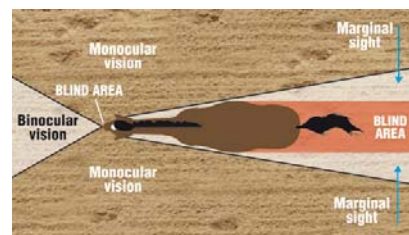


outdoor settings by bouncing off uneven natural surfaces in all directions. Even when direct sunlight is blocked, light continues into shaded areas. This is the principle behind the Equine-Bright™ design. The reflector material appears white instead of the common metalized (silver) finish. Material used in our **BRIGHT-TEC®** System has a 0.96 reflective index which is actually 60% more reflective than metal.

The color rendition index (CRI) for Equine-Bright™ lighting exceeds 0.90 so colors appear as they would under natural sunlight, providing maximum visual acuity for humans and animals... a more healthful and safe environment. Hot metal halide and other high intensity discharge (HID) lighting wastes considerable energy by emitting heat and infrared wavelengths. This light is simply wasted on both horses and human beings.

The Importance of Diffused Light –

A horse’s field of vision is very different from people. As vegetarians, horses are defensive animals meaning they are prey for carnivore hunters like large cats and wolves. Eyes on the side of its head provide a wide defensive visual field. Horses can be easily startled by motion at the edge of their peripheral vision. This is a defensive mechanism. Experiments show that points of bright light like a lamp or motion like a moving car can be highly distracting. That is why blinders are used to direct a horse’s visual attention forward.



The Equine-Bright™ design rapidly diffuses and disperses light from the fixture to drop the perceived and dynamic intensity at the light source. Unlike an LED that may be comprised of many extremely intense diodes, the large format bulb spreads the intensity over a wider area. Workers, riders, and horses can directly view an Equine-Bright™ fixture safely and without discomfort. Equally important, a horse can turn its head 180 degrees through the light field without becoming startled or apprehensive. This means a horse can move from monocular to binocular vision without encountering sudden lighting intensity.

For the first time, race tracks and equestrian competition venues can provide exceptional lighting for both horse and rider. Standard lighting usually consists of 1,000-watt to 1,500-watt metal halide fixtures mounted on high poles or a cantilevered roof. As the horse and rider move from light pole to pole, the intensity within the visual field changes. This



High intensity lights on poles can be distracting and actually refracts on the camera lens.

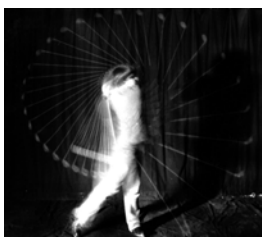
This causes the eye to constantly adjust. The bright-to-dark cycle can even have a hypnotic effect. Using Equine-Bright™ technology, indoor training areas can be properly illuminated to substantially increase safety and comfort. Generic high intensity lighting actually emits *too much light* for vision and even photography and videography. Deficiencies within the visually effective lumens (VEL) range for humans and video cameras using charged coupled devices (CCD) combines with too much intensity in the non-visual ultraviolet and infrared ranges, distorting visual perception. Charged coupled devices (CCD) used in modern digital photography and videography are sensitive to spectral imbalances.

Flicker (Strobe Effect) –

It may be coincidental that the first motion picture taken by Eadweard Muybridge in 1878 was of a race horse. It was used to determine if all four hooves simultaneously left the ground during the stride. By moving film at a constant rate over the lens aperture, Muybridge was able to capture a horse in virtual motion. From this experiment the motion picture industry was born. The Muybridge film is famous and serves as an important illustration of “strobe effect.”



Since most electricity throughout the world is Nikola Tesla’s alternating current (AC), lighting is subject to “flicker” at the AC cycle rate. In the United States the rate is 60Hz while in Europe and some other countries it is 50Hz. Flicker is a serious problem for fluorescent and LED lighting. HID fixtures are also subject to flicker and harmonics. Strobe effect from flicker can cause a loss of visual acuity. A horse and rider moving at 30mph cover 44 feet per second. Although movies are thought to cover the perceptive range of human vision at 24 frames per second, the actual eye/brain visualization is far more sensitive.



For example, a trained pilot can see a flash of light lasting only 1/1,000th of a second (light

on dark) while most of us can perceive a strobe up to 1/200th of a second (dark on light). Perception mechanics are not precise from individual to individual or horse to horse, but a 60 cycle strobe will generally remove .7333 feet per second from a static object at a viewer's acuity of 60 frames per second. If the object is a horse traveling at 45mph, the conversion is 66 feet per second causing a loss of 1 foot.

Although this missing visualization may seem trivial, visual perception is not simply object to object because the brain interpolates between each viewing cycle. At the same time, the eye moves through a 180 degree forward visual axis, altering the extent of the peripheral visual plane. From jumping to racing, strobe effect can inject substantial hazards due to loss of motion orientation and perception.

To be sure, flicker is a paramount issue for racing and equestrian competitions. Jockeys and equestrian athletes are familiar with daytime lighting inconsistencies that include intermittent cloud cover and the changing angle of the sun throughout the day. Nighttime events under artificial lighting do not suffer from such inconsistencies. However, strobe effect injects equally negative variables. That is why the flicker-free performance of Equine-Bright™ technology is so impressive and desirable. It completely solves the problems associated with flicker and strobe effect. This means more events can be safely and effectively scheduled for evenings.

Although LED is the most popular new lighting for energy efficiency, it displays the greatest propensity for flicker. Their high frequency flicker is associated with major human health issues that include strobe epilepsy, migraine headaches, nausea, impaired visual acuity, poor concentration, sleep disorders, mood swings, eye strain, and a lack of eye/hand coordination. There is no reason to believe horses do not suffer from the same consequences. The problem is serious enough for the IEEE Standards Working Group, IEEE PAR1789 to take up "Recommending practices for modulating current in High Brightness LEDs for mitigating health risks to viewers." This process has been put in place to advise the lighting industry, ANSI/NEMA, IEC, EnergyStar and other standards groups about the emerging concern over flicker in LED lighting. The objective is to develop electronics and associated standards that can either eliminate the flicker or mitigate biological impacts by raising the frequency to levels that are imperceptible to the brain.

Energy Efficiency –

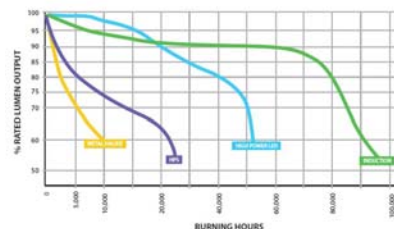
A 300-watt Equine-Bright™ fixture can generally replace a 1,000-watt metal halide lamp for more than 85% savings including ballast overheads. At the same time, Equine-Bright™ fixtures are 40% to 60% more efficient than standard fluorescent fixtures and more than 85% more efficient than metal halide or halogen. Equine-Bright™ fixtures do not emit significant heat because more than 90% of the energy is used to create visible light. Nothing is wasted in the infrared or ultra-violet range.

Equally important, most electric bills are dominated by "demand charges." This is the rate charged for the highest monthly or quarterly usage. Demand charges are directly related to "in-rush" current which is the amount of electricity required to turn something on. In-rush current can be as much as 20 times the operating current for HID lamps like metal halide,

halogen, and high pressure sodium. Even new LED fixtures can register very high in-rush current. Consider that a 1,000-watt metal halide lamp and ballast can draw 1,150 watts in operating current which can pull 23,000 watts in in-rush current. That means that just a few conventional fixtures can substantially increase your electrical demand charges *for your entire electric bill!* Equine-Bright™ fixtures have negligible in-rush current and the ballasts (drivers) have a Power Factor (PF) of .98... extremely efficient.

Low Maintenance –

As mentioned, the modern version of Nikola Tesla’s “Forever Bulb” has a rated lifecycle of 100,000 hours. This is 500% longer than an HID bulb with common ratings of less than 5,000 hours. Although some LEDs claim 50,000 and 100,000 hour lifecycles, the technology has not been deployed in the real world long enough to prove the claim. As the installed base of LED expands, consumers are discovering that LEDs fail far sooner than their ratings.



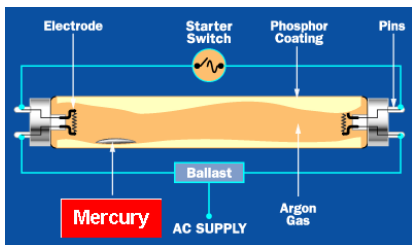
Conventional lighting can lose up to 20% of light output within the first few months of operation and more than 50% before total failure. By comparison, Equine-Bright™ fixtures have a 50,000 hour or 5-year warranty. They retain 90% of their lumen output for 90% of their lifecycle. This translates into impressive savings and payback. When considering the labor costs, disposal fees, and equipment resources required for proper maintenance, the proven lifecycle benefits represent bottom line performance and convenience.

Environmentally Friendly –

Equine-Bright™ bulbs do not use dispersed mercury. Instead, there is a solid amalgam slug similar to dental filling material that can be removed and shipped back to Ultra-Tech™ Lighting for recycling. The remainder of the bulb may be discarded as regular glass and metal. This saves on disposal costs and protects against expensive clean-up procedures now mandated by the EPA, OSHA, and other regulatory agencies.



More and more emphasis is being placed upon health risks associated with dispersed mercury contained in all forms of fluorescent lighting. Standards for cleaning up accidental breakage are being tightened to the point where “hazardous materials” (“HAZMATS”) handling is now required. Broken bulbs cannot be swept or vacuumed. Special procedures must be used in accordance with Environmental Protection Agency (“EPA”) rules and regulations. Not only is a broken fluorescent bulb *hazardous to your health*, but fines for improper clean-up and disposal can be *hazardous to your wealth*.



The problem stems from “dispersed mercury” that is present in the body of *all fluorescent tubes*. If the tube is broken, this mercury can spread throughout the indoor environment. Aside from HAZMATS (hazardous materials) risks, why expose animals and working staff to mercury dangers?

Dark Sky Compliance –

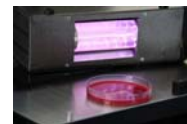
Light pollution has become a major issue for communities across North America. Regulations and guidelines have been established, or are being considered to limit the amount of light that can be used for outdoor areas. These regulations and guidelines are called “Dark Sky” rules and regulations... pertaining to the level of “darkness” that is preserved or protected by ordinances. What started out with good intentions has become a nightmare for some equestrian venues that rely upon nighttime lighting. This is because there may be very little, if any accommodation permitting existing installations to continue without Dark Sky compliance (grandfathering).

Equestrian venues must maintain sufficient lighting to provide visual acuity, adequate enjoyment and safety, but traditional metal halide (MH) and high pressure sodium (HPS) lighting cannot provide enough usable light at lower powers (wattages) to comply with many Dark Sky provisions.

Equine-Bright™ lighting has features that comply with Dark Sky guidelines while providing an enhanced visual experience for horses and athletes. The specially tuned spectrum maximizes Visually Effective Lumens (VELs) while lowering overall lux and power consumption. The effect is quite astounding. Although Equine-Bright™ may appear less bright than conventional lighting from a *distance*, the clarity within the “visual field” is actually **2.77 times the VEL lux** of MH and HPS. Since spectral enhancement targets the visual acuity of horses, the impact for their vision is even greater. That means that a 300W Field-Bright™ fixture will represent the equivalent of 831W for a white MH lamp *without diffusion considerations*. Since HPS is monochromatic (orange), the equivalence is more than 1,200W. At the spectral range for horses the equivalence is more than 1,500W. (Mescopic vision)

An Extra Bonus for Indoor Facilities –

While harmful ultraviolet (UV) light is truncated, some Equine-Bright™ lamps can be ordered that emit small amounts of energy in the UV range to inhibit bacterial growth, fungi, and viruses. This can be very helpful for disease control along with standard sanitization procedures. The 207nm wavelength is not harmful to humans or animals, but is destructive to pathogens. It is one more benefit provided by the technology.



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