Comparing Fluorescent and HID.

by Stan Walerczyk and Brooks Sheifer

Stan Walerczyk and Brooks Sheifer are vice presidents of Alamo Lighting, where they focus on turnkey, energy-efficient lighting upgrades, consulting, and new construction design. Advances in high-intensity discharge may not always outshine reliable fluorescents Based on recent improvements to fluorescent lighting technology--and on newer, more accurate ways to measure how the human eye perceives light--high-intensity discharge (HID) lighting may not always be the best option for many applications. This decade has produced dramatic improvements in fluorescent lamp and electronic ballast technology, with substantial advances in such areas as CR1 (color rendition index), light output, and efficiency. There are three established fluorescent systems: * 85-CRI (daylight has a CR1 of 100), 4-foot F32T8 lamps with high-power 1.15 to 1.20 ballast factor (BF) electronic ballasts. * 40- to 55-watt biaxial lamps with electronic ballasts. * Three-loop compact fluorescents with electronic ballasts. In addition, there are two systems being introduced that will have several advantages: * Straight T5 lamps with electronic ballasting. Although the lumens per watt (W) is no better than T8s with electronic ballasts, the T5 system provides more lumens per lamp foot and better control of the light because the lamp diameter is smaller. * Induction fluorescents without electrodes, which have a 100,000-hour rating at 64 percent of initial light levels. All of these fluorescent systems have high brightness and intensity, not just sufficient lumens. That is why--at a distance--a single 100-watt incandescent lamp is seen much easier than two side-by-side 60-watt incandescent lamps, even though both conditions have the same lumens. This can also be illustrated through a retrofit project of a few years ago, which involved an old drum fixture with a thick white glass lens and a 75-watt incandescent lamp. First, the incandescent lamp was replaced with two 13-watt compact fluorescents. That did not provide enough light. Later, a third 13-watt compact-fluorescent lamp was installed, which still did not make much difference. In fact, the fixture could have been filled with 13-watt lamps with little gain. Although the lumens from the three compact fluorescents more than doubled the lumens from the one incandescent lamp, the compact fixtures were not bright or intense enough for the light to get through the thick white lens, In the end, the entire fixture was replaced. New fluorescent lamps are able to deliver long-range punch to penetrate translucent material. State-of-the-art fluorescent systems feature instant-on with no restrike time, so they can easily be used with frequent on-and-off switching, photocell-based controls, and occupancy sensors. Fixtures with more than one ballast can offer multilevel lighting. Dimming ballasts can also be used with fluorescents, and there is a fairly linear relationship between light level and wattage. HID fixtures, on the other hand, often bum for extended periods only because of their unacceptable warm-up times and restrike times, which can waste a ton of electricity. RELATIVE SYSTEM ADVANTAGES Fluorescents are a linear or area light source, and therefore cause less shadowing, contrast, and glare than other types of illumination. When used with electronic ballasts there is no stroboscopic effect. For operations and maintenance staffs, fluorescent systems offer another advantage: If any lamps or ballasts bum out in a given fixture, those remaining keep operating normally. With HID fixtures, if the single lamp or ballast burns out, there is a large dark area that needs attention immediately. On the plus side for HID maintenance, if the staff uses a pole with bulb changer, HID lamps are easier to handle. Replacement lamp costs are about the same. For example, eight F32T8 lamps cost about the same as one 400W high-pressure sodium (HPS) or metal-halide lamp. Of course, HID technology has not stood still. The most significant ongoing improvement is the pulse-start metal-halide lamp and ballast system, which is driven by ignitors. Pulse-start systems offer substantial gains in lumens per watt, lumen maintenance, color stability, minimum ambient temperature starting, and warm-up and restrike times. Pulse-start systems can also extend lamp life, and they may suitably replace standard metal-halide and HPS systems. Currently, there is price premium for pulse-start, but that could shrink as the technology is more widely accepted. There are other HID improvements, such as energy-saving and extended-life lamps, double-arc tube lamps, high-color-rendering lamps, electronic ballasts for lower wattage systems, two stage (high low) systems with occupancy sensors and/or photocontrols, and fixtures with quartz backup. Unfortunately, most of these upgrades are quite expensive. In addition, some of these improvements come with noteworthy drawbacks. An example is the color-corrected HPS lamp, which offers very good color rendering but at a higher cost, reduced light output, and shorter lamp life. Electronic HID ballasts consume about half as much wattage as magnetic HID ballasts, but HID lamps draw the same wattage either way. Lastly, the two-stage systems for HID use can reduce power at low stage, but they are not linear; at 50 percent light output, wattage is considerably higher than 50 percent- often in the 60 to 70 percent range. BETTER WAY To MEASURE LIGHT The long established way of measuring the amount of light a source produces has been the photopic lumen. Lumen ratings listed in lamp catalogs, for example, are photopic lumens. However, some lighting experts would argue that photopic lumens are not a realistic measure of

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lighting efficacy. For example, compare a 14,000 photopic lumen, 175W 65-CRI standard metal halide with a 16,000 photopic lumen, 150W 22-CRI standard HPS (high pressure sodium). Although the metal halide offers slightly fewer photopic lumens, most endusers would perceive that it is brighter than the HPS. Another example: Consider four fluorescent lamps of various color tone with similar photopic lumen output and identical CR1. When an F32T8 830 lamp, F32T8 835 lamp, F32T8 841 lamp and F32T8 850 lamp are compared apples to apples, most end-users perceive the 850 lamp to be the brightest, followed by the 841 lamp, the 835 lamp, and the 830 lamp, in that order. Due to the substantial inconsistency between photopic lumens and general perception, many lighting consultants (the authors included) no longer base lighting recommendations on photopic lumens or light-meter measurements alone. As a more scientific alternative, consider the concept of "work-on-pupil lumens"-later called "task-modified lumens"- discussed by Sam Berman and Brian Liebel (LD+A, 1996). Photopic lumens are based on the human eye's 2-degree central field of vision. This is only 0.02 percent of the total visual field. There are two types of photoreceptors: cones and rods. In the central field of vision, cones are the main photoreceptors, and photopic lumens are based on cone sensitivity. Rods, which greatly outnumber cones, are excluded in photopic lumens. The peak sensitivity for rods is the in the blue-green region of the spectrum, compared to green-yellow for cones. Scopotic lumens are based on rod sensitivity. Both cones and rods contribute to how the eye perceives light for daytime tasks. Scotopic/photopic (SIP) ratios can be used as a tool to show how the human eye really sees. Some manufacturers include S/P ratios in their catalogs or specification and application guides. Typical S/P ratios for fluorescent and HID lamps are listed below: * F32T8 850 1.83 S/P * F32T8 841 1.62 S/P * 40K clear metal halide 1.49 S/P * Standard HPS 0.62 S/P * Low pressure sodium 0.40 S/P Generally speaking, for the majority of applications, higher ratios are better. RECENT APPLICATION DATA Contra Costa Newspapers, Walnut Creek, Calif.

Mercuryvapor, high-bay fixtures (1,000 watt) mounted at 18 feet in this Knight-Ridder company's s production area and warehouse were replaced with 8-foot "gull-wing" industrial fixtures. The fixtures use eight F32T8 841 lamps, two three-lamp, high-power l.18-BF electronic ballasts and one two-lamp, high-power l.18-BF electronic ballast. Fixture wattage was reduced from 1,075 to 302. Horizontal foot-candles at floor level, however, remained about the same. A major advantage of the fluorescent system is substantial increase in vertical foot-candles, which is necessary for the loading and unloading of materials in shelves and racks. Similar original mercury-vapor fixtures in the main press area of the facility were left intact so that maintenance could continue using a pole and cup to replace lamps in these hard-to-access areas. Reed School District, Tiburon, Calif. The main gymnasium in this school had two-foot by two-foot surface-mounted fixtures with 400W metal-halide lamps mounted at 20 feet. Each fixture was retrofited with four 55W biaxial lamps, two two-lamp electronic ballasts and a custom reflector kit. The District's fixture wattage was reduced from 455 to 220, with acceptable lighting levels. With instant-on and no restrike delay, the fixtures are no longer left on all day and are used only as needed, saving kWh, not just kW. San Jose Unified School District, San Jose, Calif. Three gymnasiums at schools in this district had 400-watt HPS high bays mounted at 20 to 25 feet high. Each fixture was replaced with eight or more F32T8 lamps in 8-foot fixtures, reducing fixture wattage from 465 to as low as 305. With no warm up time or restrike time, the new fixtures are turned off much more than the old fixtures, so both kW and KWh are reduced. Fairfield-Suisun Unified School District, Fairfield, Calif. Fairfield High School had eight-foot, hooded industrial fixtures with two F96T12 VHO lamps. The District wanted more light; thus, each fixture was retrofitted with a hooded industrial kit, six F32T8 841 lamps, and two three-lamp high-power 1.1 8-BE electronic ballasts. Wattage was reduced from about 450 to 224 per fixture. Kaiser Hospital, Vallejo, Calif. Metal-halide troffers (175 watt, two by two) on an exterior covered loading dock were replaced with new troffers, three-lamp electronic ballasts, three 40watt biaxial lamps, and 95-percent reflective aluminum reflectors. Light levels were increased by about 20 percent as wattage was cut in hall. Additionally, photocells were installed for three fixtures closest in the area that received the most sunlight. Maintenance is likely to be reduced, because the lamps are rated for 20,000 hours compared to 10,000 hours for the metal halide originals a big positive for the fixtures, which are hard to access. Eastmont Mall, Oakland, Calif. At this shopping center, recessed cans in interior areas were replaced with retrofit fixtures using 42-watt, triple-loop electronically ballasted fluorescent lamps rather than another alternative considered: 50watt metal halide. Other locations received units with two 42-watt triple-loop lamps over 100-watt metal halide. Kaiser Hospital, Walnut Creek, Calif. An exterior maintenance area on the roof used 100-watt mercury-vapor wall packs. Due to their considerable warm-up and restrike times, these fixtures were left on all night, every night. The wall packs were replaced with flood fixtures employing two F17T8 835s and electronic ballasts. Wattages were slashed, and timers were installed to energize lights only when needed by the engineering staff. U.S. Windpower, Livermore, Calif. Quartz floodlights used for an exterior staging area were replaced by new flood fixtures with two F32T8 841s and high-power 1.18-BE electronic ballasts. Wattage was reduced from an average of 400 to 76. Mt. Diablo Medical

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Center, Concord, Calif. Exterior recessed cans by an ambulance unloading deck had 175W mercury-vapor fixtures. Each can was retrofitted with a retrofit package incorporating two 26-watt 41K biaxial lamps. Wattage was reduced from 200 to 60. HIDo OR HIDON'T? When selecting lighting options for new and retrofit projects, the best light source is only part of the problem. The fixture's job is also to get as much of the available light out of the fixture as possible and direct it where needed. Like their fluorescent counterparts, some HID fixtures are well designed-and others are not. If a sales representative works for an HID fixture manufacturer, they are likely to push HID without giving due consideration to equivalent new fluorescent systems. HID may often be the better choice, especially for high-wattage pole fixtures, wall packs, and floods for exterior applications, especially where cold ambient temperatures are encountered. For these applications, pulse-start metal halide is a preferred choice. Also, fluorescents can not easily compete with the PAR metal halide lamps used for accent and display lighting.