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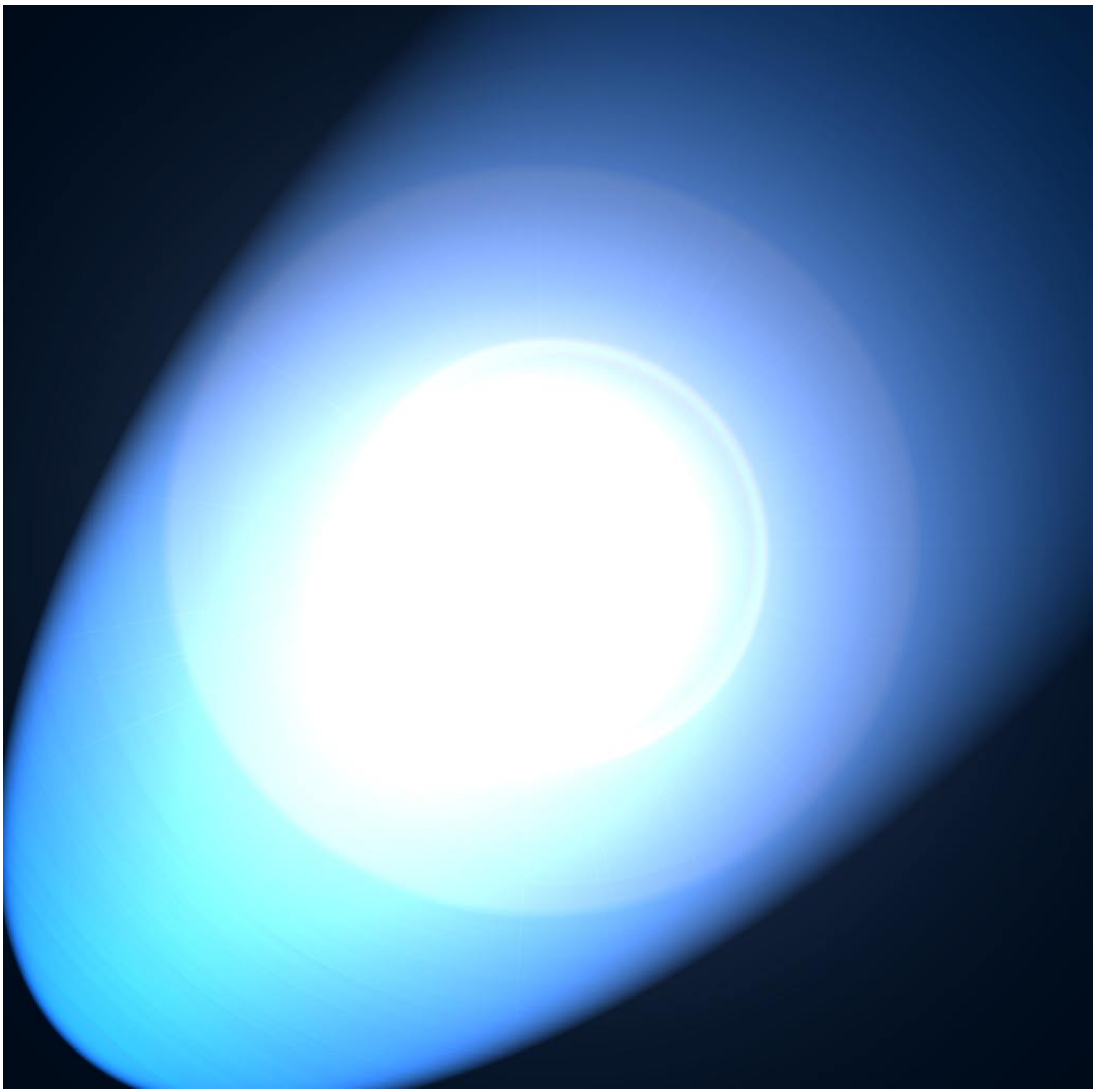
Low-wattage Metal Halide Lighting Systems

Low-wattage MH Lamps with Electronic and Magnetic Ballasts

Volume 10 Number 1, October 2006



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About NLPIP

The National Lighting Product Information Program (NLPIP) was established in 1990. NLPIP is administered by the Lighting Research Center (LRC), the world's leading university-based center devoted to lighting excellence.

NLPIP's mission is to help lighting specifiers and other lighting decision-makers choose wisely by providing the most complete, up-to-date, objective, manufacturer specific information available on energy-efficient lighting products. Priority is given to information not available or easily accessible from other sources. NLPIP tests lighting products according to accepted industry procedures or, if such procedures are not available or applicable, NLPIP develops interim tests that focus on performance issues important to specifiers or end users.

In 1998, NLPIP Online debuted at www.lrc.rpi.edu/programs/nlpip, making the information provided by NLPIP even more accessible to lighting specifiers and other interested people. NLPIP Online includes PDF files of *Specifier Reports, Lighting Answers, Lighting Diagnostics,* and several searchable databases containing manufacturer-reported data and test results.

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Contents

Introduction

Metal halide lighting systems have become a popular choice with lighting specifiers because they offer high light output in a small package. A small source size combined with long lamp life, high efficacy, and good color-rendering properties make them an attractive option for many types of lighting applications. For many years, mid-wattage and high-wattage metal halide lamps have dominated high-bay commercial lighting and stadium and sports lighting. Advances in low-wattage metal halide lamp-ballast systems, however, are allowing these lamps to be used in more applications. Specifically, low-wattage metal halide lamps are replacing higher wattage incandescent lamps, parabolic aluminized reflector (PAR) halogen lamps, and compact fluorescent lamps in applications requiring high-intensity white light, good optical control, and good color properties. These applications include recessed downlighting, accent lighting, retail lighting, and anywhere that a "punch" of light is desirable such as lobbies, foyers, and atriums.

The growth of metal halide lighting in the last 15 years has been significant. Lamp shipments more than tripled between 1990 and 2002, to more than 19 million units (U.S. Department of Energy 2004). Nearly 35 million metal halide lighting systems are installed in the United States, representing approximately one-third of the total installed base of high-intensity-discharge (HID) lighting and 50% of total electricity consumed by HID lighting (U.S. Department of Energy 2002). The energy savings potential of low-wattage metal halide lamps could be considerable. The U.S. Department of Energy estimates that replacing incandescent lamps (greater than 60 watts) with low-wattage metal halide lamps could reduce energy consumption from 0.8 quad down to 0.1 quad annually (U.S. Department of Energy 2005).

Although popular and widespread, metal halide lighting systems may cause confusion among lighting specifiers and users because of the multiple lamp and ballast options available, as well as the issues and precautions that must be considered for optimal operation.

This issue of *Specifier Reports* discusses low-wattage metal halide lamps of 150 watts or less and their operation on magnetic ballasts and non-dimming electronic ballasts. The lamps discussed include medium screwbase, non-reflector models, which represent those commonly found in low-wattage metal halide general lighting, as opposed to accent lighting where reflector lamps and models with different bases may be more common. When available, general performance ranges presented in this report are taken from the manufacturer-supplied information found in Tables 1–5. These tables provide claimed lamp and ballast data for 50, 70, 100, 125, and 150 watts. However, in an effort to cover the wide range of products commercially available, in some instances other wattages are provided for lamps only or ballasts only. These may represent new products on the market or products that operate with other models that did not fit the system selection criteria for this report.

In addition, the National Lighting Product Information Program (NLPIP) tested a limited selection of 70-watt metal halide lamps, their associated ballasts, and selected lamp-ballast combinations. The testing was designed to evaluate lamp life, lamp efficacy, lumen maintenance, and color, as well as the impact of lamp type and ballast type on the lighting system, including system power quality and system efficacy. Tables 6–10 provide the testing results and compare these results to manufacturers' claims.

This report updates information reported in *Specifier Reports: HID Accent Lighting Systems*, revised 1998, supplement 2000.

Performance Characteristics of Metal Halide Lamps

Low-wattage metal halide (MH) lamps are defined as having wattages of 150 watts (W) or less. In recent years, low-wattage MH lamps have become energy-efficient alternatives to incandescent lamps. In comparison to incandescent lamps, MH lamps offer the same benefits of compact size and, in many cases, good color properties, but they cost less over time because they offer higher efficacy and longer life than incandescent lamps. MH lamps can achieve the same light output using fewer watts of power than incandescent lamps. For example, a 70 W MH lamp could replace a 150 W halogen lamp, while a 39 W MH lamp could replace a 100 W halogen lamp. However, MH lamps cannot directly replace incandescent lamps because they require ballasts and different luminaires to operate.

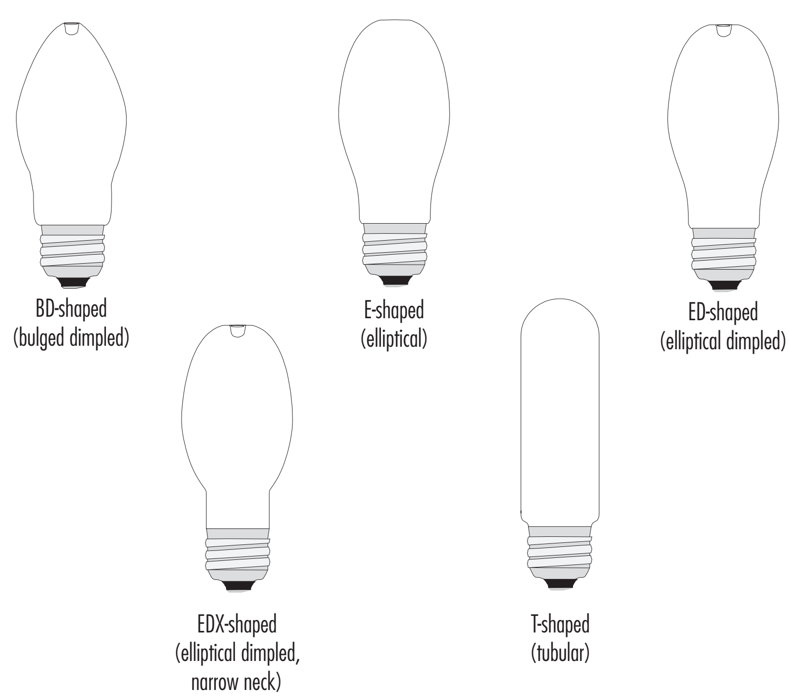
Construction and Operating Characteristics

MH lamps are a type of HID lamp, which produces light by means of an electrical arc discharge between two tungsten electrodes contained in an arc (or discharge) tube. The arc tube contains gas (typically argon or xenon), mercury, and metal halide salts that become pressurized when heated to operating temperature. Some MH lamps have a glass shroud surrounding the arc tube. This shroud contains any broken particles in the case of an arc tube rupture. The arc tube is encased in an outer bulb (also called an *envelope*) typically made of borosilicate glass, which protects the arc tube seals from oxidation, keeps the outer surface of the arc tube clean, prevents the extremely hot arc tube from coming into contact with any material, and provides a stable thermal environment. The bulb can be clear or coated with a phosphor layer finish that diffuses the light and changes the lamp's color properties. Figure 1 shows the most common low-wattage MH bulb shapes available. MH lamp bulbs are designated by letters that indicate the shape, followed by numbers that indicate the approximate maximum diameter in eighths of an inch (e.g., ED17, T13, etc.).

MH vs. CFL

Lighting specifiers seeking to replace incandescent lighting systems have turned to high-wattage compact fluorescent lamps (HW-CFLs), in addition to low-wattage MH lamps. In some cases, HW-CFLs are replacing MH lighting systems. Like MH lamps, CFLs offer long life, high efficacy, high light output, and good color rendering. HW-CFLs are typically used in high-ceiling applications where diffuse illumination is desired, such as big-box retailers and warehouses, and where a fast start-up is required. However, because of their numerous and large luminous tubes, HW-CFLs do not provide good optical control and cannot provide the non-diffuse, directional lighting of MH lamps. They also cannot work well in spaces requiring smaller lamps and lighting systems. For more information about HW-CFLs, see NLPIP's *Lighting Answers: High-wattage Compact Fluorescent Lamps*, 2006.

Figure 1. Bulb Shapes of MH Lamps



A ballast supplies a starting voltage to the lamp electrodes, either through a secondary starter electrode (called probe-start) or through a high-voltage pulse applied to the main electrodes (called pulse-start). The starting voltage ionizes the gas so that current can flow and start the lamp. A warm-up period is necessary before the lamp reaches its full light output. During this phase, the voltage and current supplied to the lamp first establish a gas discharge inside the arc tube. As the temperature of the arc tube increases, the liquid mercury vaporizes, increasing the internal pressure and the operating voltage. The high-pressure mercury discharge generates some visible light plus a substantial amount of ultraviolet (UV) radiation. As the temperature of the arc tube increases further, the metal halide salts evaporate and incorporate into the discharge. The free metals generate a high quality "white" light plus a small amount of UV radiation. Once the gas mixture reaches thermal equilibrium, the lamp voltage and current levels are set.

Types of MH Lamps

MH lamps are distinguished by the material of the arc tube and the starting technology applied. Arc tubes can be made of either fused silica (referred to as a *quartz lamp*), or polycrystalline alumina (PCA) (referred to as a *ceramic lamp*). Quartz lamps can have either probe-start or pulse-start technology. Ceramic lamps are pulse-start only but are usually not referred to as such.

Quartz lamps. Quartz lamps were the first type of MH lamp available (Figure 2). Compared with newer ceramic MH lamps, quartz lamps exhibit several inherent performance problems, including high lumen depreciation, lower efficacy, poor color rendition, excessive color shift, and lamp-to-lamp color inconsistency. Quartz-based MH lamps are still the most popular choice, however, because they are low in cost and are a proven technology (U.S. Department of Energy 2006). They may be a good choice for optical systems where compact source size is important. They also are usually a first choice for applications where color stability and lumen depreciation are not critical factors, though they will result in higher energy costs over time than MH lamps that use ceramic arc tubes and have better efficacy and better lumen maintenance (U.S. Department of Energy 2006; van Erk 2000).

Probe-start lamps. MH lamps made with traditional probe-start technology include three electrodes: a starting probe electrode and two operating electrodes (Figure 2). During start-up, a discharge is initiated across the small gap between the starting probe electrode and the adjacent operating electrode. The discharge then jumps to the other operating electrode to establish the arc and start the lamp. Once the lamp is started, a bi-metal switch removes the starting probe electrode from the circuit. Probe-start technology has several inherent disadvantages compared with pulse-start HID technologies, including lower lumen maintenance, greater color shift and color variation, and shorter life.

Pulse-start lamps. Pulse-start lamps improve upon the traditional probe-start technology with a change in ballast design and in arc tube chemistry, fill pressure, and shape. Pulse-start lamps do not have a starting probe electrode. Instead, an ignitor works with the ballast to send a series of high-voltage pulses (3 to 5 kilovolts) to start the lamp. The elimination of the starting probe electrode decreases the size of the pinch (or seal) area at the end of the arc tube, which in turn reduces heat loss and provides the arc tube with a more uniform surface temperature. Pulse-start systems offer several benefits over probe-start systems, including higher light output and efficacy, longer lamp life, greater lumen maintenance, and better cold-starting capability (starting at temperatures as low as –40°F/–40°C). Because of the better performance and efficacy of pulse-start lamps, as of January 1, 2006, the state of California prohibits the use of probe-start lamps in all new MH luminaires operating 150–500 W lamps (vertical, base-up operation) (California Energy Commission 2006). This legislation may move the market toward all pulse-start lamps in the future. The majority of low-wattage MH lamps on the market are already pulse-start lamps because of the smaller size of the arc tube. NLPIP tested pulse-start lamps only for this issue of *Specifier Reports*.

Ceramic lamps. Ceramic MH lamps improve upon the older-style quartz lamps and have become a viable, energy-efficient alternative to incandescent and halogen technologies in many applications. Introduced in the mid-1990s, ceramic lamps allow for higher temperatures inside the arc tube (Figure 3). Higher temperatures in turn provide greater efficacy, better color rendering, and increased stability over quartz lamps. Better lumen maintenance is a key feature of ceramic MH technology. Ceramic lamps have lower operating costs, longer life, and better efficacy than incandescent and halogen lamps, although their initial purchase cost is higher.

Figure 2. Quartz Lamp with Probe-start and Pulse-start Technologies

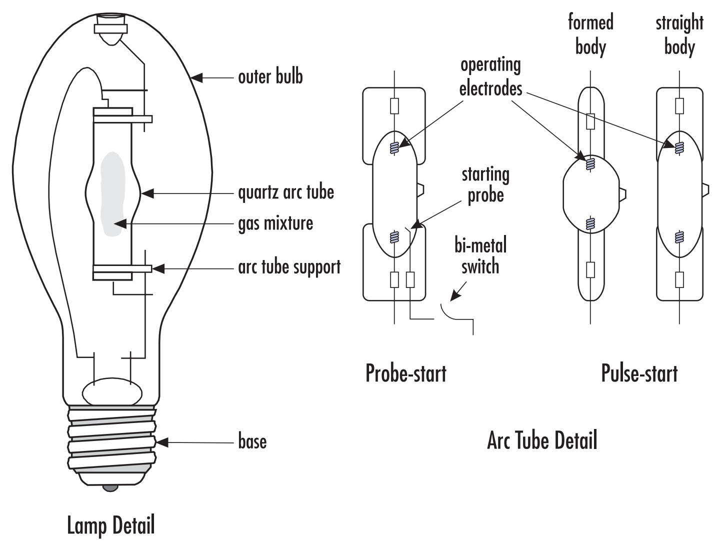
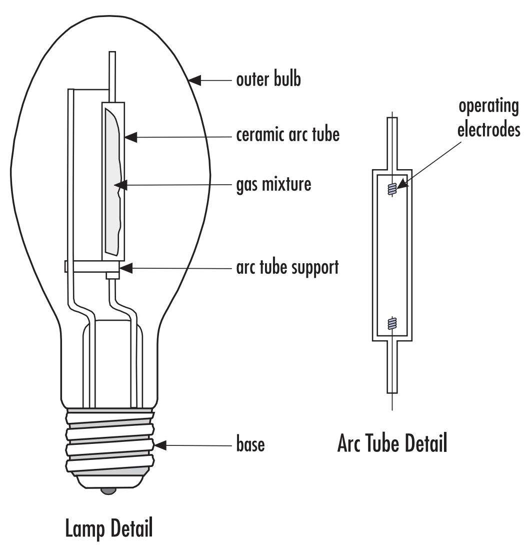


Figure 3. Ceramic Lamp with Pulse-start Technology



Lamp Safety and Luminaire Type

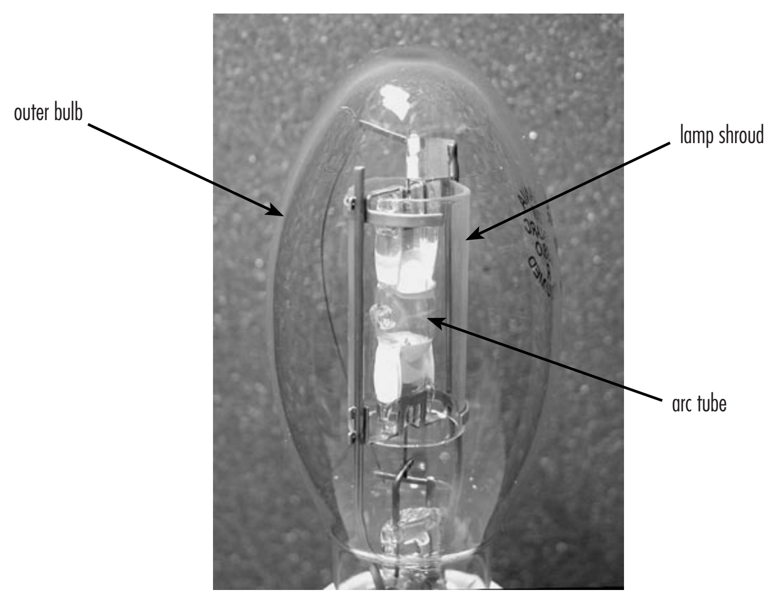
MH lamps operate under higher internal temperatures and pressures than most other light sources. While virtually all MH lamps fail passively (i.e., without exploding or rupturing), it is possible for the lamp to shatter if the arc tube ruptures. An arc tube rupture releases hot particles that can break the outer glass bulb and enter the luminaire. If the luminaire does not contain the particles, they may cause injury or fire. Consequently, different types of MH lamps are available for open and enclosed fixtures, and manufacturers provide warning information and instructions for their proper use.

The American National Standards Institute (ANSI) requires lamp manufacturers to designate the type of luminaire in which MH lamps may safely be used (ANSI C78.380-2005). The three classifications include:

- **E – Enclosed:** These lamps must be used in enclosed luminaires that meet the industry safety requirements outlined in UL 1598.
- **O – Open:** These lamps are allowed in open (non-enclosed) luminaires. They have undergone ANSI-specified containment testing and are constructed to prevent ruptured tube particles from breaching the outer bulb wall. O-type MH lamps have a special base with an extended center pin. This base will work in conventional MH sockets but is designed for newer open luminaires that hold only O-type lamps.
- **S – Suitable:** These lamps traditionally have been acceptable for both open and enclosed luminaires, with their use in open luminaires restricted to the vertical position. They must also be used under certain on-off cycling and group relamping requirements. However, a change in 2005 to the National Electric Code (NEC) requires open luminaires under NEC jurisdiction to accept only "O" lamps. This code change virtually eliminates the use of "S" lamps in open luminaires. (This classification applies to certain types of lamps in the 360 to 1000 W range only.)

In open luminaires, one way that lamp manufacturers reduce the risk of lamp particles scattering is with the addition of a lamp shroud. A glass shroud (Figure 4) inside the outer bulb surrounds the arc tube. If the arc tube bursts, the shroud should prevent the ruptured particles from shattering the outer bulb. Some lamps have a metal, spiral-shaped shroud to contain the ruptured particles.

Figure 4. Lamp Shroud



The National Electrical Manufacturers Association (NEMA) recommends several ways that users can minimize risks with MH lamps, including: 1) following manufacturers' warnings and instructions for safety, installation, and maintenance; 2) group relamping at the time recommended by manufacturers; 3) following lamp manufacturers' instructions for lamp cycling (i.e., turning the lamps off and on after a specified time); and 4) operating lamps on ballasts designed to provide the appropriate wattage (NEMA 2004).

MH lamps must always operate on a ballast specifically designed for the lamp. Operating an MH lamp on the incorrect ballast can increase the risk of lamp failure and lead to personal injury and property damage. MH lamps and ballasts are matched by their designated ANSI code (e.g., M98, M139, etc.).

Lamp Current and Voltage

MH lamps, like all other discharge lamps, are negative-incremental-impedance devices, which means that the operating voltage decreases as the current increases. If operated from a constant voltage source, the current will increase until the lamp is destroyed. A current-limiting ballast is necessary to avoid damaged circuits and destruction of the lamp.

MH lamp voltage typically rises over time. The magnitude of the voltage rise can be as high as an additional 18–35% of the initial lamp voltage (Rasch and Statnic 1991; Fukumori et al. 1995). The loss of sodium and the buildup of free metals in the arc tube are believed to cause the lamp voltage to rise. This can cause the voltage waveform to change, leading to lamp extinction, or it can cause the lamp to cycle on and off. The loss of sodium typically is caused by the permeation of sodium through the quartz wall of the arc tube in a quartz lamp. For a ceramic lamp, the PCA arc tube greatly reduces the permeation of sodium through the wall. Thus, by theoretical deduction, ceramic lamps should have a smaller voltage rise over time than quartz lamps when operated by the same type of ballast; however, NLPIP did not find any previous study results that directly relate lamp voltage rise to the type of arc tube material.

Performance Characteristics

Light Output and Lumen Maintenance

Light output is defined as the quantity of light in lumens (lm) produced by the lamp. Manufacturers provide the initial light output value, measured at 100 hours, and the mean light output value, which is typically measured at 40% of manufacturer-rated life.

Initial light output and mean light output in combination are used to determine a lamp's lumen maintenance. Because all lamps undergo a decrease in light output over time, manufacturers usually use a lumen maintenance (or lumen depreciation) curve to illustrate the decrease in a lamp's light output over its life. Lumen maintenance is expressed as a percentage of maintained light output, with a higher percentage equating to a lower light loss. A high lumen maintenance value is good because it means that the lamp has a higher average efficacy over time and can operate longer before it needs to be replaced. Ceramic lamps and quartz pulse-start lamps generally have better lumen maintenance than quartz probe-start lamps.

In low-wattage MH lamps, light output decreases as the electrodes deteriorate, the arc tube blackens, and the chemical composition of the lamp shifts. If the lamp has a phosphor coating, the phosphor can degrade and reduce light output as well. Depending upon their construction and operating environment, MH lamps at 40% of manufacturer-rated life can exhibit light output losses of 20–50%. Often at this point, they produce too little light for many applications and would require group relamping. The need for group relamping before the end of rated life is a cost consideration: MH lamps with better lumen maintenance will be more cost-effective than those that must be replaced earlier.

Lamp Efficacy

Lamp efficacy (also called luminous efficacy) is the initial light output of a lamp divided by its active power (watts), expressed as lumens per watt (LPW). A high efficacy means that lamps of a lower wattage can replace higher wattage lamps to achieve the same light output while using less energy. Low-wattage MH lamps have lamp efficacies ranging from 60–100 LPW. In comparison, incandescent and halogen lamps have efficacies of 14–20 LPW. Ceramic lamps and quartz pulse-start lamps have slightly better lamp efficacies than quartz probe-start lamps.

Color Properties

In MH lamps, the metal halide salts and the temperature of the cold spot inside the arc tube primarily determine the light output color. A phosphor coating added to the outer bulb can slightly change the lamp's color properties.

The color properties of a lamp are calculated from its spectral power distribution. These include correlated color temperature (CCT), chromaticity coordinates, and color rendering index (CRI). Below are brief descriptions of each of these properties and information about MH lamp color. For more about light source color, see NLPIP's *Lighting Answers: Light Sources and Color*, 2004.

Correlated color temperature (CCT). CCT indicates whether a white light source is "warm" or "cool" in appearance. Warm light sources are yellowish-white in appearance, and cool light sources appear bluer. CCT is measured in kelvins (K), with higher CCTs indicating a cooler appearance. Low-wattage MH lamps have CCTs ranging from 2700 to 4500 K, with a few at 6500 K. A range of CCTs is desirable because it allows specifiers to select lamps that complement the colors of a space or that match other types of light sources used in a space.

Chromaticity coordinates. The chromaticity of a light source is described mathematically using two numbers called *x* and *y* coordinates. These coordinates are plotted in a two-dimensional diagram of color space developed in 1931 by the International Commission on Illumination, referred to as CIE (Commission Internationale de l'Eclariage). Also plotted in the diagram is the blackbody locus, which represents the chromaticities of a blackbody radiator source and acts as a reference line for white light sources.

Chromaticity and its associated coordinates are an approximate representation of a lamp's color appearance. The chromaticity coordinates of nearly all white light sources fall close to the blackbody locus. Lamps with coordinates above the blackbody locus will appear slightly green or yellow, while those below will appear pinkish.

Light sources with the same CCT can have different chromaticity coordinates, making them look very different from each other.

Color rendering index (CRI). CRI is a measure of a light source's ability to render or depict an object's colors naturally or realistically, as compared with a reference light source (usually incandescent or daylight). The maximum CRI value is 100, indicating a highly natural appearance of an object's colors. A low CRI indicates that an object's colors may appear unnatural when illuminated by the lamp. MH lamps have CRI values ranging from 60 to 96. Incandescent lamps have CRI values above 95. Ceramic lamps generally have higher CRI values than quartz lamps.

Full-spectrum color index (FSCI). NLPIP defines FSCI as a mathematical transformation of the full-spectrum index into a zero-to-100 scale. Full-spectrum index is a measure of how much a light source's spectrum deviates from an equal energy spectrum. A light source with an equal energy spectrum over the range of visible light (380 to 730 nm) has an FSCI value of 100 because it emits an equal amount of energy at each wavelength, and therefore has good color-rendering properties. A "standard warm white" fluorescent lamp has an FSCI value of 50, and a monochromatic light source (e.g., low-pressure sodium) has an FSCI value of 0.

Gamut area (GA). Gamut area is a measure of color rendering based upon volume in color space. It represents the range of colors achievable on a given color reproduction medium under a given set of viewing conditions. GA is calculated from the polygon-shaped area defined by the chromaticities of the eight CIE standard color samples in color space. In general, a larger GA means an object's colors appear more saturated.

Color Variation

Lamps of the same type, even if made by the same manufacturer, may exhibit a certain degree of variation in color, even when operated under the same conditions and seasoned for the same amount of time. A light source with complicated physical and chemical properties is harder to manufacture with consistent color from lamp to lamp. Color variations are greater among MH lamps of the same type than among incandescent lamps or among linear fluorescent lamps.

The degree of color variation among lamps can be described by the number of MacAdam ellipse steps from one lamp to another. ANSI has designated a 4-step MacAdam ellipse as a standard for color variations among certain types of linear fluorescent lamps. All manufactured lamps of this type must have chromaticity coordinates that fall within the 4-step MacAdam ellipse in order to meet the ANSI standard. While no color standard exists for MH lamps, the four-step MacAdam ellipse is a good reference for determining noticeable color variation.

Color variations within a lighting application can be limited by choosing lamps of the same wattage and manufacturer, operating them in the same position, and replacing them on a group basis. Ceramic lamps tend to show less color variation than quartz lamps.

Color Shift

MH lamps exhibit color shifts as they age, more so than incandescent or linear fluorescent lamps. At 40% of rated life, probe-start and pulse-start quartz lamps can experience a CCT shift of as much as ±500 K. Ceramic lamps do not shift as much, typically ±200 K.

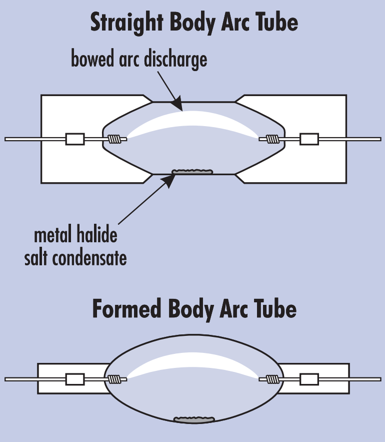
NLPIP measured color shift by using chromaticity coordinates and MacAdam ellipses, rather than CCT. It is possible for light sources to change chromaticity coordinates over time without a change in CCT. Lamps with chromaticity coordinates falling along a given isotemperature line will all have the same CCT. Over life, a lamp's coordinates may shift off an isotemperature line, resulting in a change in CCT, or they may shift up or down an isotemperature line and not change CCT. However, lamps with the same CCT but different chromaticity coordinates can appear different. Lamps with chromaticity coordinates that shift beyond a 4-step MacAdam ellipse generally will appear different than when new.

Warm-up Time and Restrike Time

MH lamps require a warm-up period before reaching 90% of their full light output. This period can range from 1–5 minutes, depending on the lamp type and its power rating. Once extinguished, a MH lamp cannot be immediately turned on again without use of a special and expensive ballast. The arc tube requires a period of time to cool down before restarting. This period is referred to as the *restrike time*. Restrike time for low-wattage MH lamps ranges widely, from 1–20 minutes. NLPIP did not measure restrike time for this issue of *Specifier Reports.*

Arc Discharge Bowing

When the electric discharge heats the gas inside the arc tube, a convective gas flow is created. When the arc tube is operated in a vertical position, the convective gas flow is balanced on all sides, keeping the discharge operating along an axis between the two electrodes. When the arc tube is operated in a horizontal position, the convective gas flow causes the discharge to bow upward; hence, the term "arc" discharge. The bowing that occurs with horizontal operation causes the discharge to move close to or against the upper wall of the arc tube, heating this portion of the arc tube to temperatures perhaps as high as the upper temperature limits of the arc tube material. This can reduce arc tube life. The lower half of the arc tube, on the other hand, operates at lower temperatures, promoting condensation of the metal halide salts, which reduces light output and changes the color of the light. Manufacturers that make horizontal-position lamps use designs intended to counteract this natural occurrence, including arc tubes with offset electrodes and formed-body arc tubes shaped to match the bowing arc.

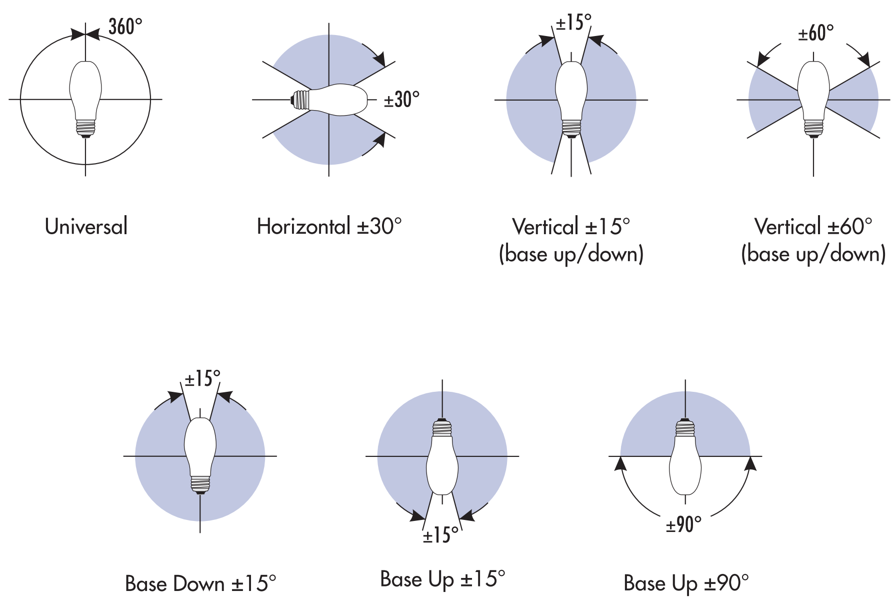


Arc Discharge Bowing in the Horizontal Burning Position
The arc discharge inside the straight body arc tube bows closer to the upper wall than in the formed body arc tube.

Operating Position

The operating or burning position of a MH lamp can affect its light output and life, and its degree of color variation and color shift. Figure 5 shows some common operating positions. Vertical operation generally provides the best performance because it keeps the arc discharge centered inside the arc tube.

Figure 5. Lamp Operating Position Examples



Manufacturers specify the proper operating positions for their lamps. Operating a lamp in a position other than specified can negatively affect performance and may even lead to early failure. Most low-wattage MH lamps are manufactured as universal-burn lamps (i.e., any position). If a lamp is specified with a universal-burn position, manufacturers often give the initial and mean light output values for both the vertical and horizontal positions. The lowest light output is found in lamps operating 60–70° from the vertical position, which should be avoided. One manufacturer states that its lamps have a 5% lower lumen maintenance at the end of life when operated in the horizontal position.

Performance Characteristics of Metal Halide Ballasts

MH lamps require a ballast that is electrically compatible with the lamp in order to operate. Proper ballast operation is critical to MH lamp performance. The ballast supplies the voltage to start the lamp, regulates the lamp's operating current, and maintains suitable voltage to sustain the lamp's discharge. MH ballasts limit the current drawn by the lamp to the proper level for operation. Ideally, proper regulation ensures that the ballast maximizes lamp life, color, light output, and lumen maintenance. Both magnetic and electronic ballasts are available for low-wattage MH lamps.

Types of Ballasts

This section discusses the types of ballasts available for low-wattage MH lamps. The ballast operating characteristics mentioned in this section are defined and detailed in: "Performance Characteristics of Metal Halide Ballasts—Operating Characteristics" (p. 15) and "Lamp-Ballast Interactions" (p. 17).

Magnetic Ballasts

Magnetic ballasts start and operate MH lamps through an electromagnetic core of laminated steel plates wrapped with copper or aluminum windings (coil). A capacitor may be added to improve power factor (see p. 15), which may subsequently reduce current draw, depending upon the placement of the capacitor. In some cases, the capacitor works with the core-and-coil to set the lamp operating wattage. Ballasts that operate pulse-start lamps also include an ignitor to start the lamp. These "core-and-coil" ballasts operate at line frequency (60 Hz in North America) and have a current waveform that is approximately sinusoidal (i.e., a sine wave).

Compared with electronic ballasts, magnetic ballasts are the least expensive option in terms of initial purchase cost; however, over time they use more energy because they have higher power losses. Because of design and manufacturing practicalities, the ballast efficiency of magnetic ballasts is approximately 10% lower than that of electronic ballasts. Overall, the higher operating costs of magnetic ballasts could offset the initial savings.

The types of magnetic ballasts available for low-wattage MH lamps include reactor (R), high reactance autotransformer (HX), constant wattage autotransformer (CWA), super constant wattage autotransformer (SCWA), and linear reactor. Reactor and high reactance autotransformer ballasts are the most common on the market for low-wattage MH lamps.

Reactor (R). Also called "lag" ballasts, reactor ballasts have the simplest ballast circuitry, consisting of a single coil. Reactor ballasts can be used when the input voltage matches the starting and operating voltage requirements of the lamp. In this case, the ballast acts as current-limiting device only. Reactor ballasts provide a desirable low lamp current crest factor (CCF) of 1.4 to 1.5 (see p. 17). Without a capacitor, they are low power factor devices. In some instances, a capacitor may be added to reduce the current draw during lamp operation and create a high power factor ballast. The number of luminaires on a circuit must be limited when using a reactor ballast because the lamp-ballast system draws more current during start-up than during normal lamp operation. A weakness of the reactor ballast is that it cannot regulate the lamp wattage well with variations in input voltage. A 5% change in input voltage can result in a 10–12% change in lamp operating wattage.

High reactance autotransformer (HX). This ballast is similar to the reactor ballast but has a second coil. The HX ballast is used when the input voltage does not meet the starting and operating requirements of the lamp. The primary coil transforms the voltage to the lamp's required level, and the secondary coil limits the current. As with reactor ballasts, HX ballasts are low power factor devices, but with an added capacitor they become high power factor ballasts. A typical CCF range for these ballasts is 1.4 to 1.6. HX ballasts use more material and have higher losses than reactor ballasts, but they work well for a wide variety of applications because they come with multitap capability, which provides several inputs to accommodate different voltages. Like reactor ballasts, they do not regulate lamp wattage well when the input voltage varies.

Constant wattage autotransformer (CWA). This two-coil, high power factor ballast provides better lamp wattage regulation than reactor or HX ballasts. CWA ballasts (also called peak-lead ballasts) incorporate wave shaping to provide a higher peak voltage than a normal sine wave, which is used to start the lamp and control the lamp CCF (typically 1.6 to 1.65). The input current during start-up does not exceed the input current during stable operation. These ballasts can handle line voltage variations of approximately 10% and drops of up to 30% before the lamp extinguishes. CWA ballasts are bigger, heavier, less efficient, and more expensive than reactor and HX ballasts. At the time of this report, CWA ballasts were available for 50 W, 100 W, and 150 W lamps, although they are most common for mid-wattage and high-wattage (175–2000 W) MH lamps. One manufacturer reports that low-wattage MH lamp performance on CWA ballasts is poor.

Super constant wattage autotransformer (SCWA). This ballast is similar to the CWA ballast, but it can handle voltage variations of up to 45%. SCWA ballasts are used for pulse-start MH lamps of 150 W and up.

Linear reactor. This high power factor, single-coil ballast is used for pulse-start lamps of 150 W and up operating at 277 V. It includes an ignitor and a capacitor. This ballast is more efficient than the SCWA system because the single-coil design reduces both input lamp wattage by 8% and power loss by up to 50%. A linear reactor ballast is used in areas with very little variation in input voltage.

Electronic Ballasts

Solid-state electronic ballasts for MH lamps have become more common in recent years because they are smaller, lighter, and more efficient than magnetic ballasts. Introduced in the late 1990s for HID lamps, electronic ballasts are claimed to provide the lamps they operate with better lumen maintenance, better color stability, and longer lamp life. They work more readily with control systems for daylight dimming and occupancy sensing. Electronic ballasts offer better performance because they have lower internal power losses and they can control lamp power better throughout lamp life compared to magnetic ballasts. Unlike magnetic ballasts, they can convert the line frequency to any lamp operating frequency. Electronic ballasts also can change the shape of the current and voltage waveforms. Manufacturers generally recommend that electronic ballasts be used with ceramic lamps to achieve the best performance from these lamps.

The adoption of electronic ballasts for MH and other HID lamps has been slow, however, because of a number of issues. Electronic ballasts for fluorescent lamps successfully use high frequencies (above 20 kHz) to improve lamp efficacy. However, MH lamps do not demonstrate significantly higher lumens per watt with higher operating frequencies. Higher frequencies contribute only a 4–6% gain in the luminous efficacy of MH lamps before arc instability sets in (Campbell 1969; Faehnrich and Rasch 1988). Higher frequencies also lead to acoustic resonances that disrupt lamp operation and shorten lamp life (see p. 17). Therefore, the frequency of lamp operation is critical to MH electronic ballast design. MH ballast designers typically use low frequencies (100–400 Hz) and a square current waveform to avoid acoustic resonance and maintain lamp life, but some newer electronic MH ballasts operate lamps at frequencies higher than those where acoustic resonances can be sustained.

The most advanced MH electronic ballast designs are for lamps under 150 watts, but ballasts for higher wattages are becoming more available.

Operating Characteristics

System Efficacy

A lighting system's efficacy is the ratio of the lamp's light output to the system's power (watts) and is measured in lumens per watt (LPW). A system's power is the input power (or active power) for the lamp-and-ballast combination and includes ballast losses. System efficacy will always be lower than lamp efficacy because of the added power needed to run the ballast. For low-wattage MH lighting systems, system efficacy ranges from 50–75 LPW. In comparison, fluorescent lighting systems have a system efficacy range from 60–100 LPW, while incandescent lighting systems, which do not require ballasts, range from 14–20 LPW.

Ballast Efficiency

No ballast can transfer power to the lamp with 100% efficiency because the ballast must use a certain amount of power for its own operation. Ballasts also experience power losses from the current flowing through the wires, called I^2R losses or resistive heating. Ballast efficiency is defined as the ratio of lamp power to input power. Electronic ballasts tend to have higher ballast efficiencies than magnetic ballasts because of the high cost of manufacturing high efficiency, low frequency inductors and transformers for magnetic ballasts. Building a high efficiency magnetic ballast would also require more material, making the ballast very heavy and impractical for many applications.

Power Quality

Power factor. Power factor signifies how much power capacity is available for productive work. Power factor is defined as the ratio of input power (watts) to apparent power (the product of the root-mean-square input voltage and the root-mean-square input current to the system). Power factors range from 0 to 1 (unity), with 1 being the highest level. When input voltage and input current are in phase with each other and neither waveform is distorted, the ballast has a power factor of 1, indicating that all power is available for useful work. Low power factor ballasts, sometimes called normal power factor (NPF) ballasts, have power factors typically in the range of 0.40 to 0.60. By adding a capacitor to the ballast, the power factor of a magnetic ballast can usually be "corrected" to a higher level. Ballasts with power factors greater than 0.60 but less than 0.90 are called power factor corrected (PFC). Those with power factors greater than 0.90 are called high power factor ballasts (HPF). High power factor ballasts draw less current than low power factor ballasts for the same ballast input power.

Because a magnetic ballast is a type of inductor, its power factor is directly related to the phase displacement between the current and voltage waveforms. The current waveform lags behind the voltage waveform, reducing the amount of power available to produce work. Capacitors added to magnetic ballasts help to bring the current and the voltage into phase with each other, increasing the power factor. Electronic ballasts do not experience phase displacement, but they can draw current in short bursts rather than smoothly, which creates distortions in the current waveform. Input current distortion cannot be corrected by the addition of a capacitor. Magnetic ballasts can have waveform distortions as well, but these distortions are far less severe than those of electronic ballasts with low power factors.

Root-Mean-Square (rms)

Root-mean-square is the effective value of a periodic quantity such as an alternating current or voltage wave. It is calculated by averaging the squared values of the amplitude over one period and taking the square root of that average.

Total harmonic distortion (THD). The degree to which the main current wave (called the *fundamental*) is distorted by one or more harmonic waves is referred to as total harmonic distortion. THD is measured as a percentage, with a higher THD indicating more harmonics and a greater distortion of the wave shape. A distorted current waveform distorts the voltage in the electrical distribution system, leading to reduced power factor in the ballast and possible interference with the operation of other equipment. Distortions can also increase the current on the neutral line of a building's power system, creating a potential fire hazard. Manufacturers typically do not list THD percentages for their magnetic ballasts, though a generally accepted range is from 12 to 25%. For high power factor electronic ballasts, manufacturer-claimed THD levels are 20% or less, with some less than 10%.

Electromagnetic interference (EMI). Electronic and electrical devices generate electrical noise that is transmitted either through the air or through the power supply wiring. The U.S. Federal Communications Commission (FCC) regulates EMI levels generated by high frequency devices, including high frequency lamp ballasts. NLPIP did not measure EMI levels for this issue of *Specifier Reports*.

For more information about power, see NLPIP's *Lighting Answers: Power Quality,* 1995.

Starting and Operating Temperatures

MH lamps can start and operate in a wide range of ambient temperatures. However, ballast manufacturers generally will give a minimum starting ambient temperature, usually –22°F (–30°C). For safety reasons, the Underwriters Laboratories (UL) specifies a maximum ballast case temperature of 194°F (90°C) (UL 1029-1994). For optimal system performance, ballast manufacturers may rate their products with a maximum case temperature of less than 194°F (90°C). Some manufacturers also specify two different maximum temperatures with two different warranty periods.

Fuse Rating

A ballast's fuse is designed to remove the ballast from the power line in the case of a ballast failure. A fuse cannot keep a ballast from failing, but it can prevent fire or damage caused by overloaded or shorted circuits. Fuse ratings indicate the current capacity at which a fuse can safely interrupt the flowing current. For an HID ballast, the fuse rating is typically two to three times the maximum current that the ballast will draw during normal operation. For magnetic ballasts, a fuse must be added to the circuit. For electronic ballasts, in most cases the ballast is fused internally.

Physical Characteristics

Dimensions and Weight

Magnetic ballasts are generally larger and heavier than electronic ballasts because they operate at low frequencies and have larger metal cores. Their size is variable because of the number of components that may be added on, including capacitors, ignitors, and various types of bracketing. The smaller size of electronic ballasts makes them ideal for downlighting and track lighting applications, where low-wattage lamps are common. The weight of magnetic ballasts in this report ranges from 1.6 to 16.0 pounds (lb) (0.73 to 7.26 kg), and electronic ballasts range from 0.4 lb to 3.5 lb (0.18 to 1.59 kg).

Noise

Magnetic ballasts generate noise from vibrations of the core, which cannot be completely eliminated. Electronic ballasts are less noisy because they are made of different materials than magnetic ballasts. Ballast noise can increase or decrease with temperature, luminaire design, mounting method, electrical connections, and space acoustics. Because sound standards do not exist for HID ballasts, care should be taken to install ballasts in a manner that will minimize noise. Despite the lack of noise standards for HID ballasts, some manufacturers provide sound ratings (A, B, C, and D) for their HID ballasts, similar to those provided for fluorescent lamp ballasts. An "A" rated ballast makes the least noise, while a "D" rated ballast is the loudest. All electronic ballasts are "A" rated.

Lamp-Ballast Interactions

Lamp Regulation

Ballasts are designed to stabilize lamp operation, and subsequently light output and color, through current and, in some cases, power regulation. Lamp power, or wattage, varies with fluctuations in input voltage and lamp voltage. For MH lamps, ANSI specifies that the lamp operating power for a ballast operating at rated input voltage be within ±5% of the rated lamp power (ANSI C78.43-2004; ANSI C82.4-2002). Ballast manufacturers provide regulation percentages for input voltage and lamp power.

In terms of input voltage, for reactor and HX ballasts, lamp power varies approximately 2% for each 1% change in input voltage. For CWA ballasts, lamp power variation is approximately equal to input voltage variation. Modern power systems regulate input voltage to within ±5%; however, older systems can have voltage variations of up to ±10%. Specifiers should consider the voltage variances found on the power system when selecting a ballast.

Manufacturers claim that electronic ballasts are designed to minimize both input and lamp voltage fluctuations to keep the lamp operating at its rated power.

Lamp Frequency and Acoustic Resonance

Proper lamp operating frequency is critical to maintaining the life of MH lamps. When MH lamps operate at high frequencies, acoustic resonance occurs. At frequencies above 4 kHz, standing pressure sound waves (acoustic resonances) build inside the lamp's arc tube, which can lead to visible distortions and instability of the electrical discharge, light flickering, decreased lamp life, and possible cracking of the tube. Cracking occurs when the arc touches the wall of the tube, often leading to a non-passive failure of the lamp.

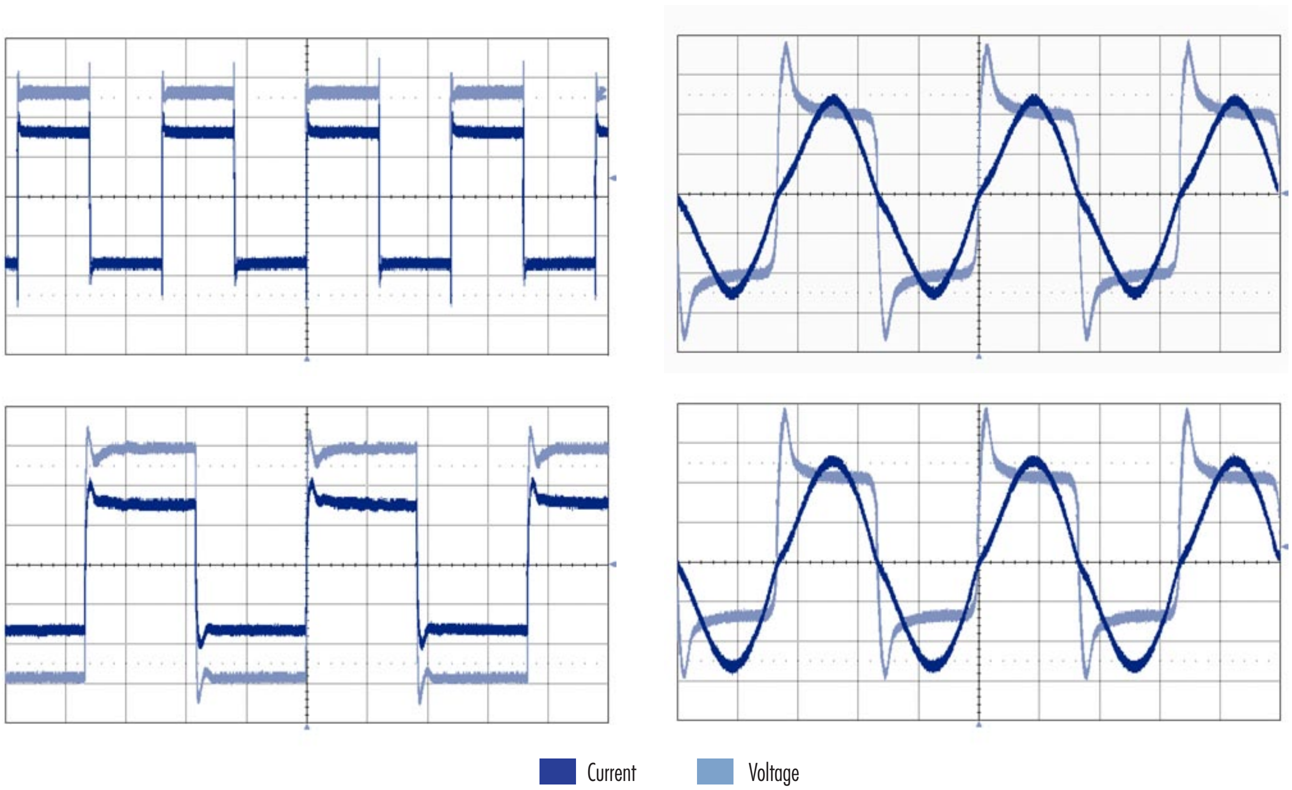
Acoustic resonances are driven by the size and geometry of the arc tube. If the lamp operating frequency delivered by the ballast matches closely with the resonant frequency, pressure waves will travel through the lamp. These waves reflect off the tube wall, resulting in standing waves with large amplitudes. Strong variations in gas pressure distort the arc discharge path, creating visible twists and bends in the arc discharge that may touch the tube wall. Smaller lamp geometries, such as those found with low-wattage lamps, require either low frequencies or very high frequencies (above 300 kHz) to avoid acoustic resonance. However, very high frequencies can lead to EMI, radio frequency interference, and FCC issues. Therefore, most low-wattage lamps are operated at low frequencies (100–400 Hz).

Wave Shape and Lamp Current Crest Factor

The ballast circuitry design primarily determines the shape of the lamp current waveform, and the characteristics of the lamp then determine the lamp voltage waveform. A magnetic ballast creates a sinusoidal waveform, whereas an electronic ballast can create any shape of waveform. Nearly all low frequency electronic ballasts for MH lamps use an approximately square-shaped waveform, which is known to help maintain lamp life. The square wave was designed to help straighten the arc discharge of a lamp operating in a horizontal position, or any position in which the arc discharge bows toward the bulb wall because of the convection of heat.

Current waveforms often exhibit spikes, or distortions, because of periodic fluctuations in lamp current (Figure 6). Lamp current crest factor (CCF) is a measure of the waveform distortion supplied to the lamp by the ballast. Crest factor plays an important role in lumen maintenance and lamp life. High CCFs can damage lamp electrodes and reduce lamp life. CCF is defined as the ratio of the peak lamp current to the root-mean-square value of the lamp current. CCF ranges from 1.0 to infinity. For low-wattage MH lamps, ANSI specifies a maximum CCF of 1.8 (ANSI C78.43-2004).

Figure 6. Waveform Distortions



Square current waveforms of two electronic ballasts (left) and sinusoidal current waveforms of two magnetic ballasts (right).

An ideal sinusoidal waveform (and therefore, a magnetic ballast) cannot have a CCF below 1.4. Most magnetic ballasts have CCFs ranging from 1.5 to 1.7. The square current waveform of an electronic ballast allows the lamp CCF to approach 1.0.

Performance Evaluations

This NLPIP report presents photometric and electrical performance data for selected low-wattage metal halide lamps, ballasts, and lamp-ballast combinations. The goal of NLPIP's evaluation was to verify manufacturer-supplied data against NLPIP-tested data and determine how the variability of lamp and ballast characteristics affects overall performance. Manufacturer-supplied data for available products at the time of this report are presented in Tables 1–5. The NLPIP-tested performance evaluations are divided into three sections: lamps, ballasts, and lamp-ballast systems. The NLPIP-tested data are presented in Tables 6–10. Manufacturer contact information is presented in Table 11.

Lamp Evaluation

NLPIP tested 70-watt ceramic and quartz MH lamps from seven manufacturers. Of the nine lamp models selected, three were ceramic and six were quartz. NLPIP selected these models as representative of the most common 70-watt MH lamps on the market in 2004, when testing began. NLPIP purchased multiple samples of each lamp model on the open market from local suppliers and through the Internet.

Evaluation Methods

NLPIP divided the lamp testing and evaluation into two parts. In the first part, NLPIP measured or calculated the photometric and electrical characteristics of the lamp models after a seasoning period of 100 hours (h). NLPIP measured the spectral power distribution of the lamps and calculated light output, lamp efficacy, CCT, CRI, chromaticity coordinates, and color variation. NLPIP also measured lamp power, lamp voltage, lamp current, and warm-up time. All of the lamps evaluated at 100 h were aged on magnetic ballasts.

After the 100-hour measurements, NLPIP aged all of the lamps to 40% of their manufacturer-rated life. Lamps reached 40% of their rated lives at 4000, 4800, or 6000 h, depending on the rated life of the individual lamp model. Again, all lamps were aged on magnetic ballasts, but additional samples of the three ceramic lamp models were aged on electronic ballasts to evaluate any differences in performance among lamps operated on electronic and magnetic ballasts. (Lamps aged on electronic ballasts were not included in the table of 100-hour performance data because the ballast type would not create any significant difference in initial lamp performance.) After aging the lamps, NLPIP measured their photometric performance and calculated light output, lumen maintenance, chromaticity coordinates, and color shift.

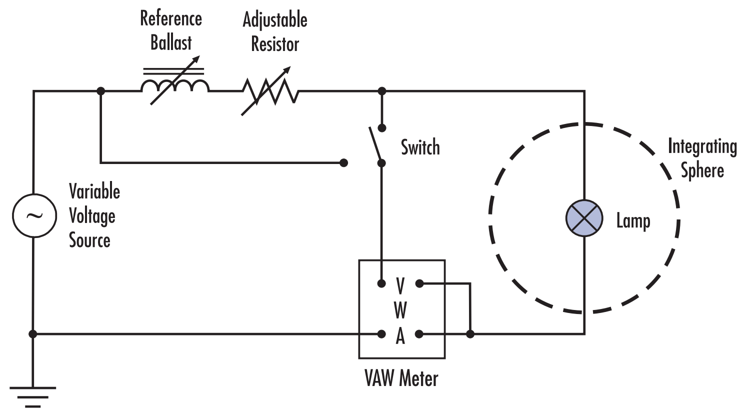
NLPIP Testing Procedure

Five samples of each lamp model were aged and measured. All lamps were aged in a vertical base-up operating position at the Lighting Research Center's (LRC) laboratory in Watervliet, New York. All lamps were measured with an integrating sphere system located at the LRC's Troy, New York, laboratory.

Each test lamp was installed into the sphere system one at a time for photometric measurements. The electrical measurements were taken at the same time using the circuit shown in Figure 7, following the requirements described in IES standard LM-51-00, "Electrical and Photometric Measurements of HID Lamps," and ANSI standard C78.389-2004, "High Intensity Discharge—Methods of Measuring Characteristics."

NLPIP used a reference ballast, a Warner Power variable linear reactor (model number 24688), to operate the test lamp during the measurement of the lamp's photometric and electrical characteristics. Prior to taking lamp measurements, the reference ballast and its associated adjustable resistor were set to provide the required current and power factor, per ANSI standards C82.5-1990, “Reference Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps,” and C78.43-2004, “Single-ended Metal Halide Lamps.”

Figure 7. Circuit Schematic of NLPIP Lamp-testing Apparatus



Color Calculations

Color variation calculation. For each lamp model, the x, y chromaticity coordinates of each lamp sample were plotted in CIE 1931 color space and average x, y coordinates for a model were obtained. Average color variation at 100 h was determined by calculating and averaging the number of MacAdam ellipse steps from the average coordinates of a lamp model to the coordinates of each lamp sample.

Color shift calculation. NLPIP measured the amount of color shift from 100 h to 40% of rated life. The average x, y coordinates of a lamp model at 100 h and at 40% of rated life were plotted in color space, and the number of MacAdam ellipse steps between the two was calculated.

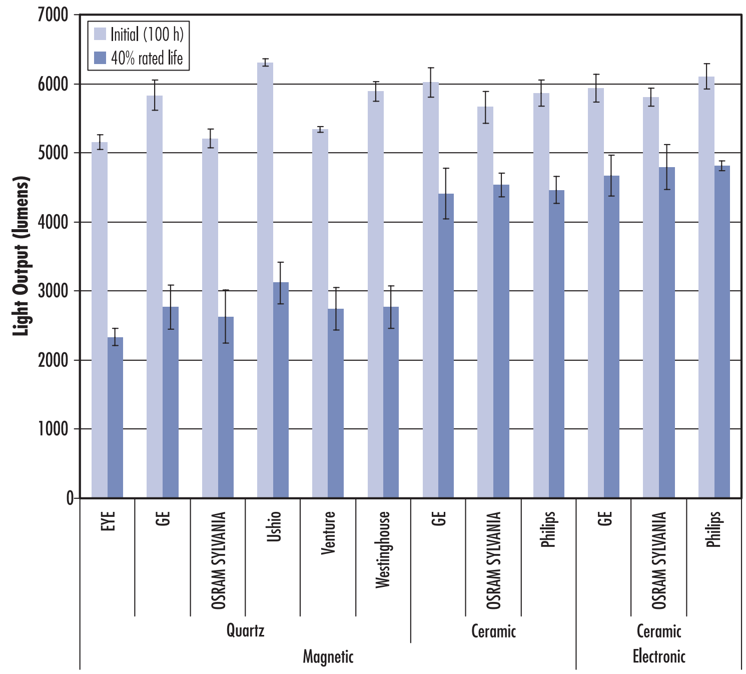
Results

NLPIP-tested data at 100 h are presented in Table 6, and NLPIP-tested data at 40% of rated life are presented in Table 7. The data represent the average measurement of five samples for each lamp model. For comparison purposes, each table includes manufacturer-supplied data for initial light output, mean light output, lumen maintenance, CCT, and CRI.

Initial light output, mean light output, and lumen maintenance. NLPIP found that the initial light output at 100 h across lamp models measured from 5158 to 6305 lm. Light output differences between ceramic and quartz lamps did not differ considerably during this initial period. The measured light output of quartz lamps at 100 h was consistent with or higher than manufacturers’ claims. However, NLPIP-measured light output values of ceramic lamps were approximately 4% lower than claimed. While ceramic lamps are thought to have higher initial light output values than quartz lamps, NLPIP found this was not always the case. Several NLPIP-tested quartz lamp models had higher average values of initial light output than those of certain ceramic lamp models.

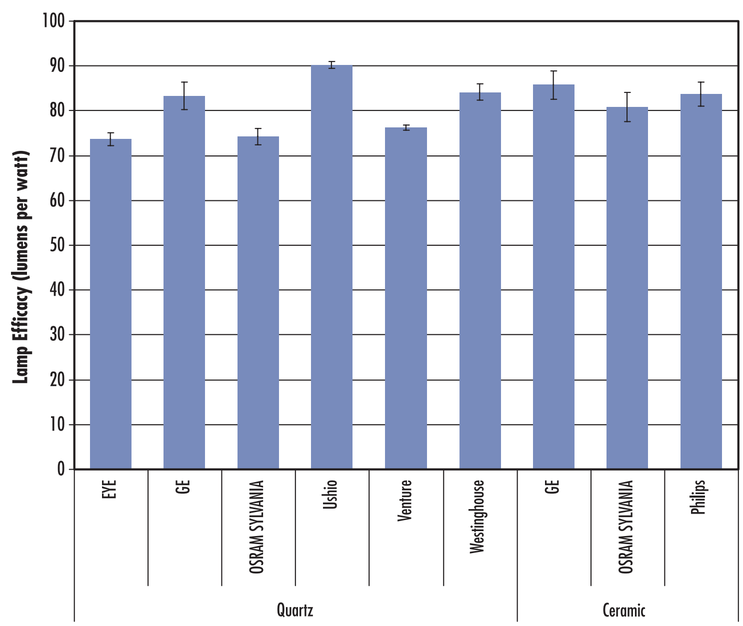
At 40% of rated life, mean light output measurements across lamp models ranged from 2331 to 4824 lm. The ceramic MH lamps tested exhibited much higher lumen maintenance values (73 to 82%) than the quartz lamps tested (45 to 51%). The ceramic lamps aged on electronic ballasts had slightly, although not significantly, higher lumen maintenance values than those aged on magnetic ballasts. Overall, the measured lumen maintenances of the ceramic lamps were all higher than rated by the manufacturers. For quartz lamps, the measured values were 13 to 30 percentage points lower than the claimed values. Figure 8 shows initial light output and mean light output at 40% of rated life for each lamp model, sorted by lamp type and ballast type.

Figure 8. Initial and Mean Light Output



Lamp efficacy. At 100 h, the lamp efficacy of the quartz lamps tested ranged from 74 to 90 LPW, while the efficacy of the ceramic lamps ranged from 81 to 86 LPW. Figure 9 shows the average range of lamp efficacies, plus error bars, for the samples tested. On average, NLPIP did not find a major difference in lamp efficacy between the ceramic and quartz lamps tested.

Figure 9. Lamp Efficacy at 100 h



Arc Tube Blackening

The figure below shows samples of the two types of lamp tested, quartz and ceramic, from the same manufacturer. NLPIP photographed the ten tested samples after aging them to 40% of rated life. Both types of lamp were aged on magnetic ballasts. At 40% of rated life, the quartz lamp had a lumen maintenance of approximately 50%. The quartz lamp experienced considerable blackening of the arc tube, which led to the high depreciation of light output. In comparison, the ceramic lamp experienced much less blackening of the arc tube. This lamp at 40% of rated life had a lumen maintenance of approximately 80%.

Quartz lamp samples from Manufacturer A—50.5% lumen maintenance

New lamp   Lamps aged to 40% rated life

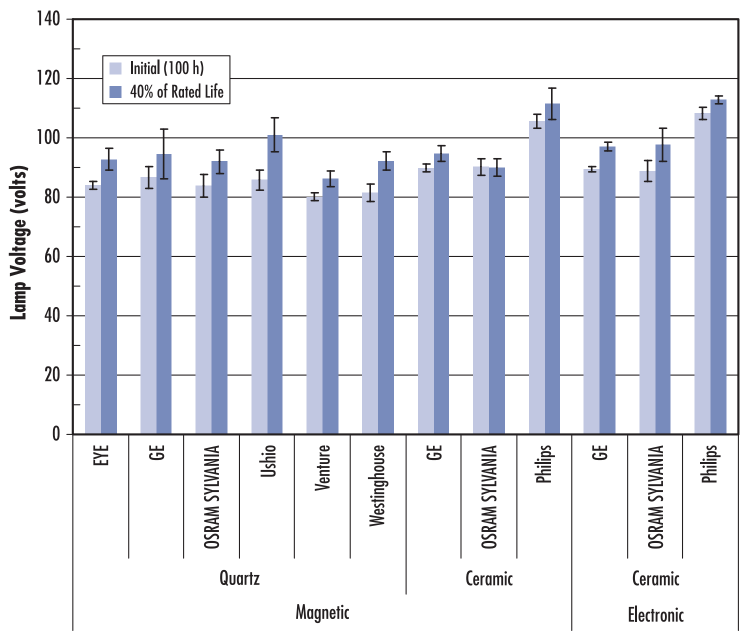
Ceramic lamp samples from Manufacturer A—80.3% lumen maintenance

New lamp   Lamps aged to 40% rated life

Lamp voltage and lamp current. The lamp voltages measured across lamp models at 100 h ranged from 80 to 106 V, with ceramic lamps exhibiting higher voltages than quartz lamps. Lamp current ranged from 0.793 to 0.968 A. The Philips lamp had a much higher lamp voltage than the other models tested, measuring 106 V, which brought down its lamp current to 0.793 A. The higher voltage has an impact on system performance, including higher light output and higher lamp power, as shown in Table 9.

Figure 10 shows lamp voltage at 100 h and at 40% of rated life for the tested lamps, grouped by the lamp type and by the ballast type used for aging the lamp. The average voltage rise over time for all lamps was 8%, with a maximum rise of 18% for the Ushio lamp and a minimum rise of 0% for the OSRAM SYLVANIA ceramic lamp aged on a magnetic ballast. The average voltage rise was higher for the quartz lamps (11%) than for the ceramic lamps (6%). Average voltage rise for ceramic lamps was higher on electronic ballasts (8%) than on magnetic ballasts (4%).

Figure 10. Voltage Rise



Color. NLPIP measured CCT and CRI at 100 h. The CCT of the lamps ranged from 2880 to 3853 K, with little difference between the average ceramic lamp and the average quartz lamp. Ceramic lamps ranged from 2972 to 3074 K; quartz lamps had a larger CCT range, from 2880 to 3853 K. The CCT values of the ceramic lamps were consistent with manufacturers' claims, with differences between measured and rated values being –0.9 to +2.4%. For quartz lamps, differences between measured and rated CCT were –4.1 to +6.2%.

NLPIP-measured CRI ranged from 54 to 92, with the ceramic lamps showing higher CRI values (82 and 92). The OSRAM SYLVANIA ceramic lamp had a measured CRI of 92, 10 points higher than the GE and Philips ceramic lamps. Quartz lamps had CRI values of 54 to 74. Measured CRI was considerably different than manufacturer-claimed CRI in one instance: Venture's quartz lamp was measured with a CRI 11 points lower than the manufacturer claimed.

Figure 11 illustrates a new method devised by NLPIP to represent values of CRI, full-spectrum color index (FSCI), gamut area (GA), and lamp efficacy for various electric light sources. These vector plots provide a visual method of comparing the efficacy and color properties of a group of lamps. For a selected light source, the three color-rendering values are shown as dark blue vectors, while the lamp efficacy value is shown as a light blue vector. To make GA more directly comparable to CRI and FSCI, GA values have been scaled so that an equal energy spectrum has a GA value of 100. Electric light sources cannot have CRI or FSCI values greater than 100, but both GA and lamp efficacy values can exceed 100. For more information about this method, see NLPIP's *Lighting Answers: Light Sources and Color,* 2004.

Shown in Figure 11 are four lamps representing the range of color and efficacy differences found among the lamps tested. These lamps show an FSCI range from 70 to 81, and GA range from 52 to 63.

Figure 11. Color-rendering Properties and Lamp Efficacy

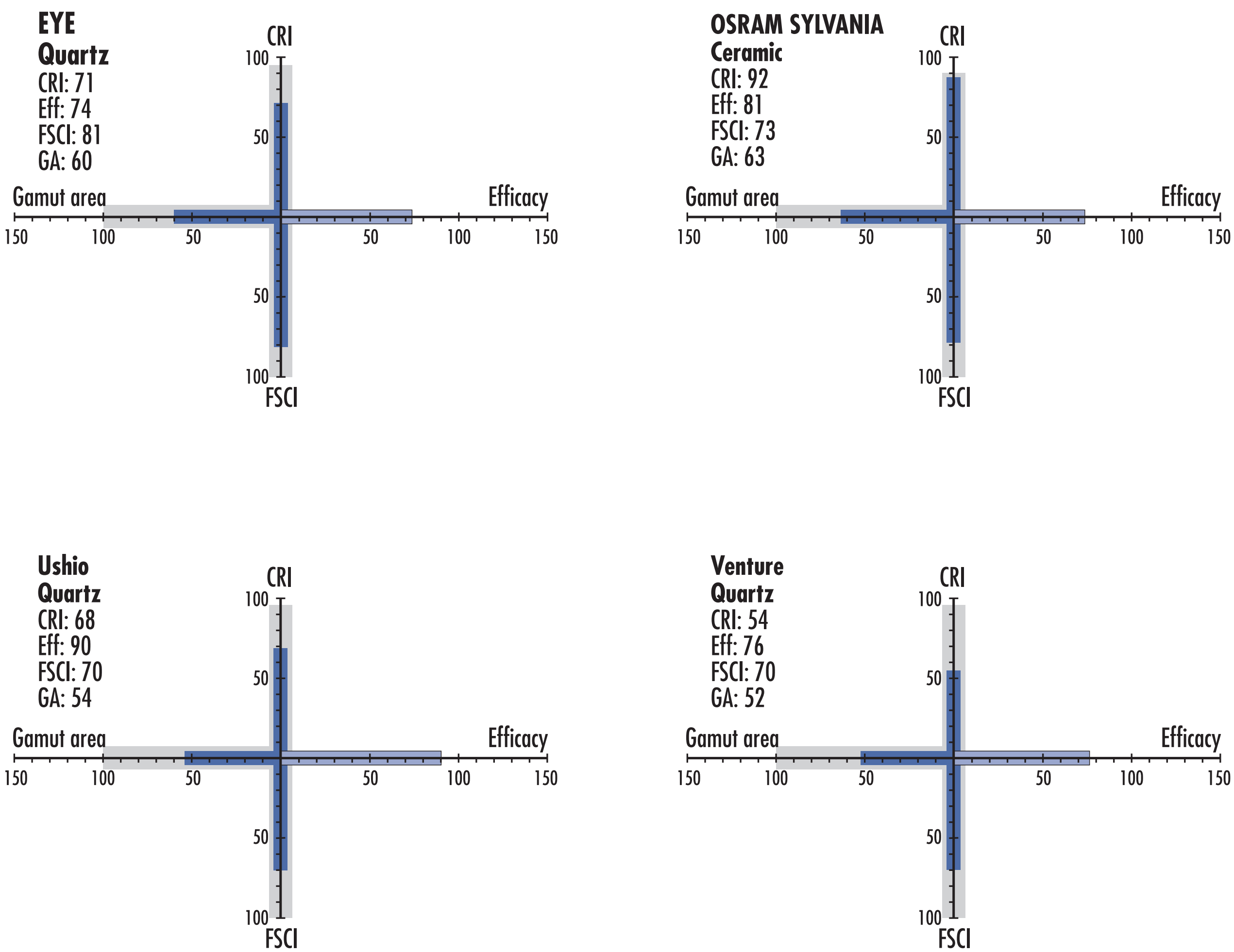


Figure 12 charts the average color variation and standard deviation at 100 h for each lamp model. The color variation among the ceramic lamp models was small overall, 1.2 to 2.7 MacAdam ellipse steps. Color variation among quartz lamp models ranged from 1.3 to 6.4 MacAdam ellipse steps. Within the quartz lamp group, four lamp models had color variations of less than four MacAdam ellipse steps.

Figure 12. Color Variation at 100 h

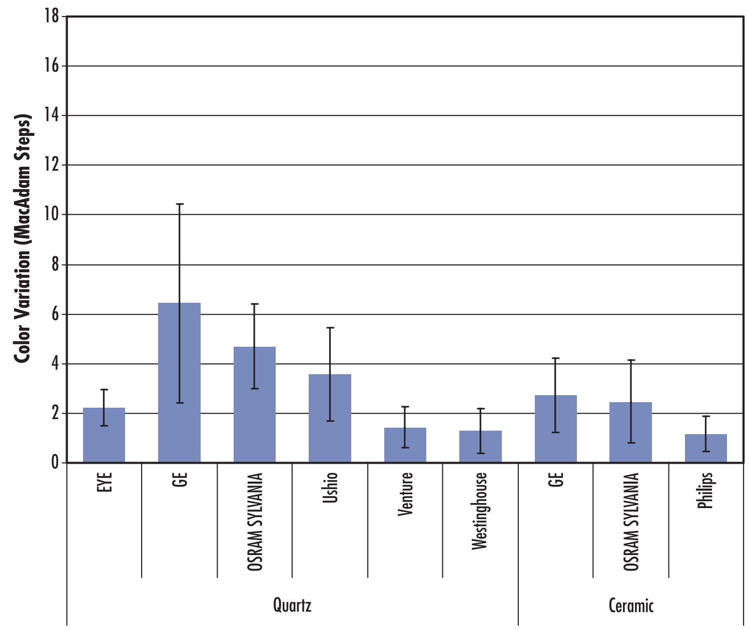
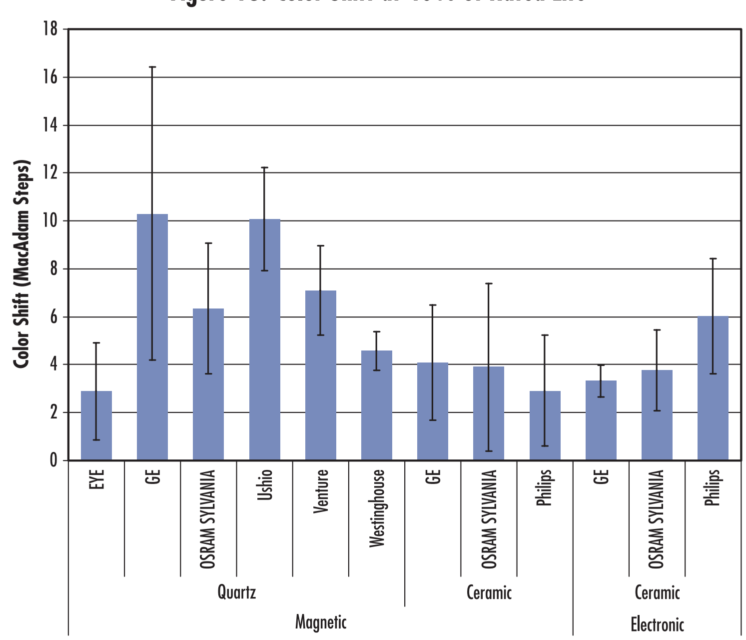


Figure 13 shows that the average color shift for quartz lamps at 40% of rated life ranged from 2.9 to 10.3 MacAdam ellipse steps. The color shift over time for ceramic lamps was smaller than for quartz lamps, 3.3 to 6.0 MacAdam ellipse steps. Samples of the GE quartz lamp showed the greatest variations in color shift, denoted by the error bar.

Figure 13. Color Shift at 40% of Rated Life



Warm-up time. The time needed for each lamp to warm up varied widely, from 34.5 to 82.4 seconds (s). The majority of lamps had warm-up times between 52 and 62 s. The warm-up time for ceramic lamps was longer on average, 59 to 82 s. Quartz lamps had warm-up times between 34 and 63 s.

Differences in Lamps from the Same Manufacturer

To suit different lighting needs and preferences, lamp manufacturers often produce the same lamp in two or more color temperatures. However, the differences between these lamp models may be more than just CCT.

NLPIP evaluated two ceramic lamps from the same manufacturer, a 3000 K model and a 4000 K model. The manufacturer reports these lamps as having the same lamp power, bulb type, bulb finish, operating position, and enclosure requirements. Their initial light output values are nearly identical. The 3000 K model, however, is rated as having a higher mean light output. The 4000 K model is reported as having a longer rated life and a higher CRI.

NLPIP tested the performance of these two lamp models. Five samples of each lamp model were aged on electronic ballasts. The lamps were measured on a reference ballast, as shown in Figure 7, at 100 h and again at 40% of the manufacturer-rated life. The table below shows the manufacturer-supplied and NLPIP-tested performance data for these lamps.

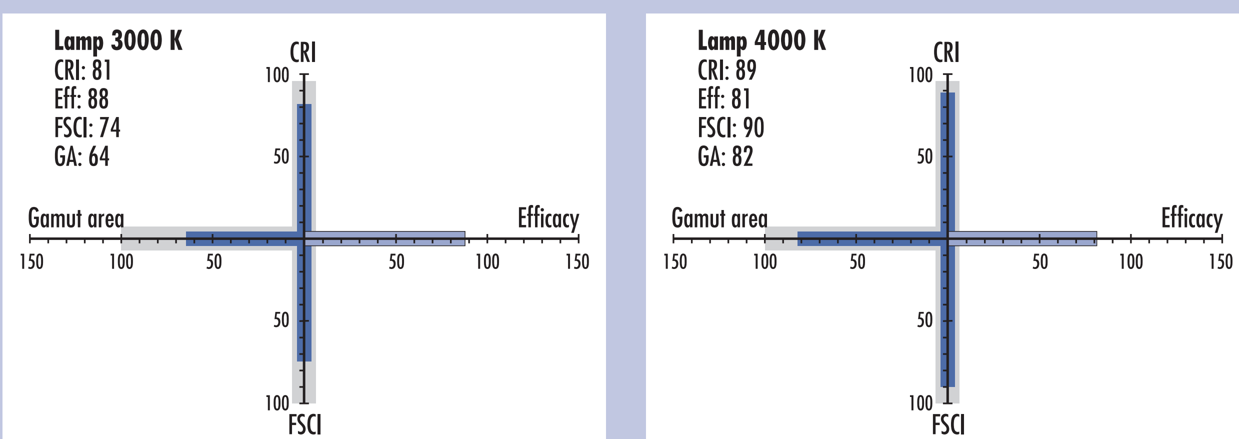
NLPIP found differences between its performance data and that reported by the manufacturer. At 100 h, the initial light output of both lamp models were lower than rated, with the 4000 K model being significantly lower; however, the mean light output measured significantly higher than rated for both lamps. Calculations of the lumen maintenance from the rated initial and mean light output values indicated that the 3000 K lamp should have a lumen maintenance of 74%, while the 4000 K lamp should have a lumen maintenance of 70%. NLPIP found that both lamps had higher lumen maintenances than reported, 78% for the 3000 K lamp and 82% for the 4000 K lamp. The lamp efficacy was higher for the 3000 K lamp.

These lamps showed color differences besides CCT. The rated CRI was different for each lamp, and measured lower than rated for both lamps. The color variation at 100 h and the color shift from 100 h to 40% of rated life for the 3000 K lamp were greater than for the 4000 K lamp. The figure below shows the relationship between lamp efficacy and three color-rendering properties (CRI, FSCI, and GA) for the two lamps (see discussion on pp. 23–24 for more information). The color-rendering values for the 3000 K lamp were lower than those for the 4000 K lamp. FSCI for the two lamps ranged from 74 to 90, and GA ranged from 64 to 82.

Manufacturer-rated and NLPIP-tested performance of two 70 W ceramic lamps from the same manufacturer

Lamp Model (CCT)	Bulb Shape	Bulb Finish	Operating Position	Luminaire Type	Rated Life (h)	Lamp Efficacy (LPW)	Initial Light Output (lm)		Mean Light Output (lm)		Measured CCT	CRI		Color Variation (MacAdam ellipse steps)	Color Shift (MacAdam ellipse steps)
							Rated	Measured	Rated	Measured		Rated	Measured		
3000 K	ED-17	Clear	Universal	Enclosed	16000	87.9	6200	6160	4585	4824	3063	85	81	2.00	6.00
4000 K	ED-17	Clear	Universal	Enclosed	20000	81.4	5900	5706	4130	4653	4004	92	89	0.89	1.45

Color-rendering Properties and Lamp Efficacy



Ballast Evaluation

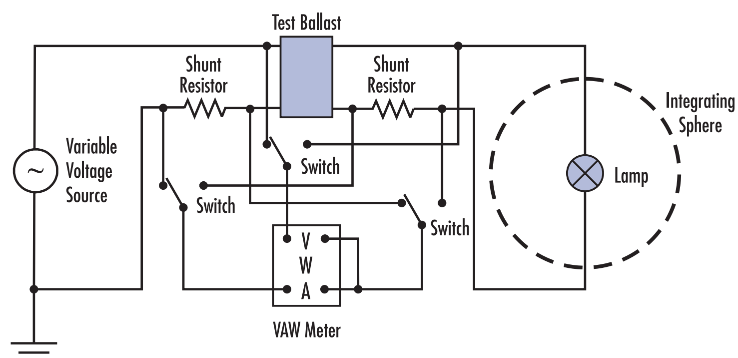
NLPIP tested 13 ballast models designed for low-wattage MH lamps. NLPIP selected eight electronic ballasts and five magnetic ballasts from a total of 11 manufacturers, representing common models at the time testing began in 2004. Three of the models selected were listed as the recommended ballasts by the manufacturers of three of the lamp models tested. NLPIP purchased multiple samples of each ballast model on the open market from local suppliers and through the Internet.

NLPIP Testing Procedure

NLPIP evaluated the variability among the ballasts by measuring or calculating the following characteristics: light output, lamp efficacy, lamp power, lamp voltage, system power factor, lamp frequency, lamp CCF, input current THD, system efficacy, input power, input voltage, input current, ballast efficiency, CCT, CRI, chromaticity coordinates, and warm-up time.

NLPIP tested each ballast with a single 70-watt GE ceramic lamp (CMH70/U/830/MED). Three samples of each ballast model were measured in the same sphere system used for the lamp measurements. The GE lamp was installed in the sphere system, and a test ballast was connected to the circuit, as shown in Figure 14. NLPIP tested the ballasts following ANSI standard C82.6-1985, "Ballasts for High-Intensity-Discharge Lamps—Methods of Measurement," and IES standard LM-51-00, "Electrical and Photometric Measurements of HID Lamps."

Figure 14. Circuit Schematic of NLPIP Ballast-testing Apparatus



Results

NLPIP-tested data for the ballasts are presented in Table 8. The data represent the average measurement of three samples for each ballast model. For comparison purposes, the table includes manufacturer-supplied data for system power factor, lamp frequency, lamp CCF, input current THD, and input power.

Light output and lamp efficacy. Measurements of light output ranged from 4995 to 5867 lm for magnetic ballasts. Little difference in average light output was found between magnetic and electronic ballasts, with electronic ballasts showing light output measurements from 5194 to 5851 lm. Lamp efficacy values were fairly consistent for both types of ballasts, between 78 and 80 LPW. However, the electronic ballasts showed a 2.6% higher lamp efficacy, a significant difference.

Lamp power and voltage. Lamp power values for the test lamp rated at 70 W fell between 64 and 75 W for magnetic ballasts and 65 to 73 W for electronic ballasts. Both categories of ballasts exhibited lamp operating powers beyond the ±5% specified by ANSI, specifically the PowerSelect electronic ballast (65.4 W or –6.6%), the Advance magnetic ballast (64 W or –8.6%), and the Robertson magnetic ballast (74.8 W or +6.9%). NLPIP measured lamp voltages from 87 to 99 V. Overall, lamp voltages for electronic ballasts were approximately 8% lower than those for magnetic ballasts.

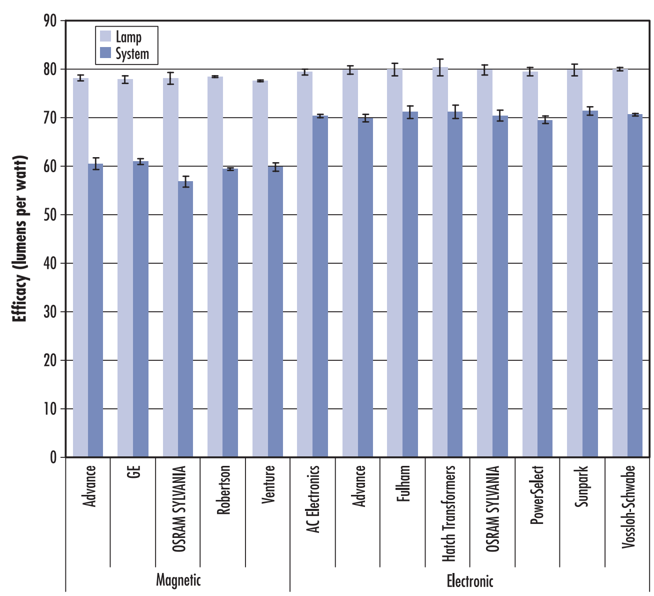
Lamp frequency. NLPIP measured the lamp frequency of the electronic ballasts only. Lamp frequencies ranged from 86 to 211 Hz and were approximately square waves.

Lamp CCF. Lamp CCFs for magnetic ballasts were consistent, ranging from 1.57 to 1.60, below the ANSI maximum of 1.8. Electronic ballasts showed lamp CCFs from 1.36 to 2.32, with three ballasts falling above the ANSI maximum of 1.8 and two bordering on 1.8. All electronic ballast models, except the Sunpark, had crest factors measuring above the manufacturer-rated values. Although the electronic ballasts used square waves, spikes occurred on the rising edge of each current waveform (similar to those illustrated in Figure 6), leading to a higher maximum current. Since CCF is the maximum current divided by the rms current, this leads to a higher CCF. Ballasts with high CCFs may reduce lamp life.

System efficacy. The overall system efficacy ranged from 57 to 71 LPW. The electronic ballasts produced an average system efficacy of 70.6 LPW, almost 19% higher than the average magnetic ballast efficacy of 59.6 LPW.

Figure 15 compares system efficacy with lamp efficacy for the 13 systems tested. While lamp efficacy values were quite consistent across ballast types, system efficacy was higher on electronic ballasts. This indicates that the ballast is the primary component affecting the energy use of the lamp-ballast system.

Figure 15. Lamp Efficacy vs. System Efficacy



All systems operated the same lamp sample.

System power quality. Across ballast models, the average system power factor ranged from 0.86 to 1.00. All electronic ballasts had high power factors at or above 0.91. On average, the electronic ballasts had system power factors that were 8% higher than those of the magnetic ballasts. All ballasts were rated by the manufacturers as having high power factors at or above 0.90. The PowerSelect electronic ballast measured 8% lower than rated, but still above the 0.90 level needed for a high power factor rating. Three of the five magnetic ballasts tested had power factors below their high power factor rating of 0.90.

Input power varied from 75 to 99 W, with electronic ballasts drawing less than 80 W on average. Electronic ballasts showed lower input power than magnetic ballasts, consistent with their higher system efficacy. All ballasts measured close to their rated values for input power, within 3%. Input voltage was maintained at 120 V for all models. Input current ranged from 0.637 to 0.849 A, with electronic ballasts showing lower input current.

Electronic ballasts had fairly low levels of THD, below 9%. Only the Sunpark ballast measured slightly higher than rated. Magnetic ballasts showed much higher levels of THD than the electronic ballasts, between 21 and 39%.

Ballast efficiency. Electronic ballasts had higher ballast efficiencies overall—an average of 16% higher than magnetic ballasts. Average ballast efficiencies ranged from 88 to 89% for electronic ballasts and 73 to 78% for magnetic ballasts.

Color. CCT ranged from 2861 to 3002 K, with magnetic ballasts showing slightly higher CCTs. The test lamp had lower CCT values on all tested ballasts than on the reference ballast (3069 K). CRI varied from 81 to 85, a sizeable difference considering that all of these measurements are for the same test lamp. The average CRI of three lamp samples at 100 h on a reference ballast was 82. CRI, FSCI, and GA measured for these ballasts did not vary more than 5% from the lamp data measured on a reference ballast.

Warm-up time. The warm-up times were considerably different across ballast models, ranging from 6 to 43 s. Electronic ballasts showed warm-up times across the entire range. Three of the five magnetic ballasts had warm-up times of approximately 42 s, with the remaining two having much shorter warm-up times.

Lamp-Ballast System Evaluation

NLPIP evaluated low-wattage MH lighting systems using the three tested ceramic lamp models (GE, OSRAM SYLVANIA, and Philips) operated on the 13 tested ballasts, for a total of 39 lamp-ballast systems.

NLPIP Testing Procedure

NLPIP tested each of the 39 lamp-ballast combinations using three samples of each system, for a total of 117 system samples tested. Three samples of each ceramic lamp model (a total of nine lamps) were used repeatedly for each ballast. NLPIP limited the number of lamp samples to minimize the variation potential among lamps. Figure 16 shows the testing matrix, which was repeated for all 13 ballasts tested.

Figure 16. Matrix of Lamp-Ballast System Testing

Lamp		Ballast
GE Sample 1	→	Ballast 1 Sample 1
GE Sample 2	→	Ballast 1 Sample 2
GE Sample 3	→	Ballast 1 Sample 3
OSRAM Sample 1	→	Ballast 1 Sample 1
OSRAM Sample 2	→	Ballast 1 Sample 2
OSRAM Sample 3	→	Ballast 1 Sample 3
Philips Sample 1	→	Ballast 1 Sample 1
Philips Sample 2	→	Ballast 1 Sample 2
Philips Sample 3	→	Ballast 1 Sample 3

For each system sample, the test lamp was installed in the sphere system, and the test ballast was connected using the same circuit design employed for ballast testing, as shown in Figure 14. NLPIP performed system testing following ANSI standard C82.6-1985, “Ballasts for High-Intensity-Discharge Lamps—Methods of Measurement,” and IES standard LM-51-00, “Electrical and Photometric Measurements of HID Lamps.”

NLPIP measured the following photometric and electrical characteristics of the lamp-ballast systems: light output, lamp efficacy, lamp power, lamp voltage, system power factor, lamp CCF, input current THD, system efficacy, input power, ballast efficiency, chromaticity coordinates, CCT, CRI, and warm-up time.

Results

NLPIP-tested data are presented in Table 9 and Table 10. Table 9 presents the data sorted by lamp model. For each characteristic, the average measurement of each lamp-ballast system is provided, along with the grand averages for all electronic ballast systems and for all magnetic ballast systems operated on a given lamp model. Table 10 presents the data sorted by ballast model. For each characteristic, the average measurement of each lamp-ballast system is provided, along with the grand average for all lamp models operated on a given ballast.

Light output. Among the three lamp models, the Philips lamp produced the highest average light output, 5912 lm on electronic ballasts and 6339 lm on magnetic ballasts. These measurements were slightly-to-considerably higher than the light output of this lamp measured on the reference ballast (5809 lm). The average light output values for the GE (5812 lm) and OSRAM SYLVANIA (5796 lm) lamp models when operated on electronic ballasts were near those measured on the reference ballast (GE 5721 lm; OSRAM SYLVANIA 5634 lm). The average light output values of the lamps operated on the magnetic ballasts (GE 5548 lm; OSRAM SYLVANIA 5316 lm) were lower than those measured on the reference ballast.

The Philips lamp produced approximately 400 lm more on magnetic ballasts than it did on electronic ballasts, The GE and OSRAM SYLVANIA lamps produced approximately 300–500 lm more on the electronic ballasts than on the magnetic ballasts.

Lamp efficacy. Lamp efficacy was approximately the same for the three lamp models and for the two ballast types, ranging from 81 to 84 LPW. The electronic ballast systems showed slightly higher average lamp efficacy at 84 LPW, compared with magnetic ballasts at 82 LPW.

Lamp power. Lamp power values for electronic and magnetic ballast systems were similar, with grand averages ranging from 65 to 73 W for electronic ballasts and 64 to 75 W for magnetic ballasts. The Philips lamp had a lamp power 1 to 2% higher than the other two lamp models when operated on electronic ballasts, but 12 to 18% higher than the other lamp models when operated on magnetic ballasts.

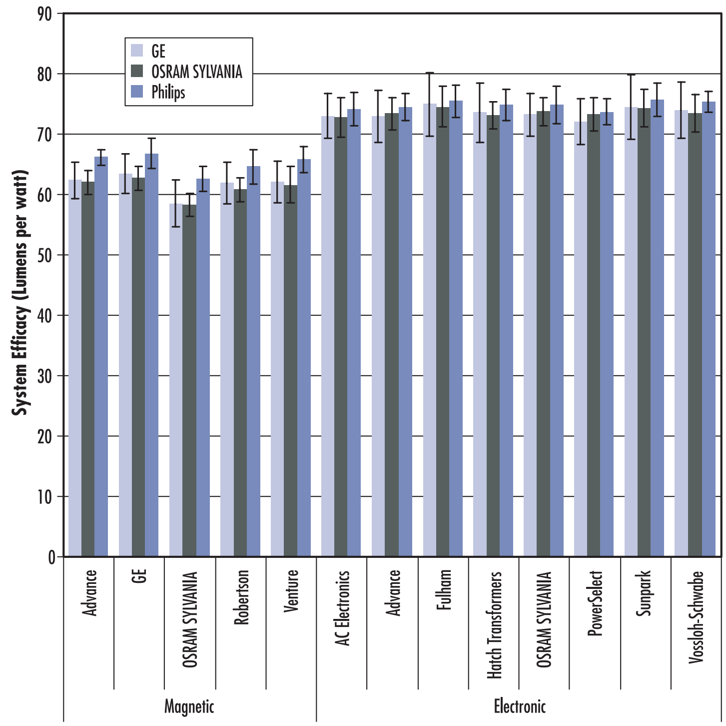
Lamp voltage. Lamp voltage was 6 to 8% higher for all lamp models operated on magnetic ballast systems when compared with electronic ballast systems. The Philips lamp showed the highest lamp voltage. When operated on an electronic ballast, its voltage was 17 to 24% higher than GE and OSRAM SYLVANIA lamps operated on electronic ballasts (Philips 98.9 V; GE 84.7 V; OSRAM SYLVANIA 79.8 V). When operated on a magnetic ballast, its voltage was 20 to 26% higher than the other two lamp models (Philips 107.2 V; GE 89.6 V; OSRAM SYLVANIA 84.8 V).

Lamp CCF. Average current crest factors for the three lamp models operated on magnetic ballasts were all below the recommended maximum value of 1.8.

For electronic ballast systems, the Philips lamp had an average CCF of 1.9. Two electronic ballast systems (AC Electronics and Fulham) had average CCF values above 2.2. These results are similar to those found during ballast testing (p. 28). Systems with magnetic ballasts generally had lower CCF values of approximately 1.6.

System efficacy. Figure 17 shows the average system efficacy for the 39 systems tested. The systems using electronic ballasts had higher system efficacies (73 to 75 LPW) than those using magnetic ballasts (60 to 64 LPW). These system efficacies, calculated from three system samples, are higher than those charted in Figure 15, which shows system efficacy for only one lamp sample. The higher system efficacies in Figure 17 are likely due to calculating averages using additional lamp samples with higher individual lamp efficacies.

Figure 17. System Efficacy



System power quality. The three lamps had nearly identical average input power values on electronic ballasts (79 W). On magnetic ballasts, the Philips lamp had the highest input power at 97 W—8 to 12% higher than the input power of the OSRAM SYLVANIA (87 W) and GE lamps (90 W) operated on magnetic ballasts. Systems with electronic ballasts had lower input power values (74 to 84 W) than those with magnetic ballasts (82 to 99 W).

The three lamp models had nearly identical average values for system power factor on electronic ballasts (approximately 0.99) and on magnetic ballasts (0.81 to 0.83), but the electronic ballast systems showed the highest power factor values. The electronic ballast systems had high power factors, all at or above 0.97 as a grand average. The magnetic ballast systems had grand average power factors ranging from 0.79 to 0.83.

Average THD for the three lamp models was approximately 5% when operated on electronic ballasts, and approximately 27 to 30% when operated on magnetic ballasts. The magnetic ballast systems showed considerably higher THD (20 to 33%) than electronic ballast systems, which had THD values ranging from 2 to 8%.

Ballast efficiency. For all three lamp models, the electronic ballast systems had higher ballast efficiencies (88 to 89%) than the magnetic ballast systems (75 to 79%). The ballasts operating the Philips lamp had slightly higher ballast efficiencies in both cases, compared with operating the other two lamp models. This was likely due to the higher voltage, and therefore lower current, of the Philips lamp, resulting in fewer ballast losses. Systems with electronic ballasts had average ballast efficiencies ranging from 88 to 90%, and systems running magnetic ballasts had average ballast efficiencies in the range of 73 to 78%.

Color. CCT values were similar for the three lamps, all in the 3000 K range, with magnetic ballasts producing slightly higher CCTs on all three lamps. The systems operating the OSRAM SYLVANIA lamp had an average CCT value close to that found on the reference ballast. The GE and Philips lamps had slightly lower CCT values (approximately 50 to 200 K lower) on the tested systems than on the reference ballast.

CRI, FSCI, and GA measured for these systems did not vary more than 5% from the lamp data measured on a reference ballast.

Warm-up time. Of the three lamp models, the Philips lamp had the shortest warm-up times for both electronic (24 s) and magnetic ballast systems (41 s). The OSRAM SYLVANIA lamp had the longest warm-up times for both types of ballasts (63 s for electronic and 78 s for magnetic). The GE lamp fell in between (36 s for electronic and 54 s for magnetic). The magnetic ballast systems had similar warm-up times between 51 and 61 s, whereas the electronic ballast systems ranged between 15 and 58 s.

Conclusions

The similarities in initial light output and lamp efficacy found among low-wattage MH lamps mean that in most instances, a lighting specifier can select either a quartz lamp or a ceramic lamp for a given application and not see a great difference in performance in these areas. Ceramic lamps are generally thought to have higher initial light output than quartz lamps, but at least for 70-watt lamps, NLPIP did not find this to be the case. The ceramic lamps tested were rated with nearly equivalent initial light output values, and the quartz lamps were rated with initial light output values similar to or below that of the ceramic lamps. In all instances, the measured initial light output for ceramic lamps was lower than manufacturers' claims. For quartz lamps, the initial light output of some models measured higher than rated, and in some cases, higher than that of ceramic lamps.

Although the ceramic lamps tested did not provide higher initial light output than quartz lamps, they did show higher mean light output as a consequence of having better lumen maintenance. The ceramic lamps tested had higher lumen maintenance values than rated by manufacturers, while quartz lamps show measured lumen maintenance values up to 30 percentage points lower than claimed. The difference between rated and measured lumen maintenance for quartz lamps stemmed from considerably lower-than-rated values of mean light output: As a group, the light output of quartz lamps depreciated faster than manufacturers stated. The better lumen maintenance of ceramic lamps will allow them to operate at higher light levels for a longer period, lengthening the amount of time before group relamping. While ceramic lamps are more expensive to purchase than quartz lamps, the reduced frequency of replacement and maintenance may make ceramic lamps a more cost-effective option over the operating life for a given lighting system or application. Additionally, standard lighting design practice is based upon mean light output, not initial light output. Therefore, specifiers can save energy by designing a lighting system that achieves a particular light level using fewer ceramic lamps.

As expected, color performance differed between ceramic and quartz lamps. As a group, the ceramic lamps tested had higher CRI values, less color variation, and less color shift than the quartz lamps tested. CCT was also more consistent with claims for the ceramic lamps. In general, ceramic lamps will perform better in spaces where visual color identification is important, and where the color appearance of light sources must remain uniform.

For the same type of lamp, manufacturers often offer two different lamp models, usually with different color temperatures. It is important to note, however, that the differences between a manufacturer's lamp models can be more than just CCT. Specifiers should carefully review and compare the lamp specifications of both models.

The performance of a lamp-ballast system depends primarily upon the performance of the ballast. For the three lamp models evaluated, system performance remained fairly consistent across electronic ballast models, but the magnetic ballasts showed more variation in performance across the lamp models. This may be because, on average, the electronic ballasts have better control over the power delivered to the lamps, as shown by the lamp power in Table 9. Within each ballast category (electronic or magnetic), the models tested had similar rated performances and similar measured performances. Among all the ballasts and systems tested, electronic ballasts showed better performance in terms of system efficacy, ballast efficiency, and power quality. Although lamps generally do not operate more efficiently on an electronic ballast, the ballast itself is more efficient, as shown by measurements of system efficacy and ballast efficiency. Because of their higher efficiency, electronic ballasts draw less power, leading to energy savings. Therefore, the higher purchase cost of an electronic ballast will be paid back through lower operating costs over the life of the ballast.

In terms of power quality, higher power factor and lower levels of total harmonic distortion mean that electronic ballasts can power lamps with less impact on the power distribution system. Nevertheless, electronic ballasts may not necessarily maintain lamp life better than magnetic ballasts. All of the electronic ballasts tested had approximately square current waveforms, which are known to help maintain lamp life. Yet the waveforms exhibited current spikes that led to high levels of lamp current crest factor, which can reduce lamp life and lead to more failures, though this possibility was not evaluated as a part of this test. High current crest factor can also affect lumen maintenance, an important part of lamp life. Some ballast manufacturers claim better lumen maintenance with electronic ballasts, but NLPIP did not find this to be true.

Aside from ballast performance, the smaller size and lighter weight of electronic ballasts are benefits, as they affect the requirements for mounting and structural support. Smaller dimensions and less weight provide more flexibility on where the ballasts can be placed.

Further Information

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List of Tables

Data Table Terms and Definitions

The following tables contain data from manufacturers on their lamps and ballasts, and results from NLPIP's testing. The alphabetical list below contains brief definitions of many of the terms used in the tables. For additional information, refer to the text.

40% rated life. The number of hours necessary to reach 40% of the manufacturer-rated lamp life (e.g., 4000 hours is 40% rated life for a lamp with a 10,000-hour rated life). The mean light output of a metal halide lamp is measured at this point.

Aging ballast type. The type of ballast (electronic or magnetic) used to age a lamp to 40% of manufacturer-rated life.

ANSI code. American National Standards Institute (ANSI) code that indicates the electrical operating designation of the lamp, which must match that of the ballast.

Average rated life. The number of hours at which half of a large group of product samples fail under standard test conditions. Rated life is a median value; any lamp or group of lamps may vary from the published rated life. Manufacturers may give different life values for a lamp operating in the vertical position and in the horizontal position.

Ballast efficiency. The ratio of lamp power to input power. Ballast efficiency is a measure of the power losses that occur when transferring power from the ballast to the lamp.

Ballast type. The type of magnetic ballast, including reactor (R), high reactance autotransformer (HX), constant wattage autotransformer (CWA), super constant wattage autotransformer (SCWA), and linear reactor. The ballast type also may indicate the power factor, including high power factor (HPF), normal (low) power factor (NPF), and power factor corrected (PFC).

Bulb finish. The coating, if any, applied to the inside surface of the bulb. Bulbs are either clear or coated with phosphor.

Bulb shape. An abbreviation of the shape and size of a lamp's outer bulb. The letter or letters indicate the shape and the numbers indicate the bulb's maximum diameter in eighths of an inch. Shapes included are BD: bulged dimpled; E: elliptical; ED: elliptical dimpled; EDX: elliptical dimpled, narrow neck; T: tubular.

CCT. Correlated color temperature indicates whether a white light source is "warm" (yellowish) or "cool" (bluish) in appearance and is measured in kelvins (K).

Chromaticity coordinates. An approximate representation of a lamp's color appearance described mathematically using two coordinates, x and y, plotted in CIE 1931 color space.

Color variation. Lamps of the same type made by the same manufacturer may exhibit a certain degree of variation in color, even when operated under the same conditions and seasoned for the same amount of time. NLPIP measures color variation using MacAdam ellipse steps.

Color shift. The change in a lamp's color appearance at 40% of the lamp's rated life. NLPIP measures color shift using MacAdam ellipse steps.

CRI. Color rendering index is a measure of a light source's ability to render or depict an object's colors naturally or realistically, as compared with a reference light source (usually incandescent or daylight). The maximum CRI value is 100, indicating a highly natural appearance of an object's colors.

Fuse rating. The current capacity at which a fuse can safely interrupt the flowing current. For an HID ballast, the fuse rating is typically two to three times the maximum current that the ballast will draw during normal operation.

Initial light output. A lamp's light output, in lumens, after 100 hours of seasoning, measured on a reference ballast.

Input current. The current flowing through the lamp-ballast system during operation, expressed in amps (A).

Input current THD. Total harmonic distortion is a measure of the degree to which a current waveform is distorted by harmonics, with higher values of THD indicating greater distortion.

Input power. The active power of a lamp-ballast system, expressed in watts (W). This value is always higher than the lamp's power.

Input voltage. The line voltage supplied to the lamp-ballast system, usually 120 or 277 volts (V), though other voltages are available.

Lamp CCF. Lamp current crest factor is the peak or maximum current divided by the root-mean-square (rms) current of a lamp. ANSI recommends a maximum CCF of 1.8 for metal halide lamps.

Lamp efficacy. The ratio of the light output of a lamp (in lumens) to its active power (in watts), expressed as lumens per watt (LPW).

Lamp operating frequency. The number of cycles completed by a periodic wave in a given unit of time. Frequency is commonly reported in cycles per second, or hertz (Hz).

Lamp current. The current flowing between a lamp's electrodes during operation, expressed in amps (A).

Lamp power. The active power required to operate the lamp, expressed in watts (W).

Lamp voltage. The operating voltage of the lamp, expressed in volts (V).

Lumen maintenance. The ability of a lamp to retain its light output over time. Greater lumen maintenance means a lamp will remain brighter for a longer time.

Luminaire type. Luminaire enclosure requirements designated by the lamp manufacturer for a given lamp. An open-rated lamp can operate in an open or enclosed luminaire; an enclosed-rated lamp must operate in an enclosed luminaire.

MacAdam ellipse steps. A measure of color variation among lamps or a lamp's color shift over time. Researcher David L. MacAdam showed that a just noticeable difference (JND) in the colors of two lights placed side-by-side was about three times the standard deviation associated with making color matches between a reference light and a test light. These JNDs form an elliptical pattern of "constant discriminability" in a chromaticity space, centered on the chromaticity coordinates of a reference light, known as a MacAdam ellipse.

Max. ballast case temp. The maximum temperature of the ballast case for which the manufacturer's life rating is valid.

Max. current. The maximum current (in amps) that the ballast is designed to draw.

Mean light output. Light output measured at 40% of manufacturer-rated life, expressed in lumens. In combination with initial light output, mean light output may be used to calculate lumen maintenance.

Measured. The performance value as measured by NLPIP.

Min. starting temp. The minimum ambient temperature at which a ballast will reliably start a lamp.

Operating position. The manufacturer-recommended operating position for a lamp.

Rated. The performance value as rated by the manufacturer and published in the manufacturer's catalog and Web site.

Restrike time. The time required for a lamp to restrike, or restart, and to return to 90% of its initial light output after the lamp is extinguished. Normally, HID lamps need to cool before they can be restarted.

Sound rating. The manufacturer's rating of the amount of noise that a ballast generates, expressed in letters A through D. An "A" rated ballast makes the least noise, while a "D" rated ballast is the loudest.

System efficacy. Measurement of a system's ability to convert electricity into light. Measured in lumens per watt (LPW), system efficacy is the ratio of the light output (in lumens) to the active power (in watts).

System power factor. The ratio of active power (in watts) to apparent power (in rms volt-amps), power factor is a measure of how effectively an electric load converts power into useful work.

Warm-up time. The time it takes for a lamp to produce 90% of its initial light output when it is started, unless otherwise indicated.

Table 1. Manufacturer-Supplied Information: Low-Wattage Ceramic Metal Halide Lamps with Medium Base (E26)

Manufacturer	Catalog Number	Bulb Shape	Bulb Finish	Operating Position [a]	Luminaire Type	ANSI Code	Lamp Voltage (V)	Lamp Current (A)	Initial Light Output (lm) [b]	
									V	H
50 W										
Halco Lighting	MHC50UMED/4K/M	ED17	CL	U	E	M110	NS	NS	3750	
OSRAM SYLVANIA	MCP50/C/U/MED/830	E17	CO	U	O	M110, M148	90	NS	3800	NS [e]
	MCP50/U/MED/830	E17	CL	U	O	M110, M148	90	NS	4100	NS [e]
Philips Lighting	MHC50/C/U/M/3K/ALTO	ED17	CO	U	E	M110, M148	100	0.6	3800	NS
	MHC50/C/U/M/4K/ALTO	ED17	CO	U	E	M110, M148	100	0.6	3600	NS
	MHC50/U/M/3K/ALTO	ED17	CL	U	E	M110, M148	100	0.6	4100	NS
	MHC50/U/M/4K/ALTO	ED17	CL	U	E	M110, M148	100	0.6	3750	NS
	MHC50/U/MP/3K/ALTO	ED17P	CL	U	O	M110, M148	100	0.6	4000	NS
	MHC50/U/MP/4K/ALTO	ED17P	CL	U	O	M110, M148	100	0.6	3600	NS
70 W										
EYE Lighting	CMT70/WW	T9.5	CL	U	O	M139	NS	NS	6000	
	CMT70F/WW	T9.5	CO	U	O	M139	NS	NS	5800	
GE Lighting	CMH70/C/U/830/MED	BD17	CO	U	E	M98, M139	NS	NS	6000	
	CMH70/C/U/830/MED/O	ED17	CO	U	O	M98, M143	90	0.9	5700	
	CMH70/C/U/942/MED/O	ED17	CO	U	O	M98, M143	90	0.9	5200	
	CMH70/U/830/MED ✓	BD17	CL	U	E	M98, M139	NS	NS	6300	
	CMH70/U/830/MED/O	ED17	CL	U	O	M98, M143	90	0.9	5700	
	CMH70/U/942/MED/O	ED17	CL	U	O	M98, M143	90	0.9	5500	
Halco Lighting	MHC70UMED/4K/M	ED17	CL	U	E	M98	NS	NS	6000	
OSRAM SYLVANIA	MCP70/C/U/MED/830	E17	CO	U	O	M98, M139	90	1.0	5500	NS [e]
	MCP70/C/U/MED/940	E17	CO	U	O	M98, M139, M143	NS	NS	5600	NS [e]
	MCP70/U/MED/830 ✓	E17	CL	U	O	M98, M139	90	1.0	5900	NS [e]
	MCP70/U/MED/940	E17	CL	U	O	M98, M139, M143	NS	NS	6000	NS [e]
Philips Lighting	MHC70/C/U/M/3K/ALTO	ED17	CO	U	E	M98, M143	100	0.8	5800	NS
	MHC70/C/U/M/4K/ALTO	ED17	CO	U	E	M98, M143	100	0.8	5500	NS
	MHC70/C/U/MP/3K/ALTO	ED17P	CO	U	O	M98, M143	100	0.8	5400	NS
	MHC70/C/U/MP/4K/ALTO	ED17P	CO	U	O	M98, M143	100	0.8	5200	NS
	MHC70/U/M/3K/ALTO ✓	ED17	CL	U	E	M98, M143	100	0.8	6200	NS
	MHC70/U/M/4K/ALTO	ED17	CL	U	E	M98, M143	100	0.8	5900	NS
	MHC70/U/MP/3K/ALTO	ED17P	CL	U	O	M98, M143	100	0.8	5900	NS
	MHC70/U/MP/4K/ALTO	ED17P	CL	U	O	M98, M143	100	0.8	5800	NS
100 W										
GE Lighting	CMH100/C/U830/MED	BD17	CO	U	E	M90, M140	NS	NS	8700	8700
	CMH100/U/830/MED	BD17	CL	U	E	M90, M140	NS	NS	9200	9200
Halco Lighting	MHC100UMED/4K/M	ED17	CL	U	E	M90	NS	NS	9000	

Mean Light Output (lm) [b]		Lamp Efficacy (LPW) [c]	Average Rated Life (h) [b]		CCT (K)	CRI	Warm-up Time (min) [d]	Restrike Time (min)
V	H		V	H				
NS	NS	75	15000		4000	90	NS	NS
2640	NS [e]	72	12000	12000	2900	88	2–4	4–6
2850	NS [e]	82	12000	12000	3000	88	2–4	4–6
2545	NS	76	10000		3000	85	2	4–8
2450	NS	72	20000		4000	92	2	4–8
2750	NS	82	10000		3000	85	2	4–8
2550	NS	75	20000		4000	92	2	4–8
2680	NS	80	10000		3000	85	2	4–8
2450	NS	72	20000		4000	92	2	4–8
4900		86	9000		3500	90	NS	NS
4800		83	9000		3500	90	NS	NS
4000		85	15000		3000	80	2–5	15
4100		81	15000		3000	80	2–5	15
4000		74	15000		4000	90	2–5	15
4100		90	15000		3000	80	2–5	15
4100		81	15000		3000	80	2–5	15
4200		78	15000		4000	90	2–5	15
NS	NS	86	15000		4000	92	NS	NS
4400	NS [e]	79	12000	12000	3000	88	2–4	4–6
4480	NS [e]	80	12000	12000	3800	90	2–4	4–6
4700	NS [e]	84	12000	12000	3000	88	2–4	4–6
4800	NS [e]	86	12000	12000	4000	90	2–4	4–6
4290	NS	83	16000		3000	85	2	4–8
3850	NS	79	20000		4000	92	2	4–8
3995	NS	77	16000		3000	85	2	4–8
3640	NS	74	20000		4000	92	2	4–8
4585	NS	89	16000		3000	85	2	4–8
4130	NS	84	20000		4000	92	2	4–8
4365	NS	84	16000		3000	85	2	4–8
4060	NS	83	20000		4000	92	2	4–8
6300	6300	87	10000	15000	3000	83	2–5	15
6600	6400	92	10000	15000	3000	83	2–5	15
NS	NS	90	15000		4000	93	NS	NS

NA = Not applicable; NS = Not supplied

O = Open; E = Enclosed; CL = Clear; CO = Coated; V = Vertical; H = Horizontal

Product tested by NLPIP

[a] BU ±15 = base up ±15°; BU ±90 = base up ±90°; BU/BD ±60 = base up or base down ±60°; H = horizontal ±30°; V ±15 = vertical ±15°; VBD ±15 = vertical base down ±15°; VBU ±15 = vertical base up ±15°; U = universal

[b] Merged cells indicate that the manufacturer's literature did not specify an operating position.

[c] Calculated from vertical initial light output, where available.

[d] The percentage of light output defined as the warm-up period varies for each manufacturer: EYE – 90%; GE – 90%; Philips – 80%; Venture – 90%; All others – Not stated

[e] Manufactuer indicates that operating this lamp in off-vertical positions will result in reduced lumen output.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 1 (continued). Manufacturer-Supplied Information: Low-Wattage Ceramic Metal Halide Lamps with Medium Base (E26)

Manufacturer	Catalog Number	Bulb Shape	Bulb Finish	Operating Position [a]	Luminaire Type	ANSI Code	Lamp Voltage (V)	Lamp Current (A)	Initial Light Output (lm) [b] V	Initial Light Output (lm) [b] H
100 W (continued)										
OSRAM SYLVANIA	MCP100/C/U/MED/830	E17	CO	U	O	M90, M140	100	1.1	8500	NS [e]
	MCP100/U/MED/830	E17	CL	U	O	M90, M140	100	1.1	9000	NS [e]
Philips Lighting	MHC100/C/U/M/3K/ALTO	ED17	CO	U	E	M90, M140	101	1.1	8800	NS
	MHC100/C/U/M/4K/ALTO	ED17	CO	U	E	M90, M140	102	1.1	8400	NS
	MHC100/C/U/MP/3K/ALTO	ED17P	CO	U	O	M90, M140	101	1.1	7900	NS
	MHC100/C/U/MP/4K/ALTO	ED17P	CO	U	O	M90, M140	104	1.1	7500	NS
	MHC100/U/M/3K/ALTO	ED17	CL	U	E	M90, M140	101	1.1	9500	NS
	MHC100/U/M/4K/ALTO	ED17	CL	U	E	M90, M140	102	1.1	9000	NS
	MHC100/U/MP/3K/ALTO	ED17P	CL	U	O	M90, M140	101	1.1	8600	NS
	MHC100/U/MP/4K/ALTO	ED17P	CL	U	O	M90, M140	104	1.1	8200	NS
150 W										
EYE Lighting	CMT150/DW/SH/BUD	T9.5	CL	BU/BD ±60	O	NS	NS	NS	15000	NA
	CMT150/DW/SH/HOR	T9.5	CL	H ±30	O	NS	NS	NS	NA	15000
	CMT150/WW	T13	CL	U	O	M142, M160	NS	NS	13500	
	CMT150F/WW	T13	CO	U	O	M142, M160	NS	NS	13000	
GE Lighting	CMH150/C/U830/MED/O	ED17	CO	U	O	M102, M142	95	1.8	11900	
	CMH150/C/U942/MED/O	ED17	CO	U	O	M102, M142	95	1.8	11000	
	CMH150/U/830/MED/O	ED17	CL	U	O	M102, M142	95	1.8	12900	
	CMH150/U/942/MED/O	ED17	CL	U	O	M102, M142	95	1.8	12000	
Halco Lighting	MHC150UMED/4K/M	ED17	CL	U	E	M102	NS	NS	13500	
OSRAM SYLVANIA	MCP150/C/U/MED/830	E17	CO	U	O	M102	95	1.8	12000	NS [e]
	MCP150/U/MED/830	E17	CL	U	O	M102	95	1.8	13000	NS [e]
Philips Lighting	MHC150/C/U/M/3K/ALTO	ED17	CO	U	E	M102, M142	95	1.5	12500	NS
	MHC150/C/U/M/4K/ALTO	ED17	CO	U	E	M102, M142	95	1.5	12000	NS
	MHC150/C/U/MP/3K/ALTO	ED17P	CO	U	O	M102, M142	95	1.8	11900	NS
	MHC150/C/U/MP/4K/ALTO	ED17P	CO	U	O	M102, M142	95	1.5	11000	NS
	MHC150/U/M/3K/ALTO	ED17	CL	U	E	M102, M142	95	1.5	14000	NS
	MHC150/U/M/4K/ALTO	ED17	CL	U	E	M102, M142	95	1.5	13000	NS
	MHC150/U/MP/3K/ALTO	ED17P	CL	U	O	M102, M142	95	1.5	12900	NS
	MHC150/U/MP/4K/ALTO	ED17P	CL	U	O	M102, M142	95	1.5	12000	NS

Mean Light Output (lm) [b]		Lamp Efficacy (LPW) [c]	Average Rated Life (h) [b]		CCT (K)	CRI	Warm-up Time (min) [d]	Restrike Time (min)
V	H		V	H				
6900	NS [e]	85	12000	12000	3000	85	2–4	4–6
7200	NS [e]	90	12000	12000	3000	85	2–4	4–6
6600	NS	88	16000		3000	85	2	4–8
6300	NS	84	20000		4000	92	2	4–8
5925	NS	79	16000		3000	85	2	4–8
5625	NS	75	20000		4000	92	2	4–8
7125	NS	95	16000		3000	85	2	4–8
6750	NS	90	20000		4000	92	2	4–8
6450	NS	86	16000		3000	85	2	4–8
6150	NS	82	20000		4000	92	2	4–8
12400	NA	100	12000	NA	3200	90	NS	NS
NA	12400	100	NA	12000	3200	90	NS	NS
11200		90	9000		3500	95	NS	NS
10800		87	9000		3500	95	NS	NS
8800		79	12000		3000	80	2–5	15
8300		73	15000		4200	90	2–5	15
9500		86	12000		3000	80	2–5	15
9000		80	15000		4200	90	2–5	15
NS	NS	90	9000		4000	93	NS	NS
10000	NS [e]	80	12000	12000	3000	89	2–4	4–6
11000	NS [e]	87	12000	NS	3000	89	2–4	4–6
9375	NS	83	16000		3000	85	2	4–8
9000	NS	80	20000		4000	92	2	4–8
8805	NS	79	16000		3000	85	2	4–8
8250	NS	73	20000		4000	92	2	4–8
10500	NS	93	16000		3000	85	2	4–8
9750	NS	87	20000		4000	92	2	4–8
9545	NS	86	16000		3000	85	2	4–8
9000	NS	80	20000		4000	92	2	4–8

NA = Not applicable; NS = Not supplied

O = Open; E = Enclosed; CL = Clear; CO = Coated; V = Vertical; H = Horizontal

✔ Product tested by NLPIP

[a] BU ±15 = base up ±15°; BU ±90 = base up ±90°;
BU/BD ±60 = base up or base down ±60°;
H = horizontal ±30°; V ±15 = vertical ±15°;
VBD ±15 = vertical base down ±15°; VBU ±15 = vertical base up ±15°;
U = universal

[b] Merged cells indicate that the manufacturer's literature did not specify an operating position.

[c] Calculated from vertical initial light output, where available.

[d] The percentage of light output defined as the warm-up period varies for each manufacturer: EYE – 90%; GE – 90%; Philips – 80%; Venture – 90%; All others – Not stated

[e] Manufactuer indicates that operating this lamp in off-vertical positions will result in reduced lumen output.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 2. Manufacturer-Supplied Information: Low-Wattage Pulse-Start Quartz Metal Halide Lamps with Medium Base (E26)

Manufacturer	Catalog Number	Bulb Shape	Bulb Finish	Operating Position [a]	Luminaire Type	ANSI Code	Lamp Voltage (V)	Lamp Current (A)	Initial Light Output (lm) [b]	
									V	H
32 W										
GE Lighting	MXR32/C/VBD/O	ED17	CO	VBD ±15	O	M100	NS	NS	2400	
	MXR32/C/VBU/O	ED17	CO	VBU ±15	O	M100	NS	NS	2400	
50 W										
EYE Lighting	MP50/U/3K	ED17	CL	U	O	M110	NS	NS	3450	
	MPF50/U/3K	ED17	CO	U	O	M110	NS	NS	3000	
GE Lighting	MXR50/C/U/MED	ED17	CO	U	E	M110	75	NS	3000	
	MXR50/C/U/MED/O	ED17	CO	U	O	M110	85	NS	3200	
	MXR50/U/MED	ED17	CL	U	E	M110	75	NS	3200	
	MXR50/U/MED/O	ED17	CL	U	O	M110	85	NS	3400	
Halco Lighting	MH50/C/U/MED/PS	BD17	CO	U	E	M110	NS	NS	3200	
	MH50/U/MED/PS	BD17	CL	U	E	M110	NS	NS	3400	
	MP50/U/MED/PS	ED17	CL	U	O	M110	NS	NS	3200	
Litetronics	MH50/U/CL/MED	ED17	CL	U	E	M110	NS	NS	3300	
	MH50/U/CT/MED	ED17	CO	U	E	M110	NS	NS	3300	
	MP50/U/CL/MED/O	ED17	CL	U	O	M110	NS	NS	3300	
	MP50/U/CT/MED/O	ED17	CO	U	O	M110	NS	NS	3300	
OSRAM SYLVANIA	MP50/C/U/MED	E17	CO	U	O	M110	85	0.7	3200	NS [e]
	MP50/U/MED	E17	CL	U	O	M110	85	0.7	3450	NS [e]
Venture Lighting	MH 50W/C/U/PS	ED17	CO	U	E	M110	85	0.7	3200	2900
	MH 50W/U/PS	ED17	CL	U	E	M110	85	0.7	3400	3100
	MP 50W/C/U/UVS/PS	EDX17	CO	U	O	M110	85	0.7	3000	2700
	MP 50W/C/U/UVS/PS/3K	EDX17	CO	U	O	M110	85	0.7	3000	2700
	MP 50W/U/UVS/PS	EDX17	CL	U	O	M110	85	0.7	3200	2900
	MP 50W/U/UVS/PS/3K	EDX17	CL	U	O	M110	85	0.7	3200	2900
Westinghouse Lighting	MH50/U	BD17	CL	U	NS	M110TM	NS	NS	3400	
70 W										
EYE Lighting	MP70/U/3K	ED17	CL	U	O	M68	NS	NS	5200	
	MPF70/U/3K	ED17	CO	U	O	M98	NS	NS	4800	
	MT70/D	T11	CL	U	O	M139	90	1.0	5000	
	MT70/SDW	T11	CL	U	O	M139	90	1.0	4500	
	MT70/SLW	T11	CL	U	O	M139	90	1.0	3800	
	MT70/SW	T11	CL	U	O	M139	90	1.0	5000	
	MT70F/D	T11	CO	U	O	M139	90	1.0	4800	
	MT70F/SDW	T11	CO	U	O	M139	90	1.0	4300	
	MT70F/SW	T11	CO	U	O	M139	90	1.0	4800	

Mean Light Output (lm) [b] V	Mean Light Output (lm) [b] H	Lamp Efficacy (LPW) [c]	Average Rated Life (h) [b] V	Average Rated Life (h) [b] H	CCT (K)	CRI	Warm-up Time (min) [d]	Restrike Time (min)
1700		75	10000		3200	70	2–5	10–15
1700		75	10000		3200	70	2–5	10–15
1900		69	10000	7500	3000	70	NS	NS
1820		60	10000	7500	2900	70	NS	NS
2000		60	10000		3400	65	2–5	10–15
1500		64	10000		3500	70	2–5	10–15
2100		64	10000		3700	60	2–5	10–15
1700		68	10000		3500	70	2–5	10–15
NS	NS	64	10000		3700	70	NS	NS
NS	NS	68	10000		4000	65	NS	NS
NS	NS	64	6000		4000	65	NS	NS
NS	NS	66	10000		4000	70	NS	NS
NS	NS	66	10000		3700	70	NS	NS
NS	NS	66	10000		4000	70	NS	NS
NS	NS	66	10000		3700	70	NS	NS
1750	NS [e]	64	20000	10000	2900	70	2–4	5–7
1900	NS [e]	69	20000	10000	3000	70	2–4	5–7
2100	1900	64	10000	7500	3700	70	1-2	1-2
2200	2000	68	10000	7500	4000	65	1-2	1-2
2000	1800	60	10000	7500	3700	70	1-2	2-4
2000	1800	60	10000	7500	3200	70	1-2	2-4
2100	1900	64	10000	7500	4000	65	1-2	2-4
2100	1900	64	10000	7500	3200	65	1-2	2-4
2600		68	10000		4000	65	NS	NS
3900		74	15000	10000	3000	75	NS	NS
3600		69	15000	10000	2900	75	NS	NS
4000		71	9000		6500	96	4	<15
3600		64	9000		3500	96	4	<15
3040		54	9000		3000	96	4	<15
4000		71	9000		4500	96	4	<15
3800		69	9000		6500	96	4	<15
3400		61	9000		3500	96	4	<15
3800		69	9000		4500	96	4	<15

NA = Not applicable; NS = Not supplied

O = Open; E = Enclosed; CL = Clear; CO = Coated; V = Vertical; H = Horizontal

✓ Product tested by NLPIP

[a] BU ±15 = base up ±15°; BU ±90 = base up ±90°; BU/BD ±60 = base up or base down ±60°; H = horizontal ±30°; V ±15 = vertical ±15°; VBD ±15 = vertical base down ±15°; VBU ±15 = vertical base up ±15°; U = universal

[b] Merged cells indicate that the manufacturer's literature did not specify an operating position.

[c] Calculated from vertical initial light output, where available.

[d] The percentage of light output defined as the warm-up period varies for each manufacturer: EYE – 90%; GE – 90%; Philips – 80%; Venture – 90%; All others – Not stated

[e] Manufactuer indicates that operating this lamp in off-vertical positions will result in reduced lumen output.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 2 (continued). Manufacturer-Supplied Information: Low-Wattage Pulse-Start Quartz Metal Halide Lamps with Medium Base (E26)

Manufacturer	Catalog Number	Bulb Shape	Bulb Finish	Operating Position [a]	Luminaire Type	ANSI Code	Lamp Voltage (V)	Lamp Current (A)	Initial Light Output (lm) [b]	
									V	H
70 W (continued)										
GE Lighting	MVR70/C/U/MED	ED17	CO	U	E	M98	85	NS	4500	
	MVR70/U/MED	ED17	CL	U	E	M98	85	NS	4700	
	MXR70/C/U/MED	ED17	CO	U	E	M98	85	NS	5300	
	MXR70/C/U/MED/O	ED17	CO	U	O	M98	85	NS	5300	
	MXR70/U/MED ✓	ED17	CL	U	E	M98	85	NS	5500	
	MXR70/U/MED/O	ED17	CL	U	O	M98	85	NS	5500	
Halco Lighting	MH70/C/U/MED/PS	BD17	CO	U	E	M98	NS	NS	5300	
	MH70/U/MED/PS	BD17	CL	U	E	M98	NS	NS	5600	
	MP70/U/MED/PS	ED17	CL	U	O	M98	NS	NS	5300	
Litetronics	MH70/U/CL/MED	ED17	CL	U	E	M98	NS	NS	5300	
	MH70/U/CT/MED	ED17	CO	U	E	M98	NS	NS	5300	
	MP70/U/CL/MED/O	ED17	CL	U	O	M98	NS	NS	5300	
	MP70/U/CT/MED/O	ED17	CO	U	O	M98	NS	NS	5300	
OSRAM SYLVANIA	MP70/C/U/MED	E17	CO	U	O	M98	85	0.9	4700	NS [e]
	MP70/U/MED ✓	E17	CL	U	O	M98	85	0.9	5200	NS [e]
	MPD70/C/U/MED/840	E17	CO	U	O	M98	85	0.9	5100	NS [e]
	MPD70/U/MED/840	E17	CL	U	O	M98	85	0.9	5500	NS [e]
Ushio	MH70/C/U/MED/32/PS	ED17	CO	U	E	M98	NS	NS	5700	5050
	MH70/C/U/MED/42/PS	ED17	CO	U	E	M98	NS	NS	5700	4650
	MH70/U/MED/32/PS ✓	ED17	CL	U	E	M98	NS	NS	6000	5250
	MH70/U/MED/42/PS	ED17	CL	U	E	M98	NS	NS	6000	4850
	MP70/C/U/MED/32/PS	EDX17	CO	U	O	M98	NS	NS	5200	4800
	MP70/C/U/MED/42/PS	EDX17	CO	U	O	M98	NS	NS	5200	4800
	MP70/U/MED/32/PS	EDX17	CL	U	O	M98	NS	NS	5500	5200
	MP70/U/MED/42/PS	EDX17	CL	U	O	M98	NS	NS	5500	5150
	UMH-70/C/U	ED17	CO	U	E	M98	NS	NS	5700	
	UMH-70/U	ED17	CL	U	E	M98	NS	NS	6000	
Venture Lighting	MH 70W/C/U/PS	ED17	CO	U	E	M98	85	0.9	5300	4800
	MH 70W/C/U/PS/3K	ED17	CO	U	E	M98	NS	NS	5300	4800
	MH 70W/U/PS	ED17	CL	U	E	M98	85	0.9	5600	5000
	MP 70W/C/U/UVS/PS	EDX17	CO	U	O	M98	85	0.9	5000	4500
	MP 70W/C/U/UVS/PS/3K	EDX17	CO	U	O	M98	85	0.9	5000	4500
	MP 70W/U/UVS/PS	EDX17	CL	U	O	M98	85	0.9	5300	4800
	MP 70W/U/UVS/PS/3K	EDX17	CL	U	O	M98	85	0.9	5300	4800
Westinghouse Lighting	MH70/U ✓	BD17	CL	U	NS	M98SJ	NS	NS	5600	

Mean Light Output (lm) [b] V	Mean Light Output (lm) [b] H	Lamp Efficacy (LPW) [c]	Average Rated Life (h) [b] V	Average Rated Life (h) [b] H	CCT (K)	CRI	Warm-up Time (min) [d]	Restrike Time (min)
2800		64	12000		4000	75	2–5	10–15
3000		67	12000		4000	75	2–5	10–15
3300		75	12000		3200	70	2–5	10–15
3300		75	15000 or 12000		3200	70	2–5	10–15
3500		78	12000		3200	70	2–5	10–15
3500		78	15000 or 12000		3200	70	2–5	10–15
NS	NS	76	15000		3700	70	NS	NS
NS	NS	80	15000		4000	65	NS	NS
NS	NS	76	12000		4000	65	NS	NS
NS	NS	76	10000		4000	75	NS	NS
NS	NS	76	10000		3700	75	NS	NS
NS	NS	76	10000		4000	75	NS	NS
NS	NS	76	10000		3700	75	NS	NS
3100	NS [e]	67	15000	10000	2900	75	2–4	5–7
3400	NS [e]	74	15000	10000	3000	75	2–4	5–7
3800	NS [e]	73	7500	6000	4000	82	2–4	5–7
4000	NS [e]	79	7500	6000	4200	80	2–4	5–7
3900	3200	81	15000		3200	70	2	4
3900	2950	81	15000		4200	75	2	4
4100	3400	86	15000		3200	70	2	4
4100	3150	86	15000		4200	75	2	4
3900	3100	74	15000		3200	70	2	4
3800	3400	74	15000		4200	75	2	4
4100	3300	79	15000		3200	70	2	4
4000	3550	79	15000		4200	75	2	4
NS	NS	81	15000	11250	4200	65–70	NS	NS
NS	NS	86	15000	11250	4200	65–70	NS	NS
3400	3100	76	15000	11250	3700	70	1-2	1-2
3400	3100	76	15000	11250	3200	70	1-2	1-2
3600	3300	80	15000	11250	4000	65	1-2	1-2
3300	3000	71	15000	11250	3700	70	1-2	2-4
3300	3000	71	15000	11250	3200	70	1-2	2-4
3400	3100	76	15000	11250	4000	65	1-2	2-4
3400	3100	76	15000	11250	3200	65	1-2	2-4
4000		80	15000		4000	65	NS	NS

NA = Not applicable; NS = Not supplied

O = Open; E = Enclosed; CL = Clear; CO = Coated; V = Vertical; H = Horizontal

Product tested by NLPIP

[a] BU ±15 = base up ±15°; BU ±90 = base up ±90°; BU/BD ±60 = base up or base down ±60°; H = horizontal ±30°; V ±15 = vertical ±15°; VBD ±15 = vertical base down ±15°; VBU ±15 = vertical base up ±15°; U = universal

[b] Merged cells indicate that the manufacturer's literature did not specify an operating position.

[c] Calculated from vertical initial light output, where available.

[d] The percentage of light output defined as the warm-up period varies for each manufacturer: EYE – 90%; GE – 90%; Philips – 80%; Venture – 90%; All others – Not stated

[e] Manufactuer indicates that operating this lamp in off-vertical positions will result in reduced lumen output.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 2 (continued). Manufacturer-Supplied Information: Low-Wattage Pulse-Start Quartz Metal Halide Lamps with Medium Base (E26)

Manufacturer	Catalog Number	Bulb Shape	Bulb Finish	Operating Position [a]	Luminaire Type	ANSI Code	Lamp Voltage (V)	Lamp Current (A)	Initial Light Output (lm) [b] V	Initial Light Output (lm) [b] H
90 W										
Litetronics	MHO 90/CL/U	ED17	CL	U	E	M90	NS	NS	8400	
	MHO 90/CT/U	ED17	CO	U	E	M90	NS	NS	8100	
100 W										
EYE Lighting	M100X/U/MED	ED17	CL	U	E	M90	NS	NS	9000	8100
	MF100X/U/MED	ED17	CO	U	E	M90	NS	NS	8500	7650
	MP100/U/3K	ED17	CL	U	O	M90	NS	NS	8500	
	MPF100/U/3K	ED17	CO	U	O	M90	NS	NS	7900	
	MT100/D	T11	CL	U	O	M168	95	1.3	7000	
	MT100/SDW	T11	CL	U	O	M164	95	1.3	6500	
	MT100/SW	T11	CL	U	O	M166	95	1.3	7000	
	MT100F/D	T11	CO	U	O	M169	95	1.3	6500	
	MT100F/SDW	T11	CO	U	O	M165	95	1.3	6000	
	MT100F/SW	T11	CO	U	O	M167	95	1.3	6500	
GE Lighting	MVR100/C/U/MED	ED17	CO	U	E	M90	100	NS	7600	
	MVR100/U/MED	ED17	CL	U	E	M90	100	NS	8100	
	MXR100/C/U/MED	ED17	CL	U	E	M90	100	NS	8500	
	MXR100/C/U/MED/O	ED17	CO	U	O	M90	100	NS	8500	
	MXR100/U/MED	ED17	CL	U	E	M90	100	NS	9000	
	MXR100/U/MED/O	ED17	CL	U	O	M90	100	NS	9000	
Halco Lighting	MH100/C/U/MED/PS	BD17	CO	U	E	M90	NS	NS	8000	
	MH100/U/MED/PS	BD17	CL	U	E	M90	NS	NS	8500	
	MP100/U/MED/PS	ED17	CL	U	O	M90	NS	NS	7800	
Litetronics	MH100/U/CL/MED	ED17	CL	U	E	M90	NS	NS	8300	
	MH100/U/CT/MED	ED17	CO	U	E	M90	NS	NS	8300	
	MP100/U/CL/MED	ED17	CL	U	O	M90	NS	NS	8300	
	MP100/U/CT/MED	ED17	CO	U	O	M90	NS	NS	8300	
OSRAM SYLVANIA	MP100/C/U/MED	E17	CO	U	O	M90	100	1.1	7900	NS [e]
	MP100/U/MED	E17	CL	U	O	M90	100	1.1	8500	NS [e]
	MPD100/C/U/MED/840	E17	CO	U	O	M90	95	1.1	7700	NS [e]
	MPD100/U/MED/840	E17	CL	U	O	M90	95	1.1	8400	NS [e]

Mean Light Output (lm) [b] V	Mean Light Output (lm) [b] H	Lamp Efficacy (LPW) [c]	Average Rated Life (h) [b] V	Average Rated Life (h) [b] H	CCT (K)	CRI	Warm-up Time (min) [d]	Restrike Time (min)
NS	NS	93	12000		4000	65	NS	NS
NS	NS	90	12000		3700	70	NS	NS
6800	6075	90	15000	11250	4000	65	NS	NS
6200	5500	85	15000	11250	3700	70	NS	NS
6400		85	15000	10000	3000	70	NS	NS
5800		79	15000	10000	2900	75	NS	NS
5600		70	9000		6500	96	4	<15
5200		65	9000		3500	96	4	<15
5600		70	9000		4500	96	4	<15
5200		65	9000		6500	96	4	<15
4800		60	9000		3500	96	4	<15
5200		65	9000		4500	96	4	<15
4900		76	15000		4000	75	2–5	10–15
5800		81	15000		4000	75	2–5	10–15
5900		85	15000		3200	70	2–5	10–15
5900		85	15000		3200	70	2–5	10–15
6200		90	15000		3200	70	2–5	10–15
6200		90	15000		3200	70	2–5	10–15
NS	NS	80	15000		3700	70	NS	NS
NS	NS	85	15000		4000	65	NS	NS
NS	NS	78	10000		4000	65	NS	NS
NS	NS	83	10000		4000	75	NS	NS
NS	NS	83	10000		3700	75	NS	NS
NS	NS	83	10000		4000	75	NS	NS
NS	NS	83	10000		3700	80	NS	NS
5800	NS [e]	79	15000	10000	2900	75	2–4	5–7
5525	NS [e]	85	15000	10000	3000	75	2–4	5–7
5500	NS [e]	77	7500	6000	4000	82	2–4	5–7
5800	NS [e]	84	7500	6000	4200	82	2–4	5–7

NA = Not applicable; NS = Not supplied

O = Open; E = Enclosed; CL = Clear; CO = Coated; V = Vertical; H = Horizontal

Product tested by NLPIP

[a] BU ±15 = base up ±15°; BU ±90 = base up ±90°;
BU/BD ±60 = base up or base down ±60°;
H = horizontal ±30°; V ±15 = vertical ±15°;
VBD ±15 = vertical base down ±15°; VBU ±15 = vertical base up ±15°;
U = universal

[b] Merged cells indicate that the manufacturer's literature did not specify an operating position.

[c] Calculated from vertical initial light output, where available.

[d] The percentage of light output defined as the warm-up period varies for each manufacturer: EYE – 90%; GE – 90%; Philips – 80%; Venture – 90%; All others – Not stated

[e] Manufactuer indicates that operating this lamp in off-vertical positions will result in reduced lumen output.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 2 (continued). Manufacturer-Supplied Information: Low-Wattage Pulse-Start Quartz Metal Halide Lamps with Medium Base (E26)

Manufacturer	Catalog Number	Bulb Shape	Bulb Finish	Operating Position [a]	Luminaire Type	ANSI Code	Lamp Voltage (V)	Lamp Current (A)	Initial Light Output (lm) [b]	
									V	H
100 W (continued)										
Ushio	MH100/C/U/MED/32/PS	ED17	CO	U	E	M90	NS	NS	8700	8100
	MH100/C/U/MED/40/PS	ED17	CO	U	E	M90	NS	NS	8000	7650
	MH100/U/MED/32/PS	ED17	CL	U	E	M90	NS	NS	9200	8550
	MH100/U/MED/40/PS	ED17	CL	U	E	M90	NS	NS	8500	8100
	MP100/C/U/MED/32/PS	EDX17	CO	U	O	M90	NS	NS	8200	7900
	MP100/C/U/MED/40/PS	EDX17	CO	U	E	M90	NS	NS	7600	7500
	MP100/U/MED/32/PS	EDX17	CL	U	O	M90	NS	NS	8800	8400
	MP100/U/MED/40/PS	EDX17	CL	U	O	M90	NS	NS	8100	8050
Venture Lighting	MH 100W/C/U/PS	ED17	CO	U	E	M90	100	1.1	8500	7700
	MH 100W/U/PS	ED17	CL	U	E	M90	100	1.1	9000	8100
	MP 100W/C/U/UVS/PS	EDX17	CO	U	O	M90	100	1.1	8100	7300
	MP 100W/C/U/UVS/PS/3K	EDX17	CO	U	O	M90	100	1.1	8100	7300
	MP 100W/C/V/UVS/PS/27K	EDX17	CO	V ±15	O	M90	100	1.1	8100	NA
	MP 100W/U/UVS/PS	EDX17	CL	U	O	M90	100	1.1	8500	7700
	MP 100W/U/UVS/PS/3K	EDX17	CL	U	O	M90	100	1.1	8500	7700
Westinghouse Lighting	MH100/U	BD17	CL	U	NS	M90TW	NS	NS	9000	
125 W										
Venture Lighting	MH 125W/C/HBU/PS	ED17	CO	BU ±90	E	M150	125	1.1	11400	10300
	MH 125W/HBU/PS	ED17	CL	BU ±90	E	M150	125	1.1	12000	10800
	MP 125W/BU/UVS/PS	EDX17	CL	BU ±15	O	M150	125	1.1	11400	NA
	MP 125W/C/BU/UVS/PS	EDX17	CO	BU ±15	O	M150	125	1.1	10800	NA
150 W										
EYE Lighting	MP150/U/3K	ED17	CL	U	O	M120	NS	NS	13300	
	MPF150/U/3K	ED17	CO	U	O	M120	NS	NS	12000	
	MT150/D	T13	CL	U	O	M160	95	1.9	11000	
	MT150/SDW	T13	CL	U	O	M160	95	1.9	10000	
	MT150/SLW	T13	CL	U	O	M160	95	1.9	9500	
	MT150/SW	T13	CL	U	O	M160	95	1.9	11000	
	MT150F/D	T13	CO	U	O	M160	95	1.9	10500	
	MT150F/SDW	T13	CO	U	O	M160	95	1.9	9600	
	MT150F/SLW	T13	CO	U	O	M160	95	1.9	9000	
	MT150F/SW	T13	CO	U	O	M160	95	1.9	10500	

Mean Light Output (lm) [b]		Lamp Efficacy (LPW) [c]	Average Rated Life (h) [b]		CCT (K)	CRI	Warm-up Time (min) [d]	Restrike Time (min)
V	H		V	H				
5750	5450	87	15000		3200	70	2	4
5000	4800	80	15000		4000	70	2	4
6000	5750	92	15000		3200	70	2	4
5300	5100	85	15000		4000	70	2	4
5600	5500	82	15000		3200	70	2	4
4800	4650	76	15000		4000	70	2	4
5700	5575	88	15000		3200	70	2	4
4900	4800	81	15000		4000	70	2	4
5500	5000	85	15000	11250	3700	70	1-2	2-4
5900	5300	90	15000	11250	4000	65	1-2	2-4
5300	4800	81	15000	11250	3700	70	1-2	3-5
5300	4800	81	15000	11250	3200	70	1-2	3-5
5300	NA	81	15000	NA	2700	70	1-2	3-5
5500	5000	85	15000	11250	4000	65	1-2	3-5
5500	5000	85	15000	11250	3200	65	1-2	3-5
6800		90	15000		4000	65	NS	NS
8000	NS	91	15000	11250	3700	70	2-3	3-5
8400	NS	96	15000	11250	4000	65	2-3	3-5
8000	NA	91	15000	NA	4000	65	2-3	3-5
7600	NA	86	15000	NA	3700	70	2-3	3-5
10000		89	15000	10000	3000	75	NS	NS
9000		80	15000	10000	2900	75	NS	NS
9000		73	12000		6500	96	4	<15
8000		67	12000		3500	96	4	<15
7600		63	12000		3000	96	4	<15
9000		73	12000		4500	96	4	<15
8600		70	12000		6500	96	4	<15
7700		64	12000		3500	96	4	<15
7200		60	12000		3000	96	4	<15
8600		70	12000		4500	96	4	<15

NA = Not applicable; NS = Not supplied

O = Open; E = Enclosed; CL = Clear; CO = Coated; V = Vertical; H = Horizontal

✔ Product tested by NLPIP

[a] BU ±15 = base up ±15°; BU ±90 = base up ±90°; BU/BD ±60 = base up or base down ±60°; H = horizontal ±30°; V ±15 = vertical ±15°; VBD ±15 = vertical base down ±15°; VBU ±15 = vertical base up ±15°; U = universal

[b] Merged cells indicate that the manufacturer's literature did not specify an operating position.

[c] Calculated from vertical initial light output, where available.

[d] The percentage of light output defined as the warm-up period varies for each manufacturer: EYE – 90%; GE – 90%; Philips – 80%; Venture – 90%; All others – Not stated

[e] Manufactuer indicates that operating this lamp in off-vertical positions will result in reduced lumen output.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 2 (continued). Manufacturer-Supplied Information: Low-Wattage Pulse-Start Quartz Metal Halide Lamps with Medium Base (E26)

Manufacturer	Catalog Number	Bulb Shape	Bulb Finish	Operating Position [a]	Luminaire Type	ANSI Code	Lamp Voltage (V)	Lamp Current (A)	Initial Light Output (lm) [b]	
									V	H
150 W (continued)										
GE Lighting	MVR150/C/U/MED	ED17	CO	U	E	M102	95	NS	13300	
	MVR150/U/MED	ED17	CL	U	E	M102	95	NS	14000	
	MXR150/C/U/MED	ED17	CO	U	E	M102	95	NS	12600	
	MXR150/C/U/MED/O	ED17	CO	U	O	M102	95	NS	12000	
	MXR150/U/MED	ED17	CL	U	E	M102	95	NS	13300	
	MXR150/U/MED/O	ED17	CL	U	O	M102	95	NS	12500	
Halco Lighting	MH150/C/U/MED/PS	BD17	CO	U	E	M102	NS	NS	11800	
	MH150/U/MED/PS	BD17	CL	U	E	M102	NS	NS	13500	
	MP150/U/MED/PS	ED17	CL	U	O	M102	NS	NS	11800	
Litetronics	MP150/U/CL/MED	ED17	CL	U	O	M102	NS	NS	12000	
OSRAM SYLVANIA	MP150/C/U/MED	E17	CO	U	O	M102	95	1.8	11600	NS[e]
	MP150/U/MED	E17	CL	U	O	M102	95	1.8	12900	NS[e]
	MPD150/C/U/MED/840	E17	CO	U	O	M102	90	1.8	11500	NS[e]
	MPD150/U/MED/840	E17	CL	U	O	M102	90	1.8	12500	NS[e]
Ushio	MH150/C/U/MED/32/PS	ED17	CO	U	E	M102	NS	NS	13500	12000
	MH150/C/U/MED/42/PS	ED17	CO	U	E	M102	NS	NS	13500	11600
	MH150/U/MED/32/PS	ED17	CL	U	E	M102	NS	NS	14000	12500
	MH150/U/MED/42/PS	ED17	CL	U	E	M102	NS	NS	14000	12100
	MP150/C/U/MED/32/PS	EDX17	CO	U	O	M102	NS	NS	12800	11600
	MP150/C/U/MED/42/PS	EDX17	CO	U	O	M102	NS	NS	11700	11400
	MP150/U/MED/32/PS	EDX17	CL	U	O	M102	NS	NS	13300	12400
	MP150/U/MED/42/PS	EDX17	CL	U	O	M102	NS	NS	12300	12200
Venture Lighting	MH 150W/C/U/PS	ED17	CO	U	E	M102	95	1.8	13300	12000
	MH 150W/U/PS	ED17	CL	U	E	M102	95	1.8	14000	12600
	MP 150W/C/U/UVS/PS	EDX17	CO	U	O	M102	95	1.8	12600	11300
	MP 150W/C/U/UVS/PS/3K	EDX17	CO	U	O	M102	95	1.8	12600	11300
	MP 150W/U/UVS/PS	EDX17	CL	U	O	M102	95	1.8	13300	12000
	MP 150W/U/UVS/PS/3K	EDX17	CL	U	O	M102	95	1.8	13300	12000

Mean Light Output (lm) [b]		Lamp Efficacy (LPW) [c]	Average Rated Life (h) [b]		CCT (K)	CRI	Warm-up Time (min) [d]	Restrike Time (min)
V	H		V	H				
10000		88	15000		3900	65	2–5	10–15
10500		93	15000		4300	65	2–5	10–15
9500		84	15000		3100	60	2–5	10–15
8300		80	15000		3500	70	2–5	10–15
10000		88	15000		3400	60	2–5	10–15
8600		83	15000		3500	70	2–5	10–15
NS	NS	79	15000		3700	70	NS	NS
NS	NS	90	10000		4000	65	NS	NS
NS	NS	79	15000		4000	65	NS	NS
NS	NS	80	10000		4000	75	NS	NS
9000	NS[e]	77	15000	10000	2900	75	2–4	5–7
10000	NS[e]	86	15000	10000	3000	75	2–4	5–7
9500	NS[e]	77	7500	6000	4000	88	2–4	5–7
11000	NS[e]	83	7500	6000	4200	88	2–4	5–7
9100	8200	90	15000		3200	70	2	4
9600	9400	90	15000		4200	75	2	4
9400	8600	93	15000		3200	70	2	4
9700	9600	93	15000		4200	75	2	4
8900	8100	85	15000		3200	70	2	4
9600	9300	78	15000		4200	75	2	4
9200	8300	89	15000		3200	70	2	4
9500	9400	82	15000		4200	75	2	4
10000	9000	89	15000	11250	3700	70	1-2	2-4
10500	9500	93	15000	11250	4000	65	1-2	2-4
9500	8500	84	15000	11250	3700	70	1-2	3-5
9500	8500	84	15000	11250	3200	70	1-2	3-5
10000	9000	89	15000	11250	4000	65	1-2	3-5
10000	9000	89	15000	11250	3200	65	1-2	3-5

NA = Not applicable; NS = Not supplied

O = Open; E = Enclosed; CL = Clear; CO = Coated; V = Vertical; H = Horizontal

✔ Product tested by NLPIP

[a] BU ±15 = base up ±15°; BU ±90 = base up ±90°; BU/BD ±60 = base up or base down ±60°; H = horizontal ±30°; V ±15 = vertical ±15°; VBD ±15 = vertical base down ±15°; VBU ±15 = vertical base up ±15°; U = universal

[b] Merged cells indicate that the manufacturer's literature did not specify an operating position.

[c] Calculated from vertical initial light output, where available.

[d] The percentage of light output defined as the warm-up period varies for each manufacturer: EYE – 90%; GE – 90%; Philips – 80%; Venture – 90%; All others – Not stated

[e] Manufactuer indicates that operating this lamp in off-vertical positions will result in reduced lumen output.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 3. Manufacturer-Supplied Information: Low-Wattage Probe-Start Quartz Metal Halide Lamps with Medium Base (E26)

Manufacturer	Catalog Number	Bulb Shape	Bulb Finish	Operating Position [a]	Luminaire Type	ANSI Code	Lamp Voltage (V)	Lamp Current (A)	Initial Light Output (lm) [b]	
									V	H
50 W										
Halco Lighting	MP50UCMED/M	ED17	CO	U	O	M110	NS	NS	3200	
Howard Lighting Products	MH50/C/U/MED	ED17	CO	U	E	M110	NS	NS	3200	
	MH50/U/MED	ED17	CL	U	E	M110	NS	NS	3400	
Ushio	UMH-50/C/U	ED17	CO	U	E	M107	NS	NS	3200	
	UMH-50/U	ED17	CL	U	E	M107	NS	NS	3400	
70 W										
Halco Lighting	MP70UCMED/M	ED17	CO	U	O	M98	NS	NS	5300	
Howard Lighting Products	MH70/C/U/MED	ED17	CO	U	E	M98	NS	NS	5700	
	MH70/U/MED	ED17	CL	U	E	M98	NS	NS	6000	
Ushio	UMH-70/C/U	ED17	CO	U	E	M98	NS	NS	5700	
	UMH-70/U	ED17	CL	U	E	M98	NS	NS	6000	
100 W										
Halco Lighting	MP100UCMED/M	ED17	CO	U	O	M90	NS	NS	8500	
Howard Lighting Products	MH100/C/U/MED	ED17	CO	U	E	M90	NS	NS	8000	
	MH100/U/MED	ED17	CL	U	E	M90	NS	NS	8500	
Ushio	UMH-100/C/U	ED17	CO	U	E	M90	NS	NS	8000	
	UMH-100/U	ED17	CL	U	E	M90	NS	NS	8500	
150 W										
Howard Lighting Products	MH150/C/U/MED	ED17	CO	U	E	M102	NS	NS	11000	
	MH150/U/MED	ED17	CL	U	E	M102	NS	NS	12000	
Philips Lighting	MH150/C/U/M	BD17	CO	U	E	M107	110	NS	12000	NS
	MH150/U/M	BD17	CL	U	E	M107	110	NS	12500	NS
Ushio	UMH-150/C/U	ED17	CO	U	E	M102	NS	NS	13500	
	UMH-150/U	ED17	CL	U	E	M102	NS	NS	14000	

Mean Light Output (lm) [b]		Lamp Efficacy (LPW) [c]	Average Rated Life (h) [b]		CCT (K)	CRI	Warm-up Time (min) [d]	Restrike Time (min)
V	H		V	H				
NS	NS	64	15000		2900	70	NS	NS
1750	NS	64	10000	7500	4000	70	NS	NS
2000	NS	68	10000	7500	4200	70	NS	NS
NS	NS	64	10000	7500	3700	65–70	NS	NS
NS	NS	68	10000	7500	4000	65–70	NS	NS
NS	NS	76	12000		3200	70	NS	NS
4100	NS	81	15000	10000	4000	70	NS	NS
4400	NS	86	15000	10000	4200	70	NS	NS
NS	NS	81	15000	11250	4200	65–70	NS	NS
NS	NS	86	15000	11250	4200	65–70	NS	NS
NS	NS	85	15000		3200	70	NS	NS
5500	NS	80	15000	10000	4000	70	NS	NS
5800	NS	85	15000	10000	4200	70	NS	NS
NS	NS	80	15000	11250	4000	65–70	NS	NS
NS	NS	85	15000	11250	4000	65–70	NS	NS
9000	NS	73	15000	10000	4000	70	NS	NS
10000	NS	80	15000	10000	4200	70	NS	NS
7900	NS	80	10000	7500	3400	65	NS	10–20
8500	NS	83	10000	7500	3700	65	NS	10–20
NS	NS	90	15000	11250	4200	65–70	NS	NS
NS	NS	93	15000	11250	4200	65–70	NS	NS

NA = Not applicable; NS = Not supplied

O = Open; E = Enclosed; CL = Clear; CO = Coated; V = Vertical; H = Horizontal

✓ Product tested by NLPIP

[a] BU ±15 = base up ±15°; BU ±90 = base up ±90°;
BU/BD ±60 = base up or base down ±60°;
H = horizontal ±30°; V ±15 = vertical ±15°;
VBD ±15 = vertical base down ±15°; VBU ±15 = vertical base up ±15°;
U = universal

[b] Merged cells indicate that the manufacturer's literature did not specify an operating position.

[c] Calculated from vertical initial light output, where available.

[d] The percentage of light output defined as the warm-up period varies for each manufacturer: EYE – 90%; GE – 90%; Philips – 80%; Venture – 90%; All others – Not stated

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 4. Manufacturer-Supplied Information: Electronic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Trade Name	Catalog Number	ANSI Code	Input Power (W)	Input Current (A)	System Power Factor	Input Current THD (%) [a]	Lamp CCF [b]	Lamp Operating Frequency (Hz)	Min. Starting Temp. (°F) [c]
One 20 W Lamp, 120-277 V										
Metrolight	SuperHID	M20MH-UX-US-C-ND	M156	24	0.36	≥0.90	<10	NS	166	–25
		M20MH-UX-US-S-ND	M156	24	0.36	≥0.90	<10	NS	166	–25
One 20 W Lamp, 230-277 V										
Metrolight	SuperHID	M20MH-277-US-C-ND	M156	24	0.36	≥0.90	<10	NS	166	–25
		M20MH-277-US-S-ND	M156	24	0.36	≥0.90	<10	NS	166	–25
One 20 W Lamp, 120 V										
AC Electronics		AC-MH20UVS	M156	24	0.20	0.99	<7	1.4	NS	–22
Future Wave Technologies		FWKMHS-120	NS	23	0.18	0.99	<10	NS	NS	–22
		FWKMHS-120S	NS	23	0.18	0.99	<10	NS	NS	–22
Hatch Transformers		MC20-1-F-120U	[e]	22	0.20	>0.99	<5	<1.3	150	–22
		MC20-1-F-120V	[e]	22	0.20	>0.99	<5	<1.3	150	–22
		MC20-1-F-120VN	[e]	22	0.20	>0.99	<5	<1.3	150	–22
		MC20-1-F-UNNV	[e]	22	0.20	>0.99	<10	<1.3	150	–22
		MC20-1-F-UNNVN	[e]	22	0.20	>0.99	<10	<1.3	150	–22
		MC20-1-J-120U	[e]	22	0.20	>0.99	<5	<1.3	150	–22
Metrolight	SuperHID	M20MH-120-US-C-ND	M156	24	0.36	≥0.90	<10	NS	166	–25
		M20MH-120-US-S-ND	M156	24	0.36	≥0.90	<10	NS	166	–25
OSRAM SYLVANIA	QUICKTRONIC	QTP1x20MH/UNV F	M156	23	NS	>0.98	<10	<1.2	165	–20
		QTP1x20MH/UNV J	M156	23	NS	>0.98	<10	<1.2	165	–20
PowerSelect		PS10B20L	M156	24	0.20	>0.95	<10	<1.2	150	–22
		PS13B20T	M156	24	0.20	>0.95	<10	<1.2	150	–22
Sage Lighting		NMHU120	M156	24	0.20	0.99	10	<1.6	170	–22
Universal Lighting Technologies [f]	E-Tensity	EC20UNVxx	M156	26	0.22	>0.90	<20	<1.5	low	–22
		EC20120xx	M156	26	0.22	>0.90	<20	<1.5	low	–22
Vossloh-Schwabe [g]		M2012-27CK-3EU-F	M156	24	0.21	>0.95	<15	1.2	170	5
		M2012-27CK-3EU-J	M156	24	0.21	>0.95	<15	1.2	170	5
		M2012CK-6EUN-F	M156	23	0.20	>0.95	<20	1.4	170	5
		M2012CK-6EU-F	M156	23	0.20	>0.95	<20	1.4	170	5
One 20 W Lamp, 208 V										
Hatch Transformers		MC20-1-F-UNNV	[e]	22	0.11	>0.99	<10	<1.3	150	–22
		MC20-1-F-UNNVN	[e]	22	0.11	>0.99	<10	<1.3	150	–22
Universal Lighting Technologies [f]	E-Tensity	EC20UNVxx	M156	26	0.14	>0.90	<20	<1.5	low	–22
One 20 W Lamp, 277 V										
AC Electronics		AC-MH20UVS	M156	24	0.09	0.98	8	1.4	NS	–22
Future Wave Technologies		FWKMHS-720	NS	23	0.08	0.99	<10	NS	NS	–22
		FWKMHS-720S	NS	23	0.08	0.99	<10	NS	NS	–22

Max. Ballast Case Temp. (°F)[c, d]	Sound Rating (A-D)	Dimensions[b] L (in.)	W (in.)	H (in.)	Total Weight (lb)[b]
194	NS	5.0	1.9	1.3	0.5
194	NS	5.0	1.9	1.3	0.5
194	NS	3.9	1.8	1.2	0.5
194	NS	3.9	1.8	1.2	0.5
194	A	4.4	3.0	1.3	0.7
167	A	5.5	3.6	1.3	NS
194	A	5.5	3.6	1.3	NS
176	A	4.1	3.1	1.3	0.6
176	A	5.8	1.7	1.3	0.6
176	A	5.8	1.7	1.3	0.6
176	A	5.5	1.7	1.2	0.6
176	A	5.0	1.7	1.2	0.6
176	A	3.5	3.1	1.3	0.6
194	NS	3.9	1.8	1.2	0.5
194	NS	3.9	1.8	1.2	0.5
176	A	5.0	3.4	1.4	0.6
176	A	4.6	3.4	1.4	0.6
176	A	5.5	1.7	1.2	1.0
176	A	3.8	3.0	1.2	0.7
194	A	4.4	3.0	1.3	NS
176	A	4.9	1.9	1.2	0.3
176	A	4.4	1.8	1.2	0.3
176	A	5.5	3.6	1.6	1.4
176	A	5.0	3.6	1.6	1.4
185	A	5.3	1.7	1.2	0.6
176	A	3.7	3.0	1.2	0.7
176	A	5.5	1.7	1.2	0.6
176	A	5.0	1.7	1.2	0.6
176	A	4.9	1.9	1.2	0.3
194	A	4.4	3.0	1.3	0.7
167	A	5.5	3.6	1.3	NS
194	A	5.5	3.6	1.3	NS

NS = Not supplied ✔ Product tested by NLPIP

[a] Units have been rounded to the nearest whole number.

[b] Units have been rounded to one decimal place.

[c] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[d] This is the maximum temperature recommended by the manufacturer. In some cases, the manufacturer may recommend an alternative lower temperature that will result in a longer warranty period. Consult the manufacturer's literature for more information.

[e] This manufacturer uses a defined list of lamps that its ballasts can operate, rather than lamps of a specific ANSI code. Contact the manufacturer for more information.

[f] Ballast model numbers are completed by the addition of a code indicating the leads and mounting options. See the manufacturer's catalog for more information.

[g] Ballasts previously made under the brand name Aromat.

[h] This ballast model was updated after NLPIP testing began. Specifications listed here reflect the most recent model.

[i] This ballast model number may also appear as 120-MH75.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 4 (continued). Manufacturer-Supplied Information: Electronic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Trade Name	Catalog Number	ANSI Code	Input Power (W)	Input Current (A)	System Power Factor	Input Current THD (%) [a]	Lamp CCF [b]	Lamp Operating Frequency (Hz)	Min. Starting Temp. (°F) [c]
One 20 W Lamp, 277 V (continued)										
Hatch Transformers		MC20-1-F-277U	[e]	22	0.09	>0.99	<5	<1.3	150	–22
		MC20-1-F-277V	[e]	22	0.09	>0.99	<5	<1.3	150	–22
		MC20-1-F-277VN	[e]	22	0.09	>0.99	<5	<1.3	150	–22
		MC20-1-F-UNNV	[e]	22	0.09	>0.99	<10	<1.3	150	–22
		MC20-1-F-UNNVN	[e]	22	0.09	>0.99	<10	<1.3	150	–22
		MC20-1-J-277U	[e]	22	0.09	>0.99	<5	<1.3	150	–22
OSRAM SYLVANIA	QUICKTRONIC	QTP1x20MH/UNV F	NS	23	NS	>0.98	<10	<1.2	165	–20
		QTP1x20MH/UNV J	NS	23	NS	>0.98	<10	<1.2	165	–20
Sage Lighting		NMHU120	M156	24	0.09	0.99	15	<1.6	170	–22
Universal Lighting Technologies [f]	E-Tensity	EC20UNVxx	M156	26	0.11	>0.90	<20	<1.5	low	–22
Vossloh-Schwabe [g]		M2012-27CK-3EU-F	M156	24	0.10	>0.95	<15	1.2	170	5
		M2012-27CK-3EU-J	M156	24	0.10	>0.95	<15	1.2	170	5
One 20 W Lamp, 347 V										
Future Wave Technologies		FWKMHS-320	NS	23	0.07	0.99	<10	NS	NS	–22
		FWKMHS-320S	NS	23	0.07	0.99	<10	NS	NS	–22
Two 20 W Lamps, 120 V										
Hatch Transformers		MC20-2-F-UNNU	[e]	44	0.20	>0.99	<10	<1.3	150	–22
		MC20-2-J-UNNU	[e]	44	0.20	>0.99	<10	<1.3	150	–22
Two 20 W Lamps, 208 V										
Hatch Transformers		MC20-2-F-UNNU	[e]	44	0.11	>0.99	<10	<1.3	150	–22
		MC20-2-J-UNNU	[e]	44	0.11	>0.99	<10	<1.3	150	–22
Two 20 W Lamps, 277 V										
Hatch Transformers		MC20-2-F-UNNU	[e]	44	0.09	>0.99	<10	<1.3	150	–22
		MC20-2-J-UNNU	[e]	44	0.09	>0.99	<10	<1.3	150	–22
One 22 W Lamp, 120 V										
Advance [f]	e-Vision	RMH-20-K-XXX	M175	26	0.23	>0.90	<15	<1.5	<200	–20
		RMH-20-E-XXX	M175	26	0.23	>0.90	<10	<1.5	<200	–4
Hatch Transformers		MC22-1-F-UNNV	[e]	25	0.21	>0.99	<10	<1.3	150	–22
		MC22-1-F-UNNVN	[e]	25	0.21	>0.99	<10	<1.3	150	–22
One 22 W Lamp, 208 V										
Hatch Transformers		MC22-1-F-UNNV	[e]	25	0.12	>0.99	<10	<1.3	150	–22
		MC22-1-F-UNNVN	[e]	25	0.12	>0.99	<10	<1.3	150	–22
One 22 W Lamp, 277 V										
Hatch Transformers		MC22-1-F-UNNV	[e]	25	0.10	>0.99	<10	<1.3	150	–22
		MC22-1-F-UNNVN	[e]	25	0.10	>0.99	<10	<1.3	150	–22

Max. Ballast Case Temp. (°F) [c, d]	Sound Rating (A-D)	Dimensions [b] L (in.)	W (in.)	H (in.)	Total Weight (lb) [b]
176	A	4.1	3.1	1.3	0.6
176	A	5.8	1.7	1.3	0.6
176	A	5.8	1.7	1.3	0.6
176	A	5.5	1.7	1.2	0.6
176	A	5.0	1.7	1.2	0.6
176	A	3.5	3.1	1.3	0.6
176	A	5.0	3.4	1.4	0.6
176	A	4.6	3.4	1.4	0.6
194	A	4.4	3.0	1.3	NS
176	A	4.9	1.9	1.2	0.3
176	A	5.5	3.6	1.6	1.4
176	A	5.0	3.6	1.6	1.4
167	A	5.5	3.6	1.3	NS
194	A	5.5	3.6	1.3	NS
176	A	5.5	3.6	1.6	0.9
176	A	4.8	3.6	1.6	0.9
176	A	5.5	3.6	1.6	0.9
176	A	4.8	3.6	1.6	0.9
176	A	5.5	3.6	1.6	0.9
176	A	4.8	3.6	1.6	0.9
194	A	5.5	1.3	1.2	0.4
158	A	5.5	1.7	1.2	0.4
176	A	5.5	1.7	1.2	0.6
176	A	5.0	1.7	1.2	0.6
176	A	5.5	1.7	1.2	0.6
176	A	5.0	1.7	1.2	0.6
176	A	5.5	1.7	1.2	0.6
176	A	5.0	1.7	1.2	0.6

NS = Not supplied ✔ Product tested by NLPIP

[a] Units have been rounded to the nearest whole number.

[b] Units have been rounded to one decimal place.

[c] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[d] This is the maximum temperature recommended by the manufacturer. In some cases, the manufacturer may recommend an alternative lower temperature that will result in a longer warranty period. Consult the manufacturer's literature for more information.

[e] This manufacturer uses a defined list of lamps that its ballasts can operate, rather than lamps of a specific ANSI code. Contact the manufacturer for more information.

[f] Ballast model numbers are completed by the addition of a code indicating the leads and mounting options. See the manufacturer's catalog for more information.

[g] Ballasts previously made under the brand name Aromat.

[h] This ballast model was updated after NLPIP testing began. Specifications listed here reflect the most recent model.

[i] This ballast model number may also appear as 120-MH75.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 4 (continued). Manufacturer-Supplied Information: Electronic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Trade Name	Catalog Number	ANSI Code	Input Power (W)	Input Current (A)	System Power Factor	Input Current THD (%) [a]	Lamp CCF [b]	Lamp Operating Frequency (Hz)	Min. Starting Temp. (°F) [c]
Two 22 W Lamps, 120 V										
Hatch Transformers		MC22-2-F-UNNU	[e]	50	0.21	>0.99	<10	<1.3	150	–22
		MC22-2-J-UNNU	[e]	50	0.21	>0.99	<10	<1.3	150	–22
Two 22 W Lamps, 208 V										
Hatch Transformers		MC22-2-F-UNNU	[e]	50	0.12	>0.99	<10	<1.3	150	–22
		MC22-2-J-UNNU	[e]	50	0.12	>0.99	<10	<1.3	150	–22
Two 22 W Lamps, 277 V										
Hatch Transformers		MC22-2-F-UNNU	[e]	50	0.10	>0.99	<10	<1.3	150	–22
		MC22-2-J-UNNU	[e]	50	0.10	>0.99	<10	<1.3	150	–22
One 35 W Lamp, 120 V										
AC Electronics		AC-MH35UVS	M130	48	0.40	0.99	<6	1.4	NS	–22
Future Wave Technologies		FWKMHS-135	NS	39	0.32	0.99	<10	NS	NS	–22
		FWKMHS-135S	NS	39	0.32	0.99	<10	NS	NS	–22
Sage Lighting		NMHU135	M130	45	0.38	0.99	10	<1.6	170	–22
Sunpark Electronics		120-MH35	M130	39	0.33	>0.99	<10	<1.7	150	–10
		120-MH35T	M130	39	0.33	>0.99	<10	<1.7	NS	–10
One 35 W Lamp, 277 V										
AC Electronics		AC-MH35UVS	M130	46	0.17	0.99	<9	1.4	NS	–22
Future Wave Technologies		FWKMHS-735	NS	39	0.15	0.99	<10	NS	NS	–22
		FWKMHS-735S	NS	39	0.15	0.99	<10	NS	NS	–22
Sage Lighting		NMHU135	M130	45	0.16	0.99	10	<1.6	170	–22
One 35 W Lamp, 347 V										
Future Wave Technologies		FWKMHS-335	NS	39	0.12	0.99	<10	NS	NS	–22
		FWKMHS-335S	NS	39	0.12	0.99	<10	NS	NS	–22
Two 35 W Lamps, 120 V										
Sage Lighting		NMHU235	M130	93	0.77	0.99	10	<1.6	170	–22
Two 35 W Lamps, 277 V										
Sage Lighting		NMHU235	M130	93	0.33	0.99	10	<1.6	170	–22
One 39 W Lamp, 120-277 V										
Metrolight	SuperHID	M39MH-UX-US-C-ND	M130	46	0.48	≥0.96	<10	NS	166	–25
		M39MH-UX-US-S-ND	M130	46	0.48	≥0.96	<10	NS	166	–25
One 39 W Lamp, 230-277 V										
Metrolight	SuperHID	M39MH-277-US-C-ND	M130	46	0.48	≥0.96	<10	NS	166	–25
		M39MH-277-US-S-ND	M130	46	0.48	≥0.96	<10	NS	166	–25

Max. Ballast Case Temp. (°F) [c, d]	Sound Rating (A-D)	Dimensions [b] L (in.)	W (in.)	H (in.)	Total Weight (lb) [b]
176	A	5.5	3.6	1.6	0.9
176	A	4.8	3.6	1.6	0.9
176	A	5.5	3.6	1.6	0.9
176	A	4.8	3.6	1.6	0.9
176	A	5.5	3.6	1.6	0.9
176	A	4.8	3.6	1.6	0.9
194	A	4.4	3.0	1.3	0.7
167	A	5.5	3.6	1.3	NS
194	A	5.5	3.6	1.3	NS
194	A	4.4	3.0	1.3	NS
185	NS	5.5	3.5	1.6	NS
185	NS	11.5	2.0	1.8	NS
194	A	4.4	3.0	1.3	0.7
167	A	5.5	3.6	1.3	NS
194	A	5.5	3.6	1.3	NS
194	A	4.4	3.0	1.3	NS
167	A	5.5	3.6	1.3	NS
194	A	5.5	3.6	1.3	NS
194	A	5.5	3.6	1.3	NS
194	A	5.5	3.6	1.3	NS
194	NS	5.0	1.9	1.3	0.5
194	NS	5.0	1.9	1.3	0.5
194	NS	3.9	1.8	1.2	0.5
194	NS	3.9	1.8	1.2	0.5

NS = Not supplied ✔ Product tested by NLPIP

[a] Units have been rounded to the nearest whole number.

[b] Units have been rounded to one decimal place.

[c] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[d] This is the maximum temperature recommended by the manufacturer. In some cases, the manufacturer may recommend an alternative lower temperature that will result in a longer warranty period. Consult the manufacturer's literature for more information.

[e] This manufacturer uses a defined list of lamps that its ballasts can operate, rather than lamps of a specific ANSI code. Contact the manufacturer for more information.

[f] Ballast model numbers are completed by the addition of a code indicating the leads and mounting options. See the manufacturer's catalog for more information.

[g] Ballasts previously made under the brand name Aromat.

[h] This ballast model was updated after NLPIP testing began. Specifications listed here reflect the most recent model.

[i] This ballast model number may also appear as 120-MH75.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 4 (continued). Manufacturer-Supplied Information: Electronic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Trade Name	Catalog Number	ANSI Code	Input Power (W)	Input Current (A)	System Power Factor	Input Current THD (%) [a]	Lamp CCF [b]	Lamp Operating Frequency (Hz)	Min. Starting Temp. (°F) [c]
One 39 W Lamp, 120 V										
Advance [f]	e-Vision	IMH-39-G-XXX	M130	46	0.39	>0.95	<15	<1.5	<200	–20
		IMH-39-J-XXX	M130	46	0.39	>0.95	<15	<1.5	<200	–20
		IMH-50-A-XXX	M130	45	0.38	>0.90	<15	<1.5	<200	–20
		RMH-39-K-XXX	M130	45	0.40	>0.90	<15	<1.5	<200	–20
Fulham	High Horse	HH-MH-120-039	M130	43	0.40	0.98	<10	1.4	NS	–20
Hatch Transformers		MC39-1-F-120U	[e]	43	0.36	>0.99	<5	<1.3	150	–22
		MC39-1-F-120V	[e]	43	0.36	>0.99	<5	<1.3	150	–22
		MC39-1-F-120VN	[e]	43	0.36	>0.99	<5	<1.3	150	–22
		MC39-1-F-UNNV	[e]	43	0.36	>0.99	<10	<1.3	150	–22
		MC39-1-F-UNNVN	[e]	43	0.36	>0.99	<10	<1.3	150	–22
		MC39-1-J-120U	[e]	43	0.36	>0.99	<5	<1.3	150	–22
Metrolight	SuperHID	M39MH-120-US-C-ND	M130	46	0.48	≥0.96	<10	NS	166	–25
		M39MH-120-US-S-ND	M130	46	0.48	≥0.96	<10	NS	166	–25
OSRAM SYLVANIA	QUICKTRONIC	QTP1x39MH/UNV F	M130	45	0.38	>0.98	<10	<1.2	165	–20
		QTP1x39MH/UNV F1	M130	44	0.37	>0.97	<15	<1.5	170	–5
		QTP1x39MH/UNV J	M130	45	0.38	>0.98	<10	<1.2	165	–20
		QTP1x39MH/UNV J1	M130	44	0.37	>0.97	<15	<1.5	170	–5
PowerSelect		PS10B39L	M130	44	0.36	>0.95	<10	<1.2	150	–22
		PS13B39L	M130	NS	0.36	>0.99	<5	<1.2	150	–22
		PS13B39T	M130	44	0.36	>0.95	<10	<1.2	150	–22
		PS13U90S	M130	45	0.37	>0.98	<7	<1.2	150	–22
		PS13U90T	M130	45	0.37	>0.98	<7	<1.2	150	–22
Sage Lighting		NMHU135	M130	45	0.38	0.99	10	<1.6	170	–22
Universal Lighting Technologies [f]	E-Tensity	EC39120xx	M130	45	0.38	>0.90	<20	<1.5	low	–22
		EC39UNVxx	M130	45	0.38	>0.90	<20	<1.5	low	–22
Vossloh-Schwabe [g]		M3912/27CK-5EU-JT2	M130	44	0.37	>0.95	<15	1.4	170	5
		M3912-27CK-5EU	M130	44	0.37	>0.95	<15	1.2	170	5
		M3912-27CK-5EU-F	M130	44	0.37	>0.95	<15	1.2	170	5
		M3912-27CK-5EU-J	M130	44	0.37	>0.95	<15	1.2	170	5
		M3912CK-6EU-F	M130	45	0.38	>0.95	<20	1.4	170	5
		M3912CK-6EUN-F	M130	45	0.38	>0.95	<20	1.4	170	5
One 39 W Lamp, 208 V										
Hatch Transformers		MC39-1-F-UNNV	[e]	43	0.21	>0.99	<10	<1.3	150	–22
		MC39-1-F-UNNVN	[e]	43	0.21	>0.99	<10	<1.3	150	–22
Universal Lighting Technologies [f]	E-Tensity	EC39UNVxx	M130	45	0.22	>0.90	<20	<1.5	low	–22

Max. Ballast Case Temp. (°F) [c, d]	Sound Rating (A-D)	Dimensions [b] L (in.)	W (in.)	H (in.)	Total Weight (lb) [b]
194	A	3.8	3.0	1.2	0.9
194	A	5.9	1.8	1.2	0.9
185	A	5.5	3.6	1.5	1.4
194	A	4.4	1.3	1.2	0.5
158	A	5.5	3.6	1.4	NS
176	A	4.1	3.1	1.3	0.6
176	A	5.8	1.7	1.3	0.6
176	A	5.8	1.7	1.3	0.6
176	A	5.5	1.7	1.2	0.6
176	A	5.0	1.7	1.2	0.6
176	A	3.5	3.1	1.3	0.6
194	NS	3.9	1.8	1.2	0.5
194	NS	3.9	1.8	1.2	0.5
176	A	5.0	3.4	1.4	0.6
176	A	5.5	3.6	1.6	1.3
176	A	4.6	3.4	1.4	0.6
176	A	5.0	3.6	1.6	1.3
176	A	5.5	1.7	1.2	1.0
194	A	8.0	1.8	1.5	1.0
176	A	3.8	3.0	1.2	0.7
176	A	4.7	3.4	1.6	1.4
176	A	5.4	3.4	1.6	1.3
194	A	4.4	3.0	1.3	NS
176	A	4.4	1.8	1.2	0.3
176	A	4.9	1.9	1.2	0.3
176	A	5.0	3.6	1.6	1.4
176	A	4.8	3.6	1.6	1.3
176	A	5.5	3.6	1.6	1.3
176	A	5.0	3.6	1.6	1.3
167	A	3.7	3.0	1.2	0.7
185	A	5.3	1.7	1.2	0.6
176	A	5.5	1.7	1.2	0.6
176	A	5.0	1.7	1.2	0.6
176	A	4.9	1.9	1.2	0.3

NS = Not supplied ✓ Product tested by NLPIP

[a] Units have been rounded to the nearest whole number.

[b] Units have been rounded to one decimal place.

[c] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[d] This is the maximum temperature recommended by the manufacturer. In some cases, the manufacturer may recommend an alternative lower temperature that will result in a longer warranty period. Consult the manufacturer's literature for more information.

[e] This manufacturer uses a defined list of lamps that its ballasts can operate, rather than lamps of a specific ANSI code. Contact the manufacturer for more information.

[f] Ballast model numbers are completed by the addition of a code indicating the leads and mounting options. See the manufacturer's catalog for more information.

[g] Ballasts previously made under the brand name Aromat.

[h] This ballast model was updated after NLPIP testing began. Specifications listed here reflect the most recent model.

[i] This ballast model number may also appear as 120-MH75.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 4 (continued). Manufacturer-Supplied Information: Electronic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Trade Name	Catalog Number	ANSI Code	Input Power (W)	Input Current (A)	System Power Factor	Input Current THD (%) [a]	Lamp CCF [b]	Lamp Operating Frequency (Hz)	Min. Starting Temp. (°F) [c]
One 39 W Lamp, 277 V										
Advance [f]	e-Vision	IMH-39-G-XXX	M130	45	0.18	>0.95	<15	<1.5	<200	–20
		IMH-39-J-XXX	M130	45	0.18	>0.95	<15	<1.5	<200	–20
		IMH-50-A-XXX	M130	44	0.16	>0.90	<15	<1.5	<200	–20
Hatch Transformers		MC39-1-F-277U	[e]	43	0.16	>0.99	<5	<1.3	150	–22
		MC39-1-F-277V	[e]	43	0.16	>0.99	<5	<1.3	150	–22
		MC39-1-F-277VN	[e]	43	0.16	>0.99	<5	<1.3	150	–22
		MC39-1-F-UNNV	[e]	43	0.16	>0.99	<10	<1.3	150	–22
		MC39-1-F-UNNVN	[e]	43	0.16	>0.99	<10	<1.3	150	–22
		MC39-1-J-277U	[e]	43	0.16	>0.99	<5	<1.3	150	–22
OSRAM SYLVANIA	QUICKTRONIC	QTP1x39MH/UNV F	M130	45	0.16	>0.98	<10	<1.2	165	–20
		QTP1x39MH/UNV F1	M130	44	0.17	>0.97	<15	<1.5	170	-5
		QTP1x39MH/UNV J	M130	45	0.16	>0.98	<10	<1.2	165	–20
		QTP1x39MH/UNV J1	M130	44	0.17	>0.97	<15	<1.5	170	–5
PowerSelect		PS13D39L	M130	45	0.16	>0.99	<7	<1.2	150	–22
		PS13D90S	M130	45	0.17	>0.98	<10	<1.2	150	–22
		PS13D90T	M130	45	0.17	>0.98	<10	<1.2	150	–22
		PS13U90S	M130	44	0.17	>0.98	<7	<1.2	150	–22
		PS13U90T	M130	44	0.17	>0.98	<7	<1.2	150	–22
Sage Lighting		NMHU135	M130	45	0.16	0.99	10	<1.6	170	–22
Universal Lighting Technologies	E-Tensity	EC39UNVxx	M130	45	0.17	>0.90	<20	<1.5	low	–22
Vossloh-Schwabe [g]		M3912/27CK-5EU-JT2	M130	44	0.17	>0.95	<15	1.4	170	5
		M3912-27CK-5EU	M130	44	0.17	>0.95	<15	1.2	170	5
		M3912-27CK-5EU-F	M130	44	0.17	>0.95	<15	1.2	170	5
		M3912-27CK-5EU-J	M130	44	0.17	>0.95	<15	1.2	170	5
One 39 W Lamp, 347 V										
AC Electronics		AC-MH335X	M130	45	0.13	0.99	<6	1.4	NS	–22
PowerSelect		PS13E90S	M130	45	0.14	>0.98	<17	<1.2	150	–22
		PS13E90T	M130	45	0.14	>0.98	<17	<1.2	150	–22
Two 39 W Lamps, 120-277 V										
Metrolight	SuperHID	M2x39MH-UX-US-C-ND	M130	92	0.48	≥0.96	<10	NS	166	–25
		M2x39MH-UX-US-S-ND	M130	92	0.48	≥0.96	<10	NS	166	–25
Two 39 W Lamps, 230-277 V										
Metrolight	SuperHID	M2x39MH-277-US-C-ND	M130	92	0.48	≥0.96	<10	NS	166	–25
		M2x39MH-277-US-S-ND	M130	92	0.48	≥0.96	<10	NS	166	–25

Max. Ballast Case Temp. (°F) [c, d]	Sound Rating (A-D)	Dimensions [b] L (in.)	W (in.)	H (in.)	Total Weight (lb) [b]
194	A	3.8	3.0	1.2	0.9
194	A	5.9	1.8	1.2	0.9
185	A	5.5	3.6	1.5	1.4
176	A	4.1	3.1	1.3	0.6
176	A	5.8	1.7	1.3	0.6
176	A	5.8	1.7	1.3	0.6
176	A	5.5	1.7	1.2	0.6
176	A	5.0	1.7	1.2	0.6
176	A	3.5	3.1	1.3	0.6
176	A	5.0	3.4	1.4	0.6
176	A	5.5	3.6	1.6	1.3
176	A	4.6	3.4	1.4	0.6
176	A	5.0	3.6	1.6	1.3
194	A	8.0	1.8	1.5	1.0
176	A	4.7	3.4	1.6	1.4
176	A	5.4	3.4	1.6	1.3
176	A	4.7	3.4	1.6	1.4
176	A	5.4	3.4	1.6	1.3
194	A	4.4	3.0	1.3	NS
176	A	4.9	1.9	1.2	0.3
176	A	5.0	3.6	1.6	1.4
176	A	4.8	3.6	1.6	1.3
176	A	5.5	3.6	1.6	1.3
176	A	5.0	3.6	1.6	1.3
194	A	4.4	3.0	1.3	0.7
176	A	4.7	3.4	1.6	1.4
176	A	5.4	3.4	1.6	1.3
194	NS	5.0	3.7	1.3	0.8
194	NS	5.0	3.7	1.3	0.8
194	NS	5.0	3.7	1.3	0.8
194	NS	5.0	3.7	1.3	0.8

NS = Not supplied ✓ Product tested by NLPIP

[a] Units have been rounded to the nearest whole number.

[b] Units have been rounded to one decimal place.

[c] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[d] This is the maximum temperature recommended by the manufacturer. In some cases, the manufacturer may recommend an alternative lower temperature that will result in a longer warranty period. Consult the manufacturer's literature for more information.

[e] This manufacturer uses a defined list of lamps that its ballasts can operate, rather than lamps of a specific ANSI code. Contact the manufacturer for more information.

[f] Ballast model numbers are completed by the addition of a code indicating the leads and mounting options. See the manufacturer's catalog for more information.

[g] Ballasts previously made under the brand name Aromat.

[h] This ballast model was updated after NLPIP testing began. Specifications listed here reflect the most recent model.

[i] This ballast model number may also appear as 120-MH75.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 4 (continued). Manufacturer-Supplied Information: Electronic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Trade Name	Catalog Number	ANSI Code	Input Power (W)	Input Current (A)	System Power Factor	Input Current THD (%) [a]	Lamp CCF [b]	Lamp Operating Frequency (Hz)	Min. Starting Temp. (°F) [c]
Two 39 W Lamps, 120 V										
AC Electronics		AC-2/39MHUVXS	M130	96	0.81	0.99	10	1.3	NS	–22
Advance [f]	e-Vision	IMH-239-A-XXX	M130	89	0.74	>0.95	<15	<1.5	<200	–4
Hatch Transformers		MC39-2-F-UNNU	[e]	86	0.36	>0.99	<10	<1.3	150	–22
		MC39-2-J-UNNU	[e]	86	0.36	>0.99	<10	<1.3	150	–22
Metrolight	SuperHID	M2x39MH-120-US-C-ND	M130	92	0.48	≥0.96	<10	NS	166	–25
		M2x39MH-120-US-S-ND	M130	92	0.48	≥0.96	<10	NS	166	–25
Sage Lighting		NMHU235	M130	93	0.77	0.99	10	<1.6	170	–22
Two 39 W Lamps, 208 V										
Hatch Transformers		MC39-2-F-UNNU	[e]	86	0.21	>0.99	<10	<1.3	150	–22
		MC39-2-J-UNNU	[e]	86	0.21	>0.99	<10	<1.3	150	–22
Two 39 W Lamps, 277 V										
AC Electronics		AC-2/39MHUVXS	M130	94	0.33	0.98	10	1.3	NS	–22
Advance [f]	e-Vision	IMH-239-A-XXX	M130	86	0.31	>0.95	<15	<1.5	<200	–4
Hatch Transformers		MC39-2-F-UNNU	[e]	86	0.16	>0.99	<10	<1.3	150	–22
		MC39-2-J-UNNU	[e]	86	0.16	>0.99	<10	<1.3	150	–22
Sage Lighting		NMHU235	M130	93	0.33	0.99	10	<1.6	170	–22
One 50 W Lamp, 120-277 V										
Metrolight	SuperHID	M50MHS-UX-US-C-ND	M110	58	0.63	≥0.96	<10	NS	166	–25
		M50MHS-UX-US-S-ND	M110	58	0.63	≥0.96	<10	NS	166	–25
One 50 W Lamp, 120 V										
AC Electronics		AC-MH50UVS	M110, M148	60	0.50	0.99	<4	1.4	NS	–22
Advance [f]	e-Vision	IMH-50-A-XXX	M110	56	0.47	>0.90	<15	<1.5	<200	–20
Fulham	High Horse	HH-MH-120-050	M110	63	0.55	0.98	<10	1.4	NS	–20
Hatch Transformers		MC50-1-F-120U	[e]	55	0.46	>0.99	<5	<1.3	150	–22
		MC50-1-F-120V	[e]	55	0.46	>0.99	<5	<1.3	150	–22
		MC50-1-F-120VN	[e]	55	0.46	>0.99	<5	<1.3	150	–22
		MC50-1-J-120U	[e]	55	0.46	>0.99	<5	<1.3	150	–22
PowerSelect		PS13U90S	M110, M148	57	0.48	>0.98	<7	<1.2	150	–22
		PS13U90T	M110, M148	57	0.48	>0.98	<7	<1.2	150	–22
Sage Lighting		NMHU150	M110, M118	56	0.46	0.99	10	<1.6	170	–22
Vossloh-Schwabe [g]		M5012-27CK-3EU-F	M110, M148	58	0.49	>0.95	<15	1.2	170	5
		M5012-27CK-3EU-J	M110, M148	58	0.49	>0.95	<15	1.2	170	5
One 50 W Lamp, 277 V										
AC Electronics		AC-MH50UVS	M110, M148	59	0.22	0.98	<12	1.4	NS	–22
Advance [f]	e-Vision	IMH-50-A-XXX	M110	55	0.20	>0.90	<15	<1.5	<200	–20

Max. Ballast Case Temp. (°F) [c, d]	Sound Rating (A-D)	Dimensions [b]			Total Weight (lb) [b]
		L (in.)	W (in.)	H (in.)	
194	A	5.5	3.6	1.3	1.5
185	A	5.5	3.6	1.5	1.6
176	A	5.5	3.6	1.6	0.9
176	A	4.8	3.6	1.6	0.9
194	NS	5.0	3.7	1.3	0.8
194	NS	5.0	3.7	1.3	0.8
194	A	5.5	3.6	1.3	NS
176	A	5.5	3.6	1.6	0.9
176	A	4.8	3.6	1.6	0.9
194	A	5.5	3.6	1.3	1.5
185	A	5.5	3.6	1.5	1.6
176	A	5.5	3.6	1.6	0.9
176	A	4.8	3.6	1.6	0.9
194	A	5.5	3.6	1.3	NS
194	NS	4.7	3.0	1.3	0.6
194	NS	4.7	3.0	1.3	0.6
194	A	5.5	3.6	1.3	1.3
185	A	5.5	3.6	1.5	1.4
158	A	5.5	3.6	1.4	NS
176	A	4.8	3.2	1.5	0.8
176	A	7.2	1.7	1.5	0.8
176	A	7.2	1.7	1.5	0.8
176	A	4.2	3.2	1.5	0.8
176	A	4.7	3.4	1.6	1.4
176	A	5.4	3.4	1.6	1.3
194	A	5.5	3.6	1.3	NS
176	A	5.5	3.5	1.6	1.4
176	A	4.7	3.5	1.6	1.4
194	A	5.5	3.6	1.3	1.3
185	A	5.5	3.6	1.5	1.4

NS = Not supplied ✓ Product tested by NLPIP

[a] Units have been rounded to the nearest whole number.

[b] Units have been rounded to one decimal place.

[c] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[d] This is the maximum temperature recommended by the manufacturer. In some cases, the manufacturer may recommend an alternative lower temperature that will result in a longer warranty period. Consult the manufacturer's literature for more information.

[e] This manufacturer uses a defined list of lamps that its ballasts can operate, rather than lamps of a specific ANSI code. Contact the manufacturer for more information.

[f] Ballast model numbers are completed by the addition of a code indicating the leads and mounting options. See the manufacturer's catalog for more information.

[g] Ballasts previously made under the brand name Aromat.

[h] This ballast model was updated after NLPIP testing began. Specifications listed here reflect the most recent model.

[i] This ballast model number may also appear as 120-MH75.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 4 (continued). Manufacturer-Supplied Information: Electronic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Trade Name	Catalog Number	ANSI Code	Input Power (W)	Input Current (A)	System Power Factor	Input Current THD (%) [a]	Lamp CCF [b]	Lamp Operating Frequency (Hz)	Min. Starting Temp. (°F) [c]
One 50 W Lamp, 277 V (continued)										
Hatch Transformers		MC50-1-F-277U	[e]	55	0.20	>0.99	<5	<1.3	150	–22
		MC50-1-F-277V	[e]	55	0.20	>0.99	<5	<1.3	150	–22
		MC50-1-F-277VN	[e]	55	0.20	>0.99	<5	<1.3	150	–22
		MC50-1-J-277U	[e]	55	0.20	>0.99	<5	<1.3	150	–22
PowerSelect		PS13U90S	M110, M148	56	0.21	>0.98	<7	<1.2	150	–22
		PS13U90T	M110, M148	56	0.21	>0.98	<7	<1.2	150	–22
Sage Lighting		NMHU150	M110, M118	56	0.20	0.99	10	<1.6	170	–22
Vossloh-Schwabe [g]		M5012-27CK-3EU-F	M110, M148	58	0.21	>0.95	<15	1.2	170	5
		M5012-27CK-3EU-J	M110, M148	58	0.21	>0.95	<15	1.2	170	5
One 70 W Lamp, 120-277 V										
Metrolight	SuperHID	M70MHS-UX-US-C-ND	M98, M143	78	0.88	≥0.96	<10	NS	166	–25
		M70MHS-UX-US-S-ND	M98, M143	78	0.88	≥0.96	<10	NS	166	–25
One 70 W Lamp, 120 V										
AC Electronics		AC-MH70EPL	M85, M98, M139, M143	82	0.69	0.99	<10	1.7	NS	–22
		AC-MH70UVS	M98, M139, M143	83	0.70	0.99	<8	1.3	NS	–22
Advance [f]	e-Vision	IMH-100-A-XXX ✓	M98, M139, M143	82	0.68	>0.90	<15	<1.5	<200	–20
		IMH-70-D-XXX	M98, M139, M143	80	0.67	>0.90	<15	<1.5	<200	–20
		IMH-70-G-XXX	M98, M139, M143	80	0.67	>0.90	<15	<1.5	<200	–20
		IMH-70-J-XXX	M98, M139, M143	80	0.67	>0.90	<15	<1.5	<200	–20
Fulham	High Horse	HH-MH-120-070 ✓	M98	82	0.72	0.98	<10	1.4	NS	–20
Future Wave Technologies		FWKMHS-170	NS	78	0.65	0.99	<10	NS	NS	–22
		FWKMHS-170S	NS	78	0.65	0.99	<10	NS	NS	–22
Hatch Transformers		MC70-1-F-120U ✓	[e]	77	0.64	>0.99	<5	<1.3	150	–22
		MC70-1-F-120V	[e]	77	0.64	>0.99	<5	<1.3	150	–22
		MC70-1-J-120U	[e]	77	0.64	>0.99	<5	<1.3	150	–22
		MC70-1-J-120V	[e]	77	0.64	>0.99	<5	<1.3	150	–22
OSRAM SYLVANIA	QUICKTRONIC	QTP1x70MH/UNV F ✓ [h]	M98, M139, M143	80	0.68	>0.98	<10	<1.2	165	–20
		QTP1x70MH/UNV F1	M98, M139	79	0.65	>0.97	<15	<1.5	170	–5
		QTP1x70MH/UNV J	M98, M139, M143	80	0.68	>0.98	<10	<1.2	165	–20
		QTP1x70MH/UNV J1	M98, M139	79	0.65	>0.97	<15	<1.5	170	–5

Max. Ballast Case Temp. (°F) [c, d]	Sound Rating (A-D)	Dimensions [b] L (in.)	W (in.)	H (in.)	Total Weight (lb) [b]
176	A	4.8	3.2	1.5	0.8
176	A	7.2	1.7	1.5	0.8
176	A	7.2	1.7	1.5	0.8
176	A	4.2	3.2	1.5	0.8
176	A	4.7	3.4	1.6	1.4
176	A	5.4	3.4	1.6	1.3
194	A	5.5	3.6	1.3	NS
176	A	5.5	3.5	1.6	1.4
176	A	4.7	3.5	1.6	1.4
194	NS	4.7	3.0	1.3	0.6
194	NS	4.7	3.0	1.3	0.6
194	A	8.1	1.8	1.3	1.3
194	A	5.5	3.5	1.3	1.3
185	A	5.5	3.6	1.5	NS
185	A	5.0	3.0	1.5	1.6
194	A	3.8	3.0	1.2	0.9
194	A	5.9	1.8	1.2	0.9
158	A	5.5	3.6	1.4	NS
167	A	5.5	3.6	1.3	NS
194	A	5.5	3.6	1.3	NS
176	A	4.8	3.2	1.5	0.8
176	A	7.2	1.7	1.5	0.8
176	A	4.2	3.2	1.5	0.8
176	A	7.2	1.7	1.5	0.8
176	A	5.0	3.4	1.4	0.6
176	A	5.5	3.6	1.6	1.3
176	A	4.6	3.4	1.4	0.6
176	A	5.0	3.6	1.6	1.3

NS = Not supplied ✓ Product tested by NLPIP

[a] Units have been rounded to the nearest whole number.

[b] Units have been rounded to one decimal place.

[c] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[d] This is the maximum temperature recommended by the manufacturer. In some cases, the manufacturer may recommend an alternative lower temperature that will result in a longer warranty period. Consult the manufacturer's literature for more information.

[e] This manufacturer uses a defined list of lamps that its ballasts can operate, rather than lamps of a specific ANSI code. Contact the manufacturer for more information.

[f] Ballast model numbers are completed by the addition of a code indicating the leads and mounting options. See the manufacturer's catalog for more information.

[g] Ballasts previously made under the brand name Aromat.

[h] This ballast model was updated after NLPIP testing began. Specifications listed here reflect the most recent model.

[i] This ballast model number may also appear as 120-MH75.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 4 (continued). Manufacturer-Supplied Information: Electronic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Trade Name	Catalog Number	ANSI Code	Input Power (W)	Input Current (A)	System Power Factor	Input Current THD (%) [a]	Lamp CCF [b]	Lamp Operating Frequency (Hz)	Min. Starting Temp. (°F) [c]
One 70 W Lamp, 120 V (continued)										
PowerSelect		PS13B70L	M85, M98, M139, M143	NS	0.65	>0.99	<5	<1.2	150	–22
		PS13B70T	M85, M98, M139, M143	76	0.64	>0.95	<10	<1.2	150	–22
		PS13U90S	M85, M98, M139, M143	79	0.66	>0.98	<7	<1.2	150	–22
		PS13U90T	M85, M98, M139, M143	79	0.66	>0.98	<7	<1.2	150	–22
Sage Lighting		NMHU170	M85, M98, M139, M143	80	0.67	0.99	10	<1.6	170	–22
Sunpark Electronics		120-MH70 [i]	M85, M98	75	0.63	>0.99	<10	<1.7	150	–10
		120-MH70T	M85, M98	75	0.63	>0.99	<10	<1.7	NS	–10
Universal Lighting Technologies [f]	E-Tensity	EC70UNVxx	M98, M139, M143	78	0.65	>0.90	<20	<1.5	low	–22
Vossloh-Schwabe [g]		JM7012CK-6EU-F	M98, M139, M143	77	0.64	>0.95	<20	1.4	170	5
		M7012/27CK-5EU-JT2	M98, M139, M143	78	0.67	>0.95	<15	1.4	170	5
		M7012-27CK-5EU	M98, M139, M143	78	0.67	>0.95	<15	1.2	170	5
		M7012-27CK-5EU-F	M98, M139, M143	78	0.67	>0.95	<15	1.2	170	5
		M7012-27CK-5EU-J	M98, M139, M143	78	0.67	>0.95	<15	1.2	170	5
		M7012CK-6EU-F	M98, M139, M143	77	0.64	>0.95	<20	1.4	170	5
		M7012CK-6EUN-F	M98, M139, M143	77	0.64	>0.95	<20	1.4	170	5
One 70 W Lamp, 208 V										
Universal Lighting Technologies [f]	E-Tensity	EC70UNVxx	M98, M139, M143	78	0.39	>0.90	<20	<1.5	low	–22
One 70 W Lamp, 277 V										
AC Electronics		AC-MH70EPL	M85, M98, M139, M143	79	0.30	0.98	<10	1.7	NS	–22
		AC-MH70UVS	M98, M139, M143	80	0.30	0.99	<8	1.3	NS	–22
Advance [f]	e-Vision	IMH-100-A-XXX	M98, M139, M143	81	0.30	>0.90	<15	<1.5	<200	–20
		IMH-70-D-XXX	M98, M143, M139	79	0.29	>0.90	<15	<1.5	<200	–20
		IMH-70-G-XXX	M98, M143, M139	79	0.30	>0.90	<15	<1.5	<200	–20
		IMH-70-J-XXX	M98, M143, M139	79	0.30	>0.90	<15	<1.5	<200	–20
Future Wave Technologies		FWKMHS-770	NS	78	0.29	0.99	<10	NS	NS	–22
		FWKMHS-770S	NS	78	0.29	0.99	<10	NS	NS	–22
Hatch Transformers		MC70-1-F-120U	[e]	77	0.28	>0.99	<5	<1.3	150	–22
		MC70-1-F-120V	[e]	77	0.28	>0.99	<5	<1.3	150	–22
		MC70-1-J-120U	[e]	77	0.28	>0.99	<5	<1.3	150	–22
		MC70-1-J-120V	[e]	77	0.28	>0.99	<5	<1.3	150	–22

Max. Ballast Case Temp. (°F) [c, d]	Sound Rating (A-D)	Dimensions [b] L (in.)	W (in.)	H (in.)	Total Weight (lb) [b]
194	A	8.0	1.8	1.5	1.0
176	A	3.8	3.0	1.2	0.7
176	A	4.7	3.4	1.6	1.4
176	A	5.4	3.4	1.6	1.3
194	A	5.5	3.6	1.3	NS
185	NS	5.5	3.5	1.6	NS
185	NS	11.5	2.0	1.8	NS
176	A	4.7	3.0	1.2	1.1
194	A	3.8	3.1	1.3	0.7
176	A	5.0	3.6	1.6	1.4
176	A	4.8	3.6	1.6	1.3
176	A	5.5	3.6	1.6	1.3
176	A	5.0	3.6	1.6	1.3
194	A	3.7	3.0	1.2	0.7
194	A	5.3	1.7	1.2	0.6
176	A	4.7	3.0	1.2	1.1
194	A	8.1	1.8	1.3	1.3
194	A	5.5	3.5	1.3	1.3
185	A	5.5	3.6	1.5	NS
185	A	5.0	3.0	1.5	1.6
194	A	3.8	3.0	1.2	0.9
194	A	5.9	1.8	1.2	0.9
167	A	5.5	3.6	1.3	NS
194	A	5.5	3.6	1.3	NS
176	A	4.8	3.2	1.5	0.8
176	A	7.2	1.7	1.5	0.8
176	A	4.2	3.2	1.5	0.8
176	A	7.2	1.7	1.5	0.8

NS = Not supplied ✓ Product tested by NLPIP

[a] Units have been rounded to the nearest whole number.

[b] Units have been rounded to one decimal place.

[c] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[d] This is the maximum temperature recommended by the manufacturer. In some cases, the manufacturer may recommend an alternative lower temperature that will result in a longer warranty period. Consult the manufacturer's literature for more information.

[e] This manufacturer uses a defined list of lamps that its ballasts can operate, rather than lamps of a specific ANSI code. Contact the manufacturer for more information.

[f] Ballast model numbers are completed by the addition of a code indicating the leads and mounting options. See the manufacturer's catalog for more information.

[g] Ballasts previously made under the brand name Aromat.

[h] This ballast model was updated after NLPIP testing began. Specifications listed here reflect the most recent model.

[i] This ballast model number may also appear as 120-MH75.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 4 (continued). Manufacturer-Supplied Information: Electronic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Trade Name	Catalog Number	ANSI Code	Input Power (W)	Input Current (A)	System Power Factor	Input Current THD (%) [a]	Lamp CCF [b]	Lamp Operating Frequency (Hz)	Min. Starting Temp. (°F) [c]
One 70 W Lamp, 277 V (continud)										
OSRAM SYLVANIA	QUICKTRONIC	QTP1x70MH/UNV F	M98, M139, M143	80	0.29	>0.98	<10	<1.2	165	–20
		QTP1x70MH/UNV F1	M98, M139	79	0.28	>0.97	<15	<1.5	170	–5
		QTP1x70MH/UNV J	M98, M139, M143	80	0.29	>0.98	<10	<1.2	165	–20
		QTP1x70MH/UNV J1	M98, M139	79	0.28	>0.97	<15	<1.5	170	–5
PowerSelect		PS13D70L	M85, M98, M139, M143	78	0.28	>0.99	<7	<1.2	150	–22
		PS13D90S	M85, M98, M139, M143	78	0.29	>0.98	<10	<1.2	150	–22
		PS13D90T	M85, M98, M139, M143	78	0.29	>0.98	<10	<1.2	150	–22
		PS13U90S	M85, M98, M139, M143	78	0.29	>0.98	<7	<1.2	150	–22
		PS13U90T	M85, M98, M139, M143	78	0.29	>0.98	<7	<1.2	150	–22
Sage Lighting		NMHU170	M85, M98, M139, M143	80	0.29	0.99	10	<1.6	170	–22
Universal Lighting Technologies [f]	E-Tensity	EC70UNVxx	M98, M139, M143	78	0.31	>0.90	<20	<1.5	low	–22
Vossloh-Schwabe [g]		M7012/27CK-5EU-JT2	M98, M139, M143	78	0.29	>0.95	<15	1.4	170	5
		M7012-27CK-5EU	M98, M139, M143	78	0.29	>0.95	<15	1.2	170	5
		M7012-27CK-5EU-F	M98, M139, M143	78	0.29	>0.95	<15	1.2	170	5
		M7012-27CK-5EU-J	M98, M139, M143	78	0.29	>0.95	<15	1.2	170	5
One 70 W Lamp, 347 V										
Future Wave Technologies		FWKMHS-370	NS	78	0.23	0.99	<10	NS	NS	–22
		FWKMHS-370S	NS	78	0.23	0.99	<10	NS	NS	–22
PowerSelect		PS13E90S	M85, M98, M139, M143	78	0.23	>0.98	<17	<1.2	150	–22
		PS13E90T	M85, M98, M139, M143	78	0.23	>0.98	<17	<1.2	150	–22
One 100 W Lamp, 120-277 V										
Metrolight	SuperHID	M100MHS-UX-US-C-ND	M90, M91, M92, M140	110	1.25	≥0.96	<10	NS	166	–25
		M100MHS-UX-US-S-ND	M90, M91, M92, M140	110	1.25	≥0.96	<10	NS	166	–25
One 100 W Lamp, 120 V										
AC Electronics		AC-MH100UVS	M90, M140	117	0.98	0.99	<10	1.4	NS	–22
Advance [f]	e-Vision	IMH-100-A-XXX	M90, M140	112	0.93	>0.90	<15	<1.5	<200	–20
		IMH-100-D-XXX	M90, M140	110	0.92	>0.90	<15	<1.5	<200	–20

Max. Ballast Case Temp. (°F) [c, d]	Sound Rating (A-D)	Dimensions [b] L (in.)	W (in.)	H (in.)	Total Weight (lb) [b]
176	A	5.0	3.4	1.4	0.6
176	A	5.5	3.6	1.6	1.3
176	A	4.6	3.4	1.4	0.6
176	A	5.0	3.6	1.6	1.3
194	A	8.0	1.8	1.5	1.0
176	A	4.7	3.4	1.6	1.4
176	A	5.4	3.4	1.6	1.3
176	A	4.7	3.4	1.6	1.4
176	A	5.4	3.4	1.6	1.3
194	A	5.5	3.6	1.3	NS
176	A	4.7	3.0	1.2	1.1
176	A	5.0	3.6	1.6	1.4
176	A	4.8	3.6	1.6	1.3
176	A	5.5	3.6	1.6	1.3
176	A	5.0	3.6	1.6	1.3
167	A	5.5	3.6	1.3	NS
194	A	5.5	3.6	1.3	NS
176	A	4.7	3.4	1.6	1.4
176	A	5.4	3.4	1.6	1.3
194	NS	4.7	3.0	1.3	0.6
194	NS	4.7	3.0	1.3	0.6
194	A	5.5	3.5	1.3	1.3
185	A	5.5	3.6	1.5	1.5
185	A	5.0	3.0	1.5	1.5

NS = Not supplied ✓ Product tested by NLPIP

[a] Units have been rounded to the nearest whole number.

[b] Units have been rounded to one decimal place.

[c] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[d] This is the maximum temperature recommended by the manufacturer. In some cases, the manufacturer may recommend an alternative lower temperature that will result in a longer warranty period. Consult the manufacturer's literature for more information.

[e] This manufacturer uses a defined list of lamps that its ballasts can operate, rather than lamps of a specific ANSI code. Contact the manufacturer for more information.

[f] Ballast model numbers are completed by the addition of a code indicating the leads and mounting options. See the manufacturer's catalog for more information.

[g] Ballasts previously made under the brand name Aromat.

[h] This ballast model was updated after NLPIP testing began. Specifications listed here reflect the most recent model.

[i] This ballast model number may also appear as 120-MH75.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 4 (continued). Manufacturer-Supplied Information: Electronic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Trade Name	Catalog Number	ANSI Code	Input Power (W)	Input Current (A)	System Power Factor	Input Current THD (%) [a]	Lamp CCF [b]	Lamp Operating Frequency (Hz)	Min. Starting Temp. (°F) [c]
One 100 W Lamp, 120 V (continued)										
Hatch Transformers		MC100-1-F-120U	[e]	110	0.92	>0.99	<5	<1.3	150	–22
		MC100-1-F-UNNU	[e]	110	0.92	>0.99	<10	<1.3	150	–22
		MC100-1-J-120U	[e]	110	0.92	>0.99	<5	<1.3	150	–22
		MC100-1-J-UNNU	[e]	110	0.92	>0.99	<10	<1.3	150	–22
OSRAM SYLVANIA	QUICKTRONIC	QTP1x100MH/UNV F	M90, M140	112	0.95	>0.98	<10	<1.2	165	–20
		QTP1x100MH/UNV F1	M90, M140	110	0.94	>0.97	<15	<1.5	170	–5
		QTP1x100MH/UNV J	M90, M140	112	0.95	>0.98	<10	<1.2	165	–20
		QTP1x100MH/UNV J1	M90, M140	110	0.94	>0.97	<15	<1.5	170	–5
PowerSelect		PS13B10S	M90, M140	NS	0.93	>0.98	<5	<1.2	150	–22
		PS13B10T	M90, M140	NS	0.93	>0.98	<5	<1.2	150	–22
		PS13U90S	M90, M140	113	0.94	>0.98	<7	<1.2	150	–22
		PS13U90T	M90, M140	113	0.94	>0.98	<7	<1.2	150	–22
Sage Lighting		NMHU1100	M90, M140, M164	112	0.93	0.99	10	<1.6	170	–22
Sunpark Electronics		120-MH100	M90, M140	110	0.93	>0.99	<10	<1.7	150	–10
Universal Lighting Technologies [f]	E-Tensity	EC100UNVxx	M90, M140	113	0.94	>0.90	<20	<1.5	low	–22
Vossloh-Schwabe [g]		M10012/27CK-5EU-JT2	M90, M140, M164	110	0.94	>0.95	<15	1.4	170	5
		M10012-27CK-5EU	M90, M140	110	0.94	>0.95	<15	1.2	170	5
		M10012-27CK-5EU-F	M90, M140	110	0.94	>0.95	<15	1.2	170	5
		M10012-27CK-5EU-J	M90, M140	110	0.94	>0.95	<15	1.2	170	5
One 100 W Lamp, 208 V										
Hatch Transformers		MC100-1-F-UNNU	[e]	110	0.53	>0.99	<10	<1.3	150	–22
		MC100-1-J-UNNU	[e]	110	0.53	>0.99	<10	<1.3	150	–22
Universal Lighting Technologies [f]	E-Tensity	EC100UNVxx	M90, M140	111	0.54	>0.90	<20	<1.5	low	–22
One 100 W Lamp, 277 V										
AC Electronics		AC-MH100UVS	M90, M140	114	0.42	0.99	<10	1.4	NS	–22
Advance [f]	e-Vision	IMH-100-A-XXX	M90, M140	110	0.40	>0.90	<15	<1.5	<200	–20
		IMH-100-D-XXX	M90, M140	109	0.40	>0.90	<15	<1.5	<200	–20
Hatch Transformers		MC100-1-F-277U	[e]	110	0.40	>0.99	<5	<1.3	150	–22
		MC100-1-F-UNNU	[e]	110	0.40	>0.99	<10	<1.3	150	–22
		MC100-1-J-277U	[e]	110	0.40	>0.99	<5	<1.3	150	–22
		MC100-1-J-UNNU	[e]	110	0.40	>0.99	<10	<1.3	150	–22
OSRAM SYLVANIA	QUICKTRONIC	QTP1x100MH/UNV F	M90, M140	112	0.40	>0.98	<10	<1.2	165	–20
		QTP1x100MH/UNV F1	M90, M140	110	0.43	>0.97	<15	<1.5	170	–5
		QTP1x100MH/UNV J	M90, M140	112	0.40	>0.98	<10	<1.2	165	–20
		QTP1x100MH/UNV J1	M90, M140	110	0.43	>0.97	<15	<1.5	170	–5

Max. Ballast Case Temp. (°F) [c, d]	Sound Rating (A-D)	Dimensions [b] L (in.)	W (in.)	H (in.)	Total Weight (lb) [b]
176	A	5.5	3.6	1.6	1.2
176	A	5.5	3.6	1.6	0.9
176	A	4.8	3.6	1.6	1.2
176	A	4.8	3.6	1.6	0.9
176	A	5.0	3.4	1.4	0.6
176	A	5.5	3.6	1.6	1.3
176	A	4.6	3.4	1.4	0.6
176	A	5.0	3.6	1.6	1.3
194	A	4.7	3.4	1.6	1.4
194	A	5.4	3.4	1.6	1.3
176	A	4.7	3.4	1.6	1.4
176	A	5.4	3.4	1.6	1.3
194	A	5.5	3.6	1.3	NS
185	NS	5.5	3.5	1.6	NS
176	A	4.7	3.0	1.2	1.1
176	A	5.0	3.6	1.6	1.4
176	A	4.8	3.6	1.6	1.4
176	A	5.5	3.6	1.6	1.4
176	A	5.0	3.6	1.6	1.4
176	A	5.5	3.6	1.6	0.9
176	A	4.8	3.6	1.6	0.9
176	A	4.7	3.0	1.2	1.1
194	A	5.5	3.5	1.3	1.3
185	A	5.5	3.6	1.5	1.5
185	A	5.0	3.0	1.5	1.5
176	A	5.5	3.6	1.6	1.2
176	A	5.5	3.6	1.6	0.9
176	A	4.8	3.6	1.6	1.2
176	A	4.8	3.6	1.6	0.9
176	A	5.0	3.4	1.4	0.6
176	A	5.5	3.6	1.6	1.3
176	A	4.6	3.4	1.4	0.6
176	A	5.0	3.6	1.6	1.3

NS = Not supplied ✓ Product tested by NLPIP

[a] Units have been rounded to the nearest whole number.

[b] Units have been rounded to one decimal place.

[c] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[d] This is the maximum temperature recommended by the manufacturer. In some cases, the manufacturer may recommend an alternative lower temperature that will result in a longer warranty period. Consult the manufacturer's literature for more information.

[e] This manufacturer uses a defined list of lamps that its ballasts can operate, rather than lamps of a specific ANSI code. Contact the manufacturer for more information.

[f] Ballast model numbers are completed by the addition of a code indicating the leads and mounting options. See the manufacturer's catalog for more information.

[g] Ballasts previously made under the brand name Aromat.

[h] This ballast model was updated after NLPIP testing began. Specifications listed here reflect the most recent model.

[i] This ballast model number may also appear as 120-MH75.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 4 (continued). Manufacturer-Supplied Information: Electronic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Trade Name	Catalog Number	ANSI Code	Input Power (W)	Input Current (A)	System Power Factor	Input Current THD (%) [a]	Lamp CCF [b]	Lamp Operating Frequency (Hz)	Min. Starting Temp. (°F) [c]
One 100 W Lamp, 277 V (continued)										
PowerSelect		PS13D90S	M90, M140	110	0.40	>0.98	<10	<1.2	150	–22
		PS13D90T	M90, M140	110	0.40	>0.98	<10	<1.2	150	–22
		PS13U90S	M90, M140	112	0.40	>0.98	<7	<1.2	150	–22
		PS13U90T	M90, M140	112	0.40	>0.98	<7	<1.2	150	–22
Sage Lighting		NMHU1100	M90, M140, M164	112	0.48	0.99	10	<1.6	170	–22
Universal Lighting Technologies [f]	E-Tensity	EC100UNVxx	M90, M140	111	0.42	>0.90	<20	<1.5	low	–22
Vossloh-Schwabe [g]		M10012/27CK-5EU-JT2	M90, M140, M164	110	0.42	>0.95	<15	1.4	170	5
		M10012-27CK-5EU	M90, M140	110	0.42	>0.95	<15	1.2	170	5
		M10012-27CK-5EU-F	M90, M140	110	0.42	>0.95	<15	1.2	170	5
		M10012-27CK-5EU-J	M90, M140	110	0.42	>0.95	<15	1.2	170	5
One 100 W Lamp, 347 V										
PowerSelect		PS13E90S	M90, M140	110	0.32	>0.98	<17	<1.2	150	–22
		PS13E90T	M90, M140	110	0.32	>0.98	<17	<1.2	150	–22
One 150 W Lamp, 120-277 V										
Metrolight	SuperHID	M150MHS-UX-US-C-ND	M81, M102, M142	158	1.88	≥0.95	<10	NS	166	–25
		M150MHS-UX-US-S-ND	M81, M102, M142	158	1.88	≥0.95	<10	NS	166	–25
One 150 W Lamp, 120 V										
AC Electronics		AC-MH150UVS	M102, M142	167	1.41	0.99	<8	1.1	NS	–22
Advance [f]	e-Vision	IMH-150-H-XXX	M102, M142	165	1.40	>0.90	<15	<1.5	<200	–20
		IMH-175-C-XXX	M102, M142	169	1.40	>0.90	<15	<1.5	<200	–20
DYnamic Ballast Corp.		DY150MH120	M81	156	1.35	>0.93	<15	<1.8	>60000	–20
Hatch Transformers		MC150-1-F-120U	[e]	164	1.37	>0.99	<10	<1.3	150	–22
		MC150-1-J-120U	[e]	164	1.37	>0.99	<10	<1.3	150	–22
PowerSelect		PS15B90L	M81, M102, M142	165	1.38	>0.99	<7	<1.2	150	–22
		PS15B90S	M81, M102, M142	166	1.38	>0.99	<7	<1.2	150	–22
		PS15B90T	M81, M102, M142	166	1.38	>0.99	<7	<1.2	150	–22
Sunpark Electronics		120-MH150	M81, M142	160	1.35	>0.99	<10	<1.7	150	–10
Universal Lighting Technologies [f]	E-Tensity	EC150UNVxx	M102, M142	166	1.39	>0.90	<20	<1.5	low	–22
Vossloh-Schwabe [g]		M15012-27CK-5EUN-F	M102, M142	167	1.40	>0.95	<15	1.4	170	5
		M15012-27CK-5EUN-J	M102, M142	167	1.40	>0.95	<15	1.4	170	5
		M15012CK-3EU-F	M102, M142	167	1.40	>0.95	<10	1.2	140	5
		M15012CK-3EU-J	M102, M142	167	1.40	>0.95	<10	1.2	140	5
One 150 W Lamp, 208 V										
Universal Lighting Technologies [f]	E-Tensity	EC150UNVxx	M102, M142	165	0.80	>0.90	<20	<1.5	low	–22

Max. Ballast Case Temp. (°F) [c, d]	Sound Rating (A-D)	Dimensions [b]			Total Weight (lb) [b]
		L (in.)	W (in.)	H (in.)	
176	A	4.7	3.4	1.6	1.4
176	A	5.4	3.4	1.6	1.3
176	A	4.7	3.4	1.6	1.4
176	A	5.4	3.4	1.6	1.3
194	A	5.5	3.6	1.3	NS
176	A	4.7	3.0	1.2	1.1
176	A	5.0	3.6	1.6	1.4
176	A	4.8	3.6	1.6	1.4
176	A	5.5	3.6	1.6	1.4
176	A	5.0	3.6	1.6	1.4
176	A	4.7	3.4	1.6	1.4
176	A	5.4	3.4	1.6	1.3
194	NS	4.6	3.4	1.5	0.7
194	NS	4.6	3.4	1.5	0.7
194	A	8.0	3.6	1.5	1.7
185	A	6.3	3.6	1.5	NS
185	A	8.0	3.6	1.5	2.5
185	A	8.4	3.7	2.0	3.0
176	A	5.5	3.6	1.6	0.9
176	A	4.8	3.6	1.6	0.9
176	A	12.4	2.6	1.9	3.1
194	A	6.0	3.5	1.9	3.1
194	A	6.4	3.5	1.9	3.1
185	NS	6.7	4.8	1.4	NS
176	A	4.7	3.4	1.5	1.6
167	A	8.3	2.6	2.2	2.0
167	A	7.5	2.6	2.2	2.0
176	A	6.7	5.2	2.2	3.5
176	A	6.0	5.2	2.2	3.5
176	A	4.7	3.4	1.5	1.6

NS = Not supplied   Product tested by NLPIP

[a] Units have been rounded to the nearest whole number.

[b] Units have been rounded to one decimal place.

[c] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[d] This is the maximum temperature recommended by the manufacturer. In some cases, the manufacturer may recommend an alternative lower temperature that will result in a longer warranty period. Consult the manufacturer's literature for more information.

[e] This manufacturer uses a defined list of lamps that its ballasts can operate, rather than lamps of a specific ANSI code. Contact the manufacturer for more information.

[f] Ballast model numbers are completed by the addition of a code indicating the leads and mounting options. See the manufacturer's catalog for more information.

[g] Ballasts previously made under the brand name Aromat.

[h] This ballast model was updated after NLPIP testing began. Specifications listed here reflect the most recent model.

[i] This ballast model number may also appear as 120-MH75.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 4 (continued). Manufacturer-Supplied Information: Electronic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Trade Name	Catalog Number	ANSI Code	Input Power (W)	Input Current (A)	System Power Factor	Input Current THD (%) [a]	Lamp CCF [b]	Lamp Operating Frequency (Hz)	Min. Starting Temp. (°F) [c]
One 150 W Lamp, 277 V										
AC Electronics		AC-MH150UVS	M102, M142	164	0.62	0.97	<13	1.1	NS	–22
Advance [f]	e-Vision	IMH-150-H-XXX	M102, M142	161	0.60	>0.90	<15	<1.5	<200	–20
		IMH-175-C-XXX	M102, M142	166	0.60	>0.90	<15	<1.5	<200	–20
DYnamic Ballast Corp.		DY150MH277	M81	156	0.60	>0.93	<40	<1.8	>60000	–20
Hatch Transformers		MC150-1-F-277U	[e]	164	0.60	>0.99	<10	<1.3	150	–22
		MC150-1-J-277U	[e]	164	0.60	>0.99	<10	<1.3	150	–22
PowerSelect		PS15D90L	M81, M102, M142	165	1.37	>0.99	<5	<1.2	150	–22
		PS15D90S	M81, M102, M142	165	0.59	>0.99	<8	<1.2	150	–22
		PS15D90T	M81, M102, M142	165	0.59	>0.99	<8	<1.2	150	–22
Universal Lighting Technologies [f]	E-Tensity	EC150UNVxx	M102, M142	165	0.62	>0.90	<20	<1.5	low	–22
Vossloh-Schwabe [g]		M15012-27CK-5EUN-F	M102, M142	167	0.61	>0.95	<15	1.4	170	5
		M15012-27CK-5EUN-J	M102, M142	167	0.61	>0.95	<15	1.4	170	5
		M15027CK-3EU-F	M102, M142	167	0.61	>0.95	<10	1.2	140	5
		M15027CK-3EU-J	M102, M142	167	0.61	>0.95	<10	1.2	140	5
One 150 W Lamp, 347 V										
PowerSelect		PS15E90S	M81, M102, M142	164	0.47	>0.99	<10	<1.2	150	–22
		PS15E90T	M81, M102, M142	164	0.47	>0.99	<10	<1.2	150	–22

Max. Ballast Case Temp. (°F) [c, d]	Sound Rating (A-D)	Dimensions [b] L (in.)	W (in.)	H (in.)	Total Weight (lb) [b]
194	A	8.0	3.6	1.5	1.7
185	A	6.3	3.6	1.5	NS
185	A	8.0	3.6	1.5	2.5
185	A	8.4	3.7	2.0	3.0
176	A	5.5	3.6	1.6	0.9
176	A	4.8	3.6	1.6	0.9
176	A	12.4	2.6	1.9	3.1
194	A	6.0	3.5	1.9	3.1
194	A	6.4	3.5	1.9	3.1
176	A	4.7	3.4	1.5	1.6
167	A	8.3	2.6	2.2	2.0
167	A	7.5	2.6	2.2	2.0
176	A	6.7	5.2	2.2	3.5
176	A	6.0	5.2	2.2	3.5
194	A	6.0	3.5	1.9	3.1
194	A	6.4	3.5	1.9	3.1

NS = Not supplied ✓ Product tested by NLPIP

[a] Units have been rounded to the nearest whole number.

[b] Units have been rounded to one decimal place.

[c] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[d] This is the maximum temperature recommended by the manufacturer. In some cases, the manufacturer may recommend an alternative lower temperature that will result in a longer warranty period. Consult the manufacturer's literature for more information.

[e] This manufacturer uses a defined list of lamps that its ballasts can operate, rather than lamps of a specific ANSI code. Contact the manufacturer for more information.

[f] Ballast model numbers are completed by the addition of a code indicating the leads and mounting options. See the manufacturer's catalog for more information.

[g] Ballasts previously made under the brand name Aromat.

[h] This ballast model was updated after NLPIP testing began. Specifications listed here reflect the most recent model.

[i] This ballast model number may also appear as 120-MH75.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 5. Manufacturer-Supplied Information: Magnetic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Catalog Number	Ballast Type	ANSI Code	Input Power (W)	Input Current (A)	Max. Current (A)	System Power Factor	Fuse Rating (A)	Min. Starting Temp. (°F)[a]	Sound Rating (A-D)	Total Weight (lb)
One 35 W Lamp, 120 V											
Advance	71A5005-P	HX-NPF	M130	55	1.30	1.50	>0.35	4	–20	NS	2.0
	71A5005-P	HX-HPF	M130	55	0.50	1.10	>0.90	3	–20	NS	2.2
	71A5081	HX-NPF	M130	56	1.25	1.60	>0.37	4	–20	NS	3.3
	71A5081	HX-HPF	M130	56	0.45	0.90	>0.90	3	–20	NS	3.5
	72C5005-NP	HX-HPF	M130	49	0.50	0.80	>0.90	2	–20	B	4.0
	72C5005-NP-BLS	HX-HPF	M130	49	0.50	0.80	>0.90	2	–20	B	4.0
	72C5081-NP	HX-HPF	M130	56	0.60	1.00	>0.90	3	–20	B	9.0
GE Lighting [b]	M50MLTLC3M500K	HX-HPF	M130	67	NS	1.16	>0.90	3	–22	NS	4.3
One 35 W Lamp, 208 V											
GE Lighting [b]	M50MLTLC3M500K	HX-HPF	M130	67	NS	0.67	>0.90	3	–22	NS	4.3
One 35 W Lamp 277 V											
Advance	71A5037-BP	R-NPF	M130	48	0.53	0.70	>0.33	2	–20	NS	1.6
	71A5037-BP	R-HPF	M130	48	0.19	0.60	>0.90	2	–20	NS	1.8
	71A5037-J	R-NPF	M130	48	0.53	0.70	>0.33	2	–20	NS	1.9
	71A5037-J	R-HPF	M130	48	0.19	0.60	>0.90	2	–20	NS	2.0
	71A5037-P	R-NPF	M130	48	0.52	0.70	>0.33	2	–20	NS	1.6
	71A5037-P	R-HPF	M130	48	0.18	0.60	>0.90	2	–20	NS	1.8
	71A5081	HX-NPF	M130	56	0.55	0.70	>0.37	2	–20	NS	3.3
	71A5081	HX-HPF	M130	56	0.20	0.40	>0.90	1	–20	NS	3.5
	72C5081-NP	HX-HPF	M130	56	0.30	0.40	>0.90	1	–20	B	9.0
GE Lighting [b]	M50MLTLC3M500K	HX-HPF	M130	67	NS	0.50	>0.90	2	–22	NS	4.3
One 39 W Lamp, 120 V											
Advance	71A5005-P	HX-NPF	M130	55	1.30	1.50	>0.35	4	–20	NS	2.0
	71A5005-P	HX-HPF	M130	55	0.50	1.10	>0.90	3	–20	NS	2.2
	71A5081	HX-NPF	M130	56	1.25	1.60	>0.37	4	–20	NS	3.3
	71A5081	HX-HPF	M130	56	0.45	0.90	>0.90	3	–20	NS	3.5
	72C5005-NP	HX-HPF	M130	49	0.50	0.80	>0.90	2	–20	B	4.0
	72C5005-NP-BLS	HX-HPF	M130	49	0.50	0.80	>0.90	2	–20	B	4.0
	72C5081-NP	HX-HPF	M130	56	0.60	1.00	>0.90	3	–20	B	9.0
GE Lighting [b]	M50MLTLC3M500K	HX-HPF	M130	67	NS	1.16	>0.90	3	–22	NS	4.3
OSRAM SYLVANIA	M35/120/277/F-CAN	HX-HPF	M130	54	0.46	1.05	>0.90	3	–20	A	9.0
One 39 W Lamp, 208 V											
GE Lighting [b]	M50MLTLC3M500K	HX-HPF	M130	67	NS	0.67	>0.90	3	–22	NS	4.3

NA = Not applicable NS = Not supplied ✓ Product tested by NLPIP

[a] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[b] GE Lighting ballasts are made by Universal Lighting Technologies.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 5 (continued). Manufacturer-Supplied Information: Magnetic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Catalog Number	Ballast Type	ANSI Code	Input Power (W)	Input Current (A)	Max. Current (A)	System Power Factor	Fuse Rating (A)	Min. Starting Temp. (°F)[a]	Sound Rating (A-D)	Total Weight (lb)
One 39 W Lamp, 277 V											
Advance	71A5037-BP	R-NPF	M130	48	0.53	0.70	>0.33	2	–20	NS	1.6
	71A5037-BP	R-HPF	M130	48	0.19	0.60	>0.90	2	–20	NS	1.8
	71A5037-J	R-NPF	M130	48	0.53	0.70	>0.33	2	–20	NS	1.9
	71A5037-J	R-HPF	M130	48	0.19	0.60	>0.90	2	–20	NS	2.0
	71A5037-P	R-NPF	M130	48	0.52	0.70	>0.33	2	–20	NS	1.6
	71A5037-P	R-HPF	M130	48	0.18	0.60	>0.90	2	–20	NS	1.8
	71A5081	HX-NPF	M130	56	0.55	0.70	>0.37	2	–20	NS	3.3
	71A5081	HX-HPF	M130	56	0.20	0.40	>0.90	1	–20	NS	3.5
	72C5081-NP	HX-HPF	M130	56	0.30	0.40	>0.90	1	–20	B	9.0
GE Lighting[b]	M50MLTLC3M500K	HX-HPF	M130	67	NS	0.50	>0.90	2	–22	NS	4.3
OSRAM SYLVANIA	M35/120/277/F-CAN	HX-HPF	M130	54	0.20	0.45	>0.90	1	–20	A	9.0
One 50 W Lamp, 120 V											
Advance	71A5105-P	HX-NPF	M110, M148	69	1.55	2.00	>0.37	5	–20	NS	2.3
	71A5105-P	HX-HPF	M110, M148	69	0.64	1.10	>0.90	3	–20	NS	2.3
	71A5181	HX-HPF	M110, M148	72	0.66	1.00	>0.90	3	–20	NS	4.0
	72C5181-NP	HX-HPF	M110, M148	72	0.70	1.20	>0.90	3	–20	B	9.0
	72C51C1-NP	HX-HPF	M110, M148	67	0.60	1.60	>0.90	4	–20	B	9.0
	73B5181	HX-HPF	M110	72	0.66	1.00	>0.90	3	–20	NS	8.0
	74P5103-011	HX-NPF	M110	69	1.55	1.80	>0.33	5	–20	NS	6.0
	74P5104-011P	HX-PFC	M110	69	0.65	1.10	>0.83	3	–20	NS	6.0
Etlin Daniels	MH-50X-D	NS	M110	NS	1.70	NS	NS	NS	NS	NS	NS
	MH-50X-D-HP	NS	M110	NS	0.69	NS	NS	NS	NS	NS	NS
OSRAM SYLVANIA	M50/120/277/F-CAN	HX-HPF	M110	67	0.60	1.33	>0.90	3	–20	B	8.5
Robertson Worldwide	BMH0050F413H	HX-HPF	M110	72	NS	0.66	>0.90	NS	–22	NS	6.3
	BMH0050F417H	HX-HPF	M110	72	NS	0.66	>0.90	NS	–22	NS	6.3
Venture Lighting	V90D5731	HX-HPF	M110	68	0.60	1.20	0.90	3	–40	NS	3.5
	V90H5731	HX-HPF	M110	68	0.60	1.20	0.90	3	–40	NS	3.5
	V90J5731	HX-HPF	M110	72	0.65	1.20	0.90	3	–40	NS	3.3
One 50 W Lamp, 208 V											
Venture Lighting	V90D5731	HX-HPF	M110	68	0.35	0.65	0.90	2	–40	NS	3.5

NA = Not applicable NS = Not supplied ✓ Product tested by NLPIP

[a] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[b] GE Lighting ballasts are made by Universal Lighting Technologies.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 5 (continued). Manufacturer-Supplied Information: Magnetic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Catalog Number	Ballast Type	ANSI Code	Input Power (W)	Input Current (A)	Max. Current (A)	System Power Factor	Fuse Rating (A)	Min. Starting Temp. (°F)[a]	Sound Rating (A-D)	Total Weight (lb)
One 50 W Lamp, 277 V											
Advance	71A5137-BP	R-NPF	M110, M148	62	0.62	0.70	>0.40	2	−20	NS	2.0
	71A5137-BP	R-HPF	M110, M148	62	0.22	0.60	>0.90	2	−20	NS	2.2
	71A5137-J	R-NPF	M110, M148	62	0.62	0.70	>0.40	2	−20	NS	2.3
	71A5137-J	R-HPF	M110, M148	62	0.22	0.60	>0.90	2	−20	NS	2.5
	71A5137-P	R-NPF	M110, M148	62	0.62	0.70	>0.40	2	−20	NS	2.0
	71A5137-P	R-HPF	M110, M148	62	0.22	0.60	>0.90	2	−20	NS	2.2
	72C5181-NP	HX-HPF	M110, M148	72	0.30	0.50	>0.90	2	−20	B	9.0
	73B5181	HX-HPF	M110	72	0.28	0.45	>0.90	2	−20	NS	8.0
Etlin Daniels	MH-50R-2	NS	M110	NS	0.63	NS	NS	NS	NS	NS	NS
	MH-50R-2-HP	NS	M110	NS	0.24	NS	NS	NS	NS	NS	NS
	MH-50X-D	NS	M110	NS	0.70	NS	NS	NS	NS	NS	NS
	MH-50X-D-HP	NS	M110	NS	0.27	NS	NS	NS	NS	NS	NS
Howard Lighting Products	M0050-08C-111	R-NPF	M110	60	0.62	0.75	<0.50	2	−40	NS	2.0
	M0050-08C-111	R-HPF	M110	60	0.22	0.55	>0.90	2	−40	NS	2.0
OSRAM SYLVANIA	M50/120/277/F-CAN	HX-HPF	M110	67	0.25	0.58	>0.90	2	−20	B	8.5
Robertson Worldwide	BMH0050D04114	R-HPF	M110	66	NS	0.26	>0.90	NS	−22	NS	2.1
	BMH0050D04914	R-HPF	M110	66	NS	0.26	>0.90	NS	−22	NS	2.1
	BMH0050F413H	HX-HPF	M110	66	NS	0.26	>0.90	NS	−22	NS	6.3
	BMH0050F417H	HX-HPF	M110	66	NS	0.26	>0.90	NS	−22	NS	6.3
	BMH005D04214	R-HPF	M110	66	NS	0.26	>0.90	NS	−22	NS	2.1
Venture Lighting	V90D5731	HX-HPF	M110	68	0.25	0.50	0.90	2	−40	NS	3.5
	V90H5731	HX-HPF	M110	68	0.25	0.50	0.90	2	−40	NS	3.5
	V90J5731	HX-HPF	M110	72	0.30	0.50	0.90	2	−40	NS	3.3
One 50 W Lamp, 347 V											
Advance	72C51C1-NP	HX-HPF	M110, M148	67	0.20	0.60	>0.90	2	−20	B	9.0
Venture Lighting	V90J5731	HX-HPF	M110	72	0.23	0.40	0.90	2	−40	NS	3.3

NA = Not applicable NS = Not supplied ✓ Product tested by NLPIP

[a] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[b] GE Lighting ballasts are made by Universal Lighting Technologies.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 5 (continued). Manufacturer-Supplied Information: Magnetic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Catalog Number	Ballast Type	ANSI Code	Input Power (W)	Input Current (A)	Max. Current (A)	System Power Factor	Fuse Rating (A)	Min. Starting Temp. (°F)[a]	Sound Rating (A-D)	Total Weight (lb)
One 70 W Lamp, 120 V											
Advance	71A5205-P	HX-NPF	M98, M143	94	2.10	2.60	<0.80	6	–20	NS	3.5
	71A5205-P	HX-PFC	M98, M143	94	0.85	1.40	0.80–0.89	4	–20	NS	3.7
	71A5282	HX-HPF	M98, M143	90	0.80	1.90	>0.90	4	–20	NS	5.0
	71A5292	HX-HPF	M98, M143	90	0.80	1.90	>0.90	4	–20	NS	5.0
	71A52A2	HX-HPF	M98, M143	90	0.81	1.90	>0.90	4	–20	NS	5.0
	72C5281-NP	HX-HPF	M139	94	0.90	1.70	>0.90	5	–20	B	8.5
	72C5281-NP-900	HX-HPF	M139	94	0.90	1.70	>0.90	5	–20	B	8.5
	72C5282-NP	HX-HPF	M98, M143	94	0.90	1.60	>0.90	4	–20	B	8.5
	72C52C1-NP-900	HX-HPF	M139	94	0.80	1.70	>0.90	5	–20	B	8.5
	72C52C2-NP ✓	HX-HPF	M98, M143	94	0.90	1.70	>0.90	5	–20	B	8.5
	72C52C2-NP-900	HX-HPF	M98, M143	94	0.90	1.60	>0.90	4	–20	B	8.5
	73B5282	HX-HPF	M98	90	0.85	1.90	>0.90	4	–20	A	9.0
Etlin Daniels	MH-70X-Q	NS	M98	NS	2.50	NS	NS	NS	NS	NS	NS
	MH-70X-Q-HP	HX	M98	NS	0.84	NS	NS	NS	NS	NS	NS
GE Lighting [b]	11210-277C-TC	HX-HPF	M85	98	0.87	2.00	>0.90	6	–22	B	11.0
	11210-506C-TC ✓	HX-HPF	M98	90	0.78	2.00	>0.90	6	–22	B	11.0
	M70MLTLC3M500K	HX-HPF	M98	95	0.85	1.70	>0.90	4	–22	NS	4.3
Howard Lighting Products	M0070-71C-511	HX-HPF	M98	85	1.60	1.60	0.91	4	–20	NS	4.6
OSRAM SYLVANIA	M70/120/277/F-CAN	HX-HPF	M139, M143	95	0.85	1.95	>0.90	6	–20	B	11.4
	M70/120/277/F-CAN ✓	HX-HPF	M98	94	0.85	1.95	>0.90	5	–20	B	11.5
Robertson Worldwide	BMH0070F413H ✓	HX-HPF	M98	92	NS	0.84	>0.90	NS	–22	NS	6.3
	BMH0070F415H	HX-HPF	M98	92	NS	0.84	>0.90	NS	–22	NS	6.3
	BMH0070F417H	HX-HPF	M98	92	NS	0.84	>0.90	NS	–22	NS	6.3
Venture Lighting	V90D5832	HX-HPF	M98	90	0.80	1.70	0.90	4	–20	NS	4.9
	V90H5832 ✓	HX-HPF	M98	90	0.80	1.70	0.90	4	–20	NS	4.9
	V90J5832	HX-HPF	M98	90	0.80	1.70	0.90	4	–20	NS	4.9
One 70 W Lamp, 208 V											
Advance	71A5292	HX-HPF	M98, M143	90	0.46	1.00	>0.90	3	–20	NS	5.0
Etlin Daniels	MH-70X-Q	NS	M98	NS	2.50	NS	NS	NS	NS	NS	NS
	MH-70X-Q-HP	HX	M98	NS	0.84	NS	NS	NS	NS	NS	NS
GE Lighting [b]	M70MLTLC3M500K	HX-HPF	M98	95	0.52	1.04	>0.90	3	–22	NS	4.3
Howard Lighting Products	M0070-71C-511	HX-HPF	M98	85	0.95	0.95	0.91	3	–20	NS	4.6
Venture Lighting	V90D5832	HX-HPF	M98	90	0.45	0.95	0.90	3	–20	NS	4.9

NA = Not applicable NS = Not supplied ✓ Product tested by NLPIP

[a] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[b] GE Lighting ballasts are made by Universal Lighting Technologies.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 5 (continued). Manufacturer-Supplied Information: Magnetic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Catalog Number	Ballast Type	ANSI Code	Input Power (W)	Input Current (A)	Max. Current (A)	System Power Factor	Fuse Rating (A)	Min. Starting Temp. (°F)[a]	Sound Rating (A-D)	Total Weight (lb)
One 70 W Lamp, 277 V											
Advance	71A5237-BP	R-NPF	M98, M143	85	0.90	1.20	<0.80	3	−20	NS	2.7
	71A5237-BP	R-HPF	M98, M143	85	0.32	0.80	<0.80	2	−20	NS	2.9
	71A5237-J	R-NPF	M98, M143	85	0.90	1.20	<0.80	3	−20	NS	3.0
	71A5237-J	R-HPF	M98, M143	85	0.32	0.80	>0.90	2	−20	NS	3.2
	71A5237-P	R-NPF	M98, M143	85	0.90	1.20	<0.80	3	−20	NS	2.7
	71A5237-P	R-HPF	M98, M143	85	0.32	0.80	>0.90	2	−20	NS	2.9
	71A5292	HX-HPF	M98, M143	90	0.35	0.80	>0.90	2	−20	NS	5.0
	71A52A2	HX-HPF	M98, M143	90	0.35	0.80	>0.90	2	−20	NS	5.0
	72C5281-NP	HX-HPF	M139	94	0.40	0.80	>0.90	2	−20	B	8.5
	72C5281-NP-900	HX-HPF	M139	94	0.40	0.80	>0.90	2	−20	B	8.5
	72C5282-NP	HX-HPF	M98, M143	94	0.40	0.80	>0.90	2	−20	B	8.5
	72C52C1-NP-900	HX-HPF	M139	94	0.30	0.60	>0.90	2	−20	B	8.5
	72C52C2-NP	HX-HPF	M98, M143	94	0.30	0.70	>0.90	2	−20	B	8.5
	72C52C2-NP-900	HX-HPF	M98, M143	94	0.40	0.80	>0.90	2	−20	B	8.5
	73B5282	HX-HPF	M98	90	0.37	0.80	>0.90	2	−20	A	9.0
Etlin Daniels	MH-70R-2	NS	M98	NS	0.90	NS	NS	NS	NS	NS	NS
	MH-70R-2-HP	NS	M98	NS	0.31	NS	NS	NS	NS	NS	NS
	MH-70X-Q	NS	M98	NS	2.50	NS	NS	NS	NS	NS	NS
	MH-70X-Q-HP	HX	M98	NS	0.84	NS	NS	NS	NS	NS	NS
GE Lighting[b]	11210-277C-TC	HX-HPF	M85	98	0.39	0.90	>0.90	3	−22	B	11.0
	11210-506C-TC	HX-HPF	M98	90	0.35	0.90	>0.90	3	−22	B	11.0
	M70MLTLC3M500K	HX-HPF	M98	95	0.39	0.78	>0.90	2	−22	NS	4.3
Howard Lighting Products	M0070-08C-111	R-NPF	M98	84	0.90	1.10	<0.50	3	−40	NS	2.5
	M0070-08C-111	R-HPF	M98	84	0.32	0.80	>0.90	2	−40	NS	2.5
	M0070-71C-511	HX-HPF	M98	85	0.70	0.70	0.91	2	−20	NS	4.6
OSRAM SYLVANIA	M70/120/277/F-CAN	HX-HPF	M139	95	0.37	0.90	>0.90	3	−20	B	11.4
	M70/120/277/F-CAN	HX-HPF	M98, M143	94	0.37	0.85	>0.90	2	−20	B	11.5
Robertson Worldwide	BMH0070D04114	R-HPF	M98	85	NS	0.32	>0.90	NS	−22	NS	2.5
	BMH0070D04214	R-HPF	M98	85	NS	0.32	>0.90	NS	−22	NS	2.5
	BMH0070D04914	R-HPF	M98	85	NS	0.32	>0.90	NS	−22	NS	2.5
	BMH0070F413H	HX-HPF	M98	85	NS	0.32	>0.90	NS	−22	NS	6.3
	BMH0070F415H	HX-HPF	M98	85	NS	0.32	>0.90	NS	−22	NS	6.3
	BMH0070F417H	HX-HPF	M98	85	NS	0.32	>0.90	NS	−22	NS	6.3
Venture Lighting	V90D5832	HX-HPF	M98	90	0.35	0.70	0.90	2	−20	NS	4.9
	V90H5832	HX-HPF	M98	90	0.35	0.70	0.90	2	−20	NS	4.9
	V90J5832	HX-HPF	M98	90	0.35	0.70	0.90	2	−20	NS	4.9

NA = Not applicable NS = Not supplied ✔ Product tested by NLPIP

[a] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[b] GE Lighting ballasts are made by Universal Lighting Technologies.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 5 (continued). Manufacturer-Supplied Information: Magnetic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Catalog Number	Ballast Type	ANSI Code	Input Power (W)	Input Current (A)	Max. Current (A)	System Power Factor	Fuse Rating (A)	Min. Starting Temp. (°F)[a]	Sound Rating (A-D)	Total Weight (lb)
One 70 W Lamp, 347 V											
Advance	71A52A2	HX-HPF	M98, M143	90	0.28	0.70	>0.90	2	–20	NS	5.0
Venture Lighting	V90J5832	HX-HPF	M98	90	0.30	0.60	0.90	2	–20	NS	4.9
One 70 W Lamp, 480 V											
GE Lighting [b]	M7048TLC3M	HX-HPF	M98	95	0.50	0.50	>0.90	1	–20	NS	4.3
One 100 W Lamp, 120 V											
Advance	71A5380	HX-HPF	M90, M140	129	1.15	2.30	>0.90	6	–20	NS	5.5
	71A5383	CWA	M90, M140	128	1.10	1.10	>0.90	3	–20	NS	5.5
	71A5390	HX-HPF	M90, M140	129	1.15	2.30	>0.90	6	–20	NS	5.5
	71A53A0	HX-HPF	M90, M140	129	1.15	2.60	>0.90	6	–20	NS	5.5
	72C5381-NP	HX-HPF	M90, M140	125	1.10	2.40	>0.90	6	–20	B	11.0
	72C5381-NP-900	HX-HPF	M90, M140	125	1.10	2.40	>0.90	6	–20	B	11.0
	72C53C1-NP	HX-HPF	M90, M140	125	1.10	2.40	>0.90	6	–20	B	11.0
	73B5380	HX-HPF	M90, M140	129	1.15	2.60	>0.90	6	–20	A	10.0
	73B5383	CWA	M90, M140	128	1.15	1.15	>0.90	3	–20	A	10.0
Etlin Daniels	MH-100X-Q	NS	M90	NS	3.40	NS	NS	NS	NS	NS	NS
	MH-100X-Q-HP	NS	M90	NS	1.20	NS	NS	NS	NS	NS	NS
GE Lighting [b]	11210-239C-TC	HX-HPF	M90	125	1.10	2.20	>0.90	8	–22	B	11.0
	M100MLTLC3M500K	HX-HPF	M90, M92	130	1.15	2.30	>0.90	5	–22	NS	6.3
Howard Lighting Products	M0100-23C-511	HX-HPF	M90	126	1.12	2.76	0.97	6	–20	NS	5.5
	M0100-71C-511	HX-HPF	M90	126	1.12	2.76	0.97	6	–20	NS	5.5
OSRAM SYLVANIA	M100/120/277/F-CAN	HX-HPF	M90	125	1.10	2.50	>0.90	8	–20	B	11.6
Robertson Worldwide	BMH0100F413H	HX-HPF	M90	123	NS	1.20	>0.90	NS	–22	NS	7.0
	BMH0100F415H	HX-HPF	M90	123	NS	1.20	>0.90	NS	–22	NS	7.0
	BMH0100F417H	HX-HPF	M90	123	NS	1.20	>0.90	NS	–22	NS	7.0
Venture Lighting	V90D5932	HX-HPF	M90	125	1.10	2.60	0.90	7	–20	NS	5.3
	V90H5932	HX-HPF	M90	125	1.10	2.60	0.90	7	–20	NS	5.8
	V90J5932	HX-HPF	M90	126	1.10	2.60	0.90	7	–20	NS	5.3
One 100 W Lamp, 208 V											
Advance	71A5390	HX-HPF	M90, M140	129	0.66	1.40	>0.90	4	–20	NS	5.5
Etlin Daniels	MH-100X-Q	NS	M90	NS	3.40	NS	NS	NS	NS	NS	NS
	MH-100X-Q-HP	NS	M90	NS	1.20	NS	NS	NS	NS	NS	NS
GE Lighting [b]	M100MLTLC3M500K	HX-HPF	M90, M92	130	0.64	1.30	>0.90	4	–22	NS	6.3
Howard Lighting Products	M0100-71C-511	HX-HPF	M90	126	0.58	1.43	0.97	4	–20	NS	5.5

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[a] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[b] GE Lighting ballasts are made by Universal Lighting Technologies.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 5 (continued). Manufacturer-Supplied Information: Magnetic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Catalog Number	Ballast Type	ANSI Code	Input Power (W)	Input Current (A)	Max. Current (A)	System Power Factor	Fuse Rating (A)	Min. Starting Temp. (°F)[a]	Sound Rating (A-D)	Total Weight (lb)
One 100 W Lamp, 208 V (continued)											
Robertson Worldwide	BMH100G417H	HX-HPF	M90	120	NS	0.70	>0.90	NS	–22	NS	7.0
Venture Lighting	V90D5932	HX-HPF	M90	125	0.65	1.50	0.90	4	–20	NS	5.3
One 100 W Lamp, 277 V											
Advance	71A5337-BP	R-NPF	M90, M140	118	1.10	1.30	<0.80	3	–20	NS	3.0
	71A5337-BP	R-HPF	M90, M140	118	0.45	1.10	>0.90	3	–20	NS	3.2
	71A5337-J	R-NPF	M90, M140	118	1.10	1.30	<0.80	3	–20	NS	3.3
	71A5337-J	R-HPF	M90, M140	118	0.45	1.10	>0.90	3	–20	NS	3.5
	71A5337-P	R-NPF	M90, M140	118	1.10	1.30	<0.80	3	–20	NS	3.0
	71A5337-P	R-HPF	M90, M140	118	0.45	1.10	>0.90	3	–20	NS	3.2
	71A5380	HX-HPF	M90, M140	129	0.50	1.00	>0.90	3	–20	NS	5.5
	71A5383	CWA	M90, M140	128	0.50	0.50	>0.90	2	–20	NS	5.5
	71A5390	HX-HPF	M90, M140	129	0.50	1.00	>0.90	3	–20	NS	5.5
	71A53A0	HX-HPF	M90, M140	129	0.50	1.20	>0.90	3	–20	NS	5.5
	72C5381-NP	HX-HPF	M90, M140	125	0.50	1.10	>0.90	3	–20	B	11.0
	72C5381-NP-900	HX-HPF	M90, M140	125	0.50	1.10	>0.90	3	–20	B	11.0
	73B5380	HX-HPF	M90, M140	129	0.50	1.20	>0.90	3	–20	A	10.0
	73B5383	CWA	M90, M140	128	0.50	0.50	>0.90	2	–20	A	10.0
Etlin Daniels	MH-100R-2	R	M90	NS	1.30	NS	NS	NS	NS	NS	NS
	MH-100R-2-HP	R	M90	NS	0.47	NS	NS	NS	NS	NS	NS
	MH-100X-Q	NS	M90	NS	3.40	NS	NS	NS	NS	NS	NS
	MH-100X-Q-HP	NS	M90	NS	1.20	NS	NS	NS	NS	NS	NS
GE Lighting[b]	11210-239C-TC	HX-HPF	M90	125	0.50	1.00	>0.90	4	–22	B	11.0
	M100MLTLC3M500K	HX-HPF	M90, M92	130	0.48	0.95	>0.90	3	–22	NS	6.3
Howard Lighting Products	M0100-23C-511	HX-HPF	M90	126	0.49	1.19	0.97	3	–20	NS	5.5
	M0100-71C-511	HX-HPF	M90	126	0.49	1.19	0.97	3	–20	NS	5.5
OSRAM SYLVANIA	M100/120/277/F-CAN	HX-HPF	M90	125	0.48	1.07	>0.90	4	–20	B	11.6
Robertson Worldwide	BMH0100D04114	R-HPF	M90	115	NS	0.43	>0.90	NS	–22	NS	2.5
	BMH0100D04214	R-HPF	M90	115	NS	0.43	>0.90	NS	–22	NS	2.5
	BMH0100D04914	R-HPF	M90	115	NS	0.43	>0.90	NS	–22	NS	2.5
	BMH0100F413H	HX-HPF	M90	115	NS	0.43	>0.90	NS	–22	NS	7.0
	BMH0100F415H	HX-HPF	M90	115	NS	0.43	>0.90	NS	–22	NS	7.0
	BMH0100F417H	HX-HPF	M90	115	NS	0.43	>0.90	NS	–22	NS	7.0
	BMH100G417H	HX-HPF	M90	115	NS	0.43	>0.90	NS	–22	NS	7.0

NA = Not applicable NS = Not supplied ✓ Product tested by NLPIP

[a] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[b] GE Lighting ballasts are made by Universal Lighting Technologies.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 5 (continued). Manufacturer-Supplied Information: Magnetic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Catalog Number	Ballast Type	ANSI Code	Input Power (W)	Input Current (A)	Max. Current (A)	System Power Factor	Fuse Rating (A)	Min. Starting Temp. (°F)[a]	Sound Rating (A-D)	Total Weight (lb)
One 100 W Lamp, 277 V (continued)											
Venture Lighting	V90D5932	HX-HPF	M90	125	0.50	1.15	0.90	3	–20	NS	5.3
	V90H5932	HX-HPF	M90	125	0.50	1.15	0.90	3	–20	NS	5.8
	V90J5932	HX-HPF	M90	126	0.50	1.15	0.90	3	–20	NS	5.3
	V90U5920	R	M90	118	0.45	1.05	0.90	3	–20	NS	2.8
One 100 W Lamp, 347 V											
Advance	71A53A0	HX-HPF	M90, M140	129	0.40	1.00	>0.90	2	–20	NS	5.5
	72C53C1-NP	HX-HPF	M90, M140	125	0.40	0.90	>0.90	2	–20	B	11.0
Venture Lighting	V90J5932	HX-HPF	M90	126	0.40	0.90	0.90	3	–20	NS	5.3
One 100 W Lamp, 480 V											
Advance	71A5340-T	HX-HPF	M90, M140	132	0.30	0.55	>0.90	2	–20	NS	5.5
GE Lighting[b]	M10048TLC3M500K	HX-HPF	M90	130	0.62	0.62	>0.90	2	–20	NS	5.0
One 125 W Lamp, 120 V											
Venture Lighting	V90D8811	CWA	M150	150	1.25	1.25	0.90	4	–20	NS	5.4
	V90H8811	CWA	M150	150	1.25	1.25	0.90	4	–20	NS	5.4
One 125 W Lamp, 208 V											
Venture Lighting	V90D8811	CWA	M150	150	0.75	0.75	0.90	3	–20	NS	5.4
One 125 W Lamp, 277 V											
Venture Lighting	V90D8811	CWA	M150	150	0.55	0.55	0.90	2	–20	NS	5.4
	V90H8811	CWA	M150	150	0.55	0.55	0.90	2	–20	NS	5.4
	V90U8820	R	M150	141	0.55	0.85	0.90	2	–20	NS	2.5
One 150 W Lamp, 120 V											
Advance	71A5482	HX-HPF	M102, M142	185	1.60	3.70	>0.90	10	–20	NS	7.0
	71A5492	HX-HPF	M102, M142	185	1.60	3.70	>0.90	10	–20	NS	7.0
	71A54A2	HX-HPF	M102, M142	185	1.60	3.70	>0.90	10	–20	NS	7.0
	71A54A3	SCWA	M102, M142	189	1.75	1.75	>0.85	5	–20	NS	9.0
	72C5482-NP	HX-HPF	M102, M142	180	1.60	3.70	>0.90	10	–20	B	13.0
	72C5482-NP-900	HX-HPF	M102, M142	180	1.60	3.70	>0.90	10	–20	B	13.0
	72C54C2-NP-900	HX-HPF	M102, M142	180	1.60	3.70	>0.90	10	–20	B	13.0
	73B5482	HX-HPF	M102, M142	185	1.60	3.70	>0.90	10	–20	A	11.0
Etlin Daniels	MH-150X-Q	NS	M102	NS	3.50	NS	NS	NS	NS	NS	NS
	MH-150X-Q-HP	NS	M102	NS	1.60	NS	NS	NS	NS	NS	NS
GE Lighting[b]	M150MLTLC3M500K	HX-HPF	M102	185	1.57	3.32	>0.90	10	–22	NS	7.3
Howard Lighting Products	M0150-71C-511	HX-HPF	M102	183	1.59	3.55	0.95	10	–20	NS	7.0

NA = Not applicable NS = Not supplied ✓ Product tested by NLPIP

[a] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[b] GE Lighting ballasts are made by Universal Lighting Technologies.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 5 (continued). Manufacturer-Supplied Information: Magnetic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Catalog Number	Ballast Type	ANSI Code	Input Power (W)	Input Current (A)	Max. Current (A)	System Power Factor	Fuse Rating (A)	Min. Starting Temp. (°F)[a]	Sound Rating (A-D)	Total Weight (lb)
One 150 W Lamp, 120 V (continued)											
OSRAM SYLVANIA	M150-PS/120/277/F-CAN	CWA	M102, M142	180	1.60	1.60	>0.90	5	–20	B	16.0
Venture Lighting	V90D6111	CWA	M107	185	1.80	1.80	0.90	5	–20	NS	6.8
	V90D7110	CWA	M102	190	1.70	1.70	0.90	4	–40	NS	8.2
	V90D7130	HX-HPF	M102	185	1.60	3.60	0.90	9	–40	NS	7.1
	V90H7130	HX-HPF	M102	185	1.60	3.60	0.90	9	–40	NS	7.1
	V90J6111	CWA	M107	210	1.80	1.80	0.90	5	–20	NS	6.8
	V90J7110	CWA	M102	190	1.65	1.65	0.90	4	–40	NS	8.6
	V90J7130	HX-HPF	M102	185	1.65	3.65	0.90	9	–40	NS	7.1
One 150 W Lamp, 208 V											
Advance	71A5492	HX-HPF	M102, M142	185	1.00	2.10	>0.90	5	–20	NS	7.0
Etlin Daniels	MH-150X-Q	NS	M102	NS	3.50	NS	NS	NS	NS	NS	NS
	MH-150X-Q-HP	NS	M102	NS	1.60	NS	NS	NS	NS	NS	NS
GE Lighting[b]	M150MLTLC3M500K	HX-HPF	M102	185	0.91	1.93	>0.90	5	–22	NS	7.3
Howard Lighting Products	M0150-71C-511	HX-HPF	M102	184	0.92	2.05	0.95	5	–20	NS	7.0
Venture Lighting	V90D6111	CWA	M107	185	1.10	1.10	0.90	3	–20	NS	6.8
	V90D7110	CWA	M102	190	1.00	1.00	0.90	3	–40	NS	8.2
	V90D7130	HX-HPF	M102	185	1.00	2.20	0.90	6	–40	NS	7.1
One 150 W Lamp, 277 V											
Advance	71A5437-BP	Linear Reactor HPF	M102	173	0.63	1.50	>0.90	4	–20	NS	4.2
	71A5437-J	Linear Reactor HPF	M102	173	0.63	1.50	>0.90	4	–20	NS	4.5
	71A5437-P	Linear Reactor HPF	M102	173	0.63	1.50	>0.90	4	–20	NS	4.2
	71A5482	HX-HPF	M102, M142	185	0.70	1.60	>0.90	4	–20	NS	7.0
	71A5492	HX-HPF	M102, M142	185	0.70	1.60	>0.90	4	–20	NS	7.0
	71A54A2	HX-HPF	M102, M142	185	0.70	1.60	>0.90	4	–20	NS	7.0
	71A54A3	SCWA	M102, M142	189	0.76	0.76	>0.85	2	–20	NS	9.0
	72C5482-NP	HX-HPF	M102, M142	180	0.70	1.60	>0.90	4	–20	B	13.0
	72C5482-NP-900	HX-HPF	M102, M142	180	0.70	1.60	>0.90	4	–20	B	13.0
	72C54C2-NP-900	HX-HPF	M102, M142	180	0.60	1.30	>0.90	4	–20	B	13.0
	73B5482	HX-HPF	M102, M142	185	0.70	1.60	>0.90	4	–20	A	11.0

NA = Not applicable NS = Not supplied ✓ Product tested by NLPIP

[a] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[b] GE Lighting ballasts are made by Universal Lighting Technologies.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 5 (continued). Manufacturer-Supplied Information: Magnetic Ballasts for Low-Wattage Metal Halide Lamps

Manufacturer	Catalog Number	Ballast Type	ANSI Code	Input Power (W)	Input Current (A)	Max. Current (A)	System Power Factor	Fuse Rating (A)	Min. Starting Temp. (°F)[a]	Sound Rating (A-D)	Total Weight (lb)
One 150 W Lamp, 277 V (continued)											
Etlin Daniels	MH-150R-2	NS	M110	NS	1.85	NS	NS	NS	NS	NS	NS
	MH-150R-2-HP	NS	M102	NS	0.71	NS	NS	NS	NS	NS	NS
	MH-150X-Q	NS	M102	NS	3.50	NS	NS	NS	NS	NS	NS
	MH-150X-Q-HP	NS	M102	NS	1.60	NS	NS	NS	NS	NS	NS
GE Lighting [b]	M150MLTLC3M500K	HX-HPF	M102	185	0.74	1.48	>0.90	4	–22	NS	7.3
Howard Lighting Products	M0150-71C-511	HX-HPF	M102	184	0.67	1.55	0.95	4	–20	NS	7.0
OSRAM SYLVANIA	M150-PS/120/277/F-CAN	CWA	M102, M142	180	0.70	0.70	>0.90	3	–20	B	16.0
Robertson Worldwide	BMH0150D04114	R-HPF	M102	170	NS	0.59	>0.90	NS	–22	NS	3.5
	BMH0150D04214	R-HPF	M102	170	NS	0.59	>0.90	NS	–22	NS	3.5
	BMH0150D04914	R-HPF	M102	170	NS	0.59	>0.90	NS	–22	NS	3.5
Venture Lighting	V90D6111	CWA	M107	185	0.80	0.80	0.90	2	–20	NS	6.8
	V90D7110	CWA	M102	190	0.75	0.75	0.90	2	–40	NS	8.2
	V90D7130	HX-HPF	M102	185	0.70	1.55	0.90	4	–40	NS	7.1
	V90H7130	HX-HPF	M102	185	0.70	1.55	0.90	4	–40	NS	7.1
	V90J6111	CWA	M107	210	0.80	0.80	0.90	2	–20	NS	6.8
	V90J7110	CWA	M102	190	0.70	0.70	0.90	2	–40	NS	8.6
	V90J7130	HX-HPF	M102	185	0.70	1.55	0.90	4	–40	NS	7.1
	V90U7120	R	M102	170	0.65	1.50	0.90	4	–40	NS	4.3
One 150 W Lamp, 347 V											
Advance	71A54A2	HX-HPF	M102, M142	185	0.55	1.30	>0.90	3	–20	NS	7.0
	71A54A3	SCWA	M102, M142	189	0.62	0.62	>0.85	2	–20	NS	9.0
Venture Lighting	V90J6111	CWA	M107	210	0.65	0.65	0.90	2	–20	NS	6.8
	V90J7110	CWA	M102	190	0.55	0.55	0.90	2	–40	NS	8.6
	V90J7130	HX-HPF	M102	185	0.55	1.25	0.90	4	–40	NS	7.1
One 150 W Lamp, 480 V											
Advance	71A5442-T	HX-HPF	M102, M142	185	0.42	0.81	>0.90	3	–20	NS	9.0
Venture Lighting	V90Y6111	CWA	M107	185	0.45	0.45	0.9	2	–20	NS	6.8
GE Lighting [b]	M15048TLC3M500K	HX-HPF	M102	180	1.00	1.00	>0.90	2	–20	NS	7.3

NA = Not applicable   NS = Not supplied   ✓ Product tested by NLPIP

[a] To convert Fahrenheit to Celsius, subtract 32 and multiply by five-ninths (0.556).

[b] GE Lighting ballasts are made by Universal Lighting Technologies.

The data contained herein were deemed reliable at the time of publishing. Contact the manufacturer to verify product availability and specifications, as these may have changed.

Table 6. NLPIP-Tested and Manufacturer-Supplied Performance Data: Lamp Performance at 100 Hours *

Manufacturer	Model Number		Initial Light Output (lm) [a]	Lamp Efficacy (LPW)	Lamp Voltage (V)	Lamp Current (A)	CCT (K)	CRI	Chromaticity Coordinates x	Chromaticity Coordinates y	Color Variation (MacAdam ellipse steps)	Warm-up Time (s)
Ceramic Lamps												
GE Lighting	CMH70/U/830/MED	Rated	6300				3000	80				
		Tested	6017	85.8	89.8	0.937	3037	82	0.435	0.404	2.7	82.4
OSRAM SYLVANIA	MCP70/U/MED/830	Rated	5900				3000	88				
		Tested	5659	80.9	90.2	0.953	2972	92	0.436	0.399	2.5	68.2
Philips Lighting	MHC70/U/M/3K/ALTO	Rated	6200				3000	85				
		Tested	5918	84.5	106.2	0.793	3074	82	0.429	0.396	1.2	59.0
Quartz Lamps												
EYE Lighting	MP70/U/3K	Rated	5200				3000	75				
		Tested	5158	73.7	84.0	0.939	2880	71	0.433	0.383	2.2	60.6
GE Lighting	MXR70/U/MED	Rated	5500				3200	70				
		Tested	5833	83.3	86.7	0.921	3341	74	0.409	0.380	6.4	34.5
OSRAM SYLVANIA	MP70/U/MED	Rated	5200				3000	75				
		Tested	5204	74.3	83.8	0.942	2932	71	0.431	0.384	4.7	62.8
Ushio America	MH70/U/MED/32/PS	Rated	6000				3200	70				
		Tested	6305	90.2	85.8	0.917	3406	68	0.415	0.404	3.6	51.9
Venture Lighting	MH 70W/U/PS/3K [b]	Rated	5600				3200	65				
		Tested	5340	76.3	80.1	0.968	3318	54	0.415	0.393	1.4	55.8
Westinghouse Lighting	MH70/U	Rated	5600				4000	65				
		Tested	5887	84.1	81.4	0.966	3853	64	0.393	0.399	1.3	61.9

* This table includes only lamps that were aged on magnetic ballasts. Rated values were taken from manufacturers' Web sites or catalogs.

[a] For vertical operation.

[b] This lamp model is no longer available.

Table 7. NLPIP-Tested and Manufacturer-Supplied Performance Data: Lamp Performance at 40% of Manufacturer-Rated Life *

Manufacturer	Model Number	40% Rated Life (h)	Aging Ballast Type		Mean Light Output (lm) [a]	Lumen Maintenance (%) [a]	Chromaticity Coordinates x	Chromaticity Coordinates y	Color Shift (MacAdam ellipse steps)
Ceramic Lamps									
GE Lighting	CMH70/U/830/MED	4000	E	Rated	4100	65.1			
				Tested	4670	78.7	0.439	0.405	3.32
OSRAM SYLVANIA	MCP70/U/MED/830	4800	E	Rated	4700	79.7			
				Tested	4716	82.1	0.434	0.398	3.77
Philips Lighting	MHC70/U/M/3K/ALTO	4000	E	Rated	4585	73.9			
				Tested	4824	78.4	0.438	0.394	6.00
GE Lighting	CMH70/U/830/MED	4000	M	Rated	4100	65.1			
				Tested	4412	73.3	0.439	0.401	4.09
OSRAM SYLVANIA	MCP70/U/MED/830	4800	M	Rated	4700	79.7			
				Tested	4540	80.3	0.430	0.395	3.89
Philips Lighting	MHC70/U/M/3K/ALTO	4000	M	Rated	4585	73.9			
				Tested	4384	74.1	0.434	0.395	3.56
Quartz Lamps									
EYE Lighting	MP70/U/3K	6000	M	Rated	3900	75.0			
				Tested	2331	45.2	0.429	0.378	2.89
GE Lighting	MXR70/U/MED	4800	M	Rated	3500	63.6			
				Tested	2765	47.4	0.421	0.380	10.30
OSRAM SYLVANIA	MP70/U/MED	6000	M	Rated	3400	65.4			
				Tested	2631	50.5	0.426	0.375	6.34
Ushio America	MH70/U/MED/32/PS	6000	M	Rated	4100	68.3			
				Tested	3119	49.5	0.420	0.388	10.07
Venture Lighting	MH 70W/U/PS/3K [c]	6000	M	Rated	3600	64.3			
				Tested	2740	51.3	0.424	0.390	7.10
Westinghouse Lighting	MH70/U	6000	M	Rated	4000	71.4			
				Tested	2772	47.1	0.394	0.392	4.58

* Rated values were taken from manufacturers' Web sites or catalogs.

E = Electronic ballast M = Magnetic ballast

[a] For vertical operation.

[b] Calculated from initial light output and mean light output.

[c] This lamp model is no longer available.

Table 8. NLPIP-Tested and Manufacturer-Supplied Performance Data: Electronic and Magnetic Ballast Performance *

Manufacturer	Model Number		Light Output (lm)	Lamp Efficacy (LPW)	Lamp Power (W)	Lamp Voltage (V)	System Power Factor	Lamp Operating Frequency (Hz)	Lamp CCF	Input Current THD (%)	System Efficacy (LPW)	Input Power (W)	Input Voltage (V)
Electronic Ballasts													
AC Electronics	MHSS-A70X [a]	Rated					0.99	NS	<1.40	9.1		78.0	
		Tested	5575	79.4	70.2	88.6	0.99	172	2.11	5.7	70.3	79.3	120.0
Advance	IMH-100-A-BLS	Rated					>0.90	NS	<1.50	<15.0		82.0	
		Tested	5851	79.8	73.3	89.4	0.97	140	1.81	6.8	69.9	83.7	120.0
Fulham	HH-MH-120-070-C	Rated					>0.98	NS	1.40	<10.0		82.0	
		Tested	5693	79.9	71.2	88.8	0.99	211	2.32	2.6	71.1	80.0	120.1
Hatch Transformers	MC70-1-F-120U	Rated					0.99	150	<1.30	<9.0		77.0	
		Tested	5404	80.3	67.3	88.1	0.99	159	1.68	4.6	71.2	75.9	120.1
OSRAM SYLVANIA	QTP1X70MH/UNV F [b]	Rated					>0.97	90	NS	<10.0		80.0	
		Tested	5751	79.9	72.0	89.0	0.97	86	2.02	5.3	70.4	81.7	120.0
PowerSelect	PS13B90T [a]	Rated					>0.99	120	<1.40	<5.0		75.3	
		Tested	5194	79.5	65.4	87.3	0.91	121	1.81	1.9	69.6	74.7	120.0
Sunpark Electronics	120-MH75 [c]	Rated					0.99	150	<1.70	7.0		79.0	
		Tested	5574	79.8	69.8	88.7	>0.99	150	1.36	8.1	71.4	78.1	120.1
Vossloh-Schwabe	M7012CK-5EU-F [d]	Rated					>0.90	170	1.20	<15.0		79.0	
		Tested	5688	79.9	71.1	88.8	>0.99	166	1.63	4.8	70.7	80.5	120.0
Magnetic Ballasts													
Advance	72C5282-NP	Rated					>0.90		NS	NS		94.0	
		Tested	4995	78.0	64.0	94.3	0.89	NT	1.59	34.7	60.8	82.2	120.0
GE Lighting	11210-506-C-TC [e]	Rated					>0.90		NS	NS		90.0	
		Tested	5447	77.8	70.0	98.9	0.87	NT	1.60	39.4	61.0	89.4	120.1
OSRAM SYLVANIA	M70/120/277/F-CAN	Rated					0.90		NS	NS		94.0	
		Tested	5472	78.1	70.0	96.2	0.95	NT	1.60	32.7	56.8	96.2	120.0
Robertson Worldwide	BMH0070F413H	Rated					>0.90		NS	NS		92.0	
		Tested	5867	78.4	74.8	97.6	0.97	NT	1.58	20.7	59.4	98.8	119.9
Venture Lighting	V90H5832	Rated					0.90		1.50	NS		90.0	
		Tested	5408	77.7	69.6	95.7	0.86	NT	1.57	26.1	59.8	90.5	119.9
Lamp Operated by Reference Ballast			5568	79.5	70.0	86.9	NA	NT	NT	NA	NA	NA	NA

Input Current (A)	Ballast Efficiency (%)	CCT (K)	CRI	Chromaticity Coordinates		Warm-up Time (s)
				x	y	
0.667	88.5	2879	82.8	0.445	0.405	16.0
0.731	87.6	2868	84.8	0.445	0.403	6.0
0.671	89.0	2861	83.8	0.446	0.404	12.7
0.637	88.7	2863	82.4	0.446	0.405	38.7
0.712	88.1	2886	84.3	0.444	0.404	40.1
0.682	87.5	2915	81.3	0.443	0.406	27.4
0.654	89.4	2888	83.3	0.444	0.404	43.4
0.673	88.4	2877	83.4	0.444	0.403	42.7
0.727	77.9	3002	80.8	0.438	0.406	42.7
0.805	78.3	2951	83.8	0.439	0.402	18.7
0.844	72.8	2953	83.8	0.439	0.403	42.7
0.849	75.7	2932	85.4	0.440	0.402	41.4
0.790	76.9	2947	83.1	0.439	0.403	30.7
NA	NA	3069	81.7	0.437	0.412	NT

* One lamp sample was used repeatedly for ballast testing, a GE ceramic 70 W, model CMH70/U/830/MED. Rated values were taken first from those printed on the ballasts, when available, and then from manufacturers' Web sites or catalogs.

NA = Not applicable NS = Not supplied NT = Not tested

[a] This ballast model is no longer available.

[b] This ballast model was updated after NLPIP testing began. Rated values listed here reflect the model as tested. Consult the manufacturer for the updated performance specifications.

[c] This ballast model number may also appear as 120-MH70.

[d] This ballast previously was made under the brand name Aromat and is no longer available.

[e] This ballast was made by Universal Lighting Technologies.

Table 9. NLPIP-Tested Performance Data: Lamp-Ballast System Performance Sorted by Lamp Model

	Light Output (lm)		Lamp Efficacy (LPW)		Lamp Power (W)		Lamp Voltage (V)		System Power Factor		Lamp CCF		Input Current THD (%)	
Ballast Manufacturer	GA	BA	GA	BA	GA	BA	GA	BA	GA	BA	GA	BA	GA	BA
GE Lighting Ceramic Lamp														
Electronic Ballasts														
AC Electronics [a]	5812	5787	83.3	83.0	69.8	69.8	84.7	84.4	0.991	0.999	1.720	2.043	4.7	4.1
Advance		6124		83.7		73.2		85.5		0.995		1.657		6.8
Fulham		5961		84.0		71.0		84.7		0.996		2.040		2.6
Hatch Transformers		5579		83.3		67.0		84.1		0.991		1.720		4.6
OSRAM SYLVANIA [b]		5955		83.4		71.4		84.8		0.976		1.783		5.5
PowerSelect [a]		5389		82.5		65.3		83.9		0.984		1.597		3.2
Sunpark Electronics		5730		83.1		69.0		84.6		>0.999		1.430		5.9
Vossloh-Schwabe [c]		5969		83.6		71.4		85.3		0.996		1.493		4.8
Magnetic Ballasts														
Advance	5548	5064	81.4	80.6	68.2	62.9	89.6	87.7	0.826	0.830	1.601	1.627	27.1	33.6
GE Lighting [d]		5622		81.7		68.8		91.5		0.797		1.600		26.4
OSRAM SYLVANIA		5527		80.8		68.4		89.4		0.835		1.580		31.4
Robertson Worldwide		5994		82.4		72.8		90.6		0.832		1.603		19.7
Venture Lighting		5537		81.4		68.1		88.9		0.836		1.593		24.6
Reference Ballast		5721		81.5		70.2		85.6		0.398		NT		NT
OSRAM SYLVANIA Ceramic Lamp														
Electronic Ballasts														
AC Electronics [a]	5796	5752	83.8	83.4	69.2	69.1	79.8	79.9	0.991	0.999	1.779	2.190	5.2	5.8
Advance		6142		84.1		73.0		80.2		0.993		1.830		9.7
Fulham		5975		84.1		71.1		80.6		0.997		1.993		2.6
Hatch Transformers		5557		83.5		66.5		79.3		0.992		1.733		4.5
OSRAM SYLVANIA [b]		5917		84.3		70.2		79.9		0.971		1.577		5.9
PowerSelect [a]		5424		83.7		64.8		78.5		0.988		1.720		1.9
Sunpark Electronics		5630		83.5		67.5		79.9		>0.999		1.450		8.5
Vossloh-Schwabe [c]		5975		84.0		71.2		80.2		0.995		1.737		2.9
Magnetic Ballasts														
Advance	5316	4850	82.0	81.5	64.8	59.5	84.8	83.1	0.812	0.812	1.628	1.680	29.8	34.9
GE Lighting [d]		5373		82.1		65.5		86.3		0.782		1.640		38.5
OSRAM SYLVANIA		5320		82.2		64.7		84.2		0.822		1.623		31.6
Robertson Worldwide		5705		82.5		69.2		85.5		0.822		1.593		19.5
Venture Lighting		5334		81.8		65.2		85.0		0.820		1.603		24.6
Reference Ballast		5634		80.7		69.8		85.9		0.389		NT		NT

GA = Grand average BA = Ballast average NA = Not applicable NT = Not tested

[a] This ballast model is no longer available.

[b] This ballast model was updated after NLPIP testing began.

[c] This ballast previously was made under the brand name Aromat and is no longer available.

[d] This ballast was made by Universal Lighting Technologies.

System Efficacy (LPW)		Input Power (W)		Ballast Efficiency (%)		CCT (K)		CRI		Chromaticity Coordinates x		Chromaticity Coordinates y		Warm-up Time (s)	
GA	BA	GA	BA	GA	BA	GA	BA	GA	BA	GA	BA	GA	BA	GA	BA
	72.9		79.4		87.9		3011		81.0		0.437		0.404		24.0
	73.0		83.9		87.3		2973		82.9		0.437		0.401		10.0
	75.0		79.6		89.3		3009		82.0		0.436		0.402		16.0
73.5	73.6	79.0	75.8	88.3	88.3	3032	3067	81.3	80.4	0.435	0.433	0.403	0.404	35.6	46.1
	73.2		81.3		87.8		3040		82.1		0.434		0.403		56.2
	72.1		74.7		87.4		3098		79.3		0.432		0.406		28.7
	74.6		76.9		89.7		3054		81.0		0.434		0.404		52.1
	73.9		80.7		88.5		3003		82.2		0.435		0.401		52.1
	62.4		81.2		77.4		3275		77.5		0.423		0.408		56.1
	63.5		88.5		77.7		3192		80.5		0.426		0.404		50.1
61.7	58.5	90.0	94.4	75.8	72.4	3186	3179	80.2	80.3	0.427	0.427	0.404	0.404	53.7	51.4
	61.9		96.9		75.1		3093		82.8		0.430		0.400		58.8
	62.1		89.2		76.3		3191		80.2		0.426		0.404		52.1
	68.4		83.6		NA		3238		79.7		0.428		0.415		NT
	72.8		79.1		87.3		3039		91.0		0.432		0.398		56.1
	73.4		83.7		87.3		3019		92.1		0.432		0.396		33.4
	74.6		80.1		88.7		3015		91.9		0.432		0.396		56.4
73.6	73.1	78.8	76.1	87.8	87.5	3039	3050	90.9	90.2	0.432	0.431	0.398	0.398	63.0	80.8
	73.7		80.2		87.5		3045		91.3		0.431		0.397		71.4
	73.3		74.0		87.6		3088		89.1		0.430		0.399		56.7
	74.3		75.8		89.0		3022		90.5		0.434		0.400		83.5
	73.5		81.3		87.5		3034		91.5		0.432		0.397		66.1
	62.0		78.3		76.1		3189		86.6		0.425		0.401		62.8
	62.7		85.7		76.4		3122		89.4		0.427		0.397		82.1
61.1	58.2	87.1	91.3	74.5	70.8	3118	3145	89.3	89.3	0.427	0.426	0.397	0.398	78.1	89.5
	60.8		93.8		73.7		3059		91.4		0.429		0.395		77.4
	61.6		86.6		75.3		3077		89.9		0.429		0.396		78.8
	67.5		83.5		NA		3079		91.2		0.433		0.406		NT

Table 9 (continued). NLPIP-Tested Performance Data: Lamp-Ballast System Performance Sorted by Lamp Model

	Light Output (lm)		Lamp Efficacy (LPW)		Lamp Power (W)		Lamp Voltage (V)		System Power Factor		Lamp CCF		Input Current THD (%)	
Ballast Manufacturer	GA	BA	GA	BA	GA	BA	GA	BA	GA	BA	GA	BA	GA	BA
Philips Lighting Ceramic Lamp														
Electronic Ballasts														
AC Electronics [a]	5912	5968	83.9	83.5	70.5	71.5	98.9	99.3	0.989	0.998	1.909	2.500	4.9	5.7
Advance		6232		84.8		73.5		99.7		0.994		1.770		6.9
Fulham		5916		83.6		70.7		99.2		0.998		2.737		2.6
Hatch Transformers		5669		83.6		67.8		98.3		0.990		1.873		4.5
OSRAM SYLVANIA [b]		6054		84.1		72.0		99.1		0.963		1.937		5.2
PowerSelect [a]		5471		83.5		65.6		97.1		0.987		1.503		1.8
Sunpark Electronics		5997		83.6		71.8		99.8		>0.999		1.350		7.6
Vossloh-Schwabe [c]		5986		84.6		70.8		98.5		0.995		1.603		4.8
Magnetic Ballasts														
Advance	6339	5790	82.9	82.8	76.4	69.9	107.2	104.2	0.824	0.830	1.607	1.633	28.7	31.7
GE Lighting [d]		6307		83.1		75.9		107.6		0.799		1.647		34.3
OSRAM SYLVANIA		6419		83.1		77.3		106.7		0.832		1.563		31.2
Robertson Worldwide		6840		82.7		82.7		110.0		0.828		1.620		20.4
Venture Lighting		6338		83.0		76.4		107.3		0.829		1.570		25.7
Reference Ballast		5809		83.0		70.0		102.0		0.478		NT		NT

GA = Grand average BA = Ballast average NA = Not applicable NT = Not tested

[a] This ballast model is no longer available.

[b] This ballast model was updated after NLPIP testing began.

[c] This ballast previously was made under the brand name Aromat and is no longer available.

[d] This ballast was made by Universal Lighting Technologies.

System Efficacy (LPW)		Input Power (W)		Ballast Efficiency (%)		CCT (K)		CRI		Chromaticity Coordinates x		Chromaticity Coordinates y		Warm-up Time (s)	
GA	BA	GA	BA	GA	BA	GA	BA	GA	BA	GA	BA	GA	BA	GA	BA	GA	BA
	74.1		80.6		88.8		2898		82.1		0.438		0.394		10.7
	74.5		83.7		87.9		2899		83.3		0.436		0.391		2.0
	75.4		78.4		90.2		2889		82.0		0.438		0.394		4.7
74.8	74.8	79.1	75.8	89.1	89.4	2917	2948	81.5	80.1	0.437	0.436	0.394	0.396	24.2	26.0
	74.8		80.9		88.9		2915		82.5		0.437		0.393		40.1
	73.6		74.3		88.2		2997		78.8		0.435		0.399		28.1
	75.6		79.3		90.5		2881		82.5		0.438		0.393		38.1
	75.4		79.4		89.1		2911		81.1		0.438		0.396		44.1
	66.1		87.6		79.8		3072		81.1		0.429		0.396		33.4
	66.8		94.5		80.4		2991		84.1		0.431		0.391		38.1
65.2	62.5	97.4	102.6	78.6	75.3	2996	2972	84.5	85.0	0.431	0.432	0.391	0.390	40.7	42.7
	64.6		105.9		78.1		2961		87.3		0.431		0.388		42.1
	65.8		96.4		79.2		2986		85.2		0.431		0.391		47.4
	73.1		79.5		NA		3103		79.8		0.433		0.409		NT

Table 10. NLPIP-Tested Performance Data: Lamp-Ballast System Performance Sorted by Ballast Model

Ballast Manufacturer	Lamp Model	Light Output (lm)		Lamp Efficacy (LPW)		Lamp Power (W)		Lamp Voltage (V)		System Power Factor		Lamp CCF		Input Current THD (%)	
		GA	LA	GA	LA	GA	LA	GA	LA	GA	LA	GA	LA	GA	LA
Electronic Ballasts															
	GE		5787		83.0		69.8		84.4		0.999		2.04		4.1
AC Electronics [a]	Sylvania	5836	5752	83.3	83.4	70.1	69.1	87.9	79.9	0.999	0.999	2.24	2.19	5.2	5.8
	Philips		5968		83.5		71.5		99.3		0.998		2.50		5.7
	GE		6124		83.7		73.2		85.5		0.995		1.66		6.8
Advance	Sylvania	6166	6142	84.2	84.1	73.2	73.0	88.5	80.2	0.994	0.993	1.75	1.83	7.8	9.7
	Philips		6232		84.8		73.5		99.7		0.994		1.77		6.9
	GE		5961		84.0		71.0		84.7		0.996		2.04		2.6
Fulham	Sylvania	5950	5975	83.9	84.1	70.9	71.1	88.2	80.6	0.997	0.997	2.26	1.99	2.6	2.6
	Philips		5916		83.6		70.7		99.2		0.998		2.74		2.6
	GE		5579		83.3		67.0		84.1		0.991		1.72		4.6
Hatch Transformers	Sylvania	5602	5557	83.5	83.5	67.1	66.5	87.2	79.3	0.991	0.992	1.78	1.73	4.5	4.5
	Philips		5669		83.6		67.8		98.3		0.990		1.87		4.5
	GE		5955		83.4		71.4		84.8		0.976		1.78		5.5
OSRAM SYLVANIA [b]	Sylvania	5975	5917	83.9	84.3	71.2	70.2	87.9	79.9	0.970	0.971	1.77	1.58	5.5	5.9
	Philips		6054		84.1		72.0		99.1		0.963		1.94		5.2
	GE		5389		82.5		65.3		83.9		0.984		1.60		3.2
PowerSelect [a]	Sylvania	5428	5424	83.2	83.7	65.2	64.8	86.5	78.5	0.986	0.988	1.61	1.72	2.3	1.9
	Philips		5471		83.5		65.6		97.1		0.987		1.50		1.8
	GE		5730		83.1		69.0		84.6		>0.999		1.43		5.9
Sunpark Electronics	Sylvania	5786	5630	83.4	83.5	69.4	67.5	88.1	79.9	>0.999	>0.999	1.41	1.45	7.3	8.5
	Philips		5997		83.6		71.8		99.8		>0.999		1.35		7.6
	GE		5969		83.6		71.4		85.3		0.996		1.49		4.8
Vossloh-Schwabe [c]	Sylvania	5977	5975	84.0	84.0	71.1	71.2	88.0	80.2	0.996	0.995	1.61	1.74	4.2	2.9
	Philips		5986		84.6		70.8		98.5		0.995		1.60		4.8

GA = Grand average LA = Lamp average

[a] This ballast model is no longer available.

[b] This ballast model was updated after NLPIP testing began.

[c] This ballast previously was made under the brand name Aromat and is no longer available.

[d] This ballast was made by Universal Lighting Technologies.

System Efficacy (LPW)		Input Power (W)		Ballast Efficiency (%)		CCT (K)		CRI		Chromaticity Coordinates x		Chromaticity Coordinates y		Warm-up Time (s)	
GA	LA	GA	LA	GA	LA	GA	LA	GA	LA	GA	LA	GA	LA	GA	LA
	72.9		79.4		87.9		3011		81.0		0.437		0.404		24.0
73.3	72.8	79.7	79.1	88.0	87.3	2983	3039	84.7	91.0	0.435	0.432	0.398	0.398	30.3	56.1
	74.1		80.6		88.8		2898		82.1		0.438		0.394		10.7
	73.0		83.9		87.3		2973		82.9		0.437		0.401		10.0
73.6	73.4	83.7	83.7	87.5	87.3	2964	3019	86.1	92.1	0.435	0.432	0.396	0.396	15.1	33.4
	74.5		83.7		87.9		2899		83.3		0.436		0.391		2.0
	75.0		79.6		89.3		3009		82.0		0.436		0.402		52.1
75.0	74.6	79.4	80.1	89.4	88.7	2971	3015	85.3	91.9	0.435	0.432	0.397	0.396	54.1	66.1
	75.4		78.4		90.2		2889		82.0		0.438		0.394		44.1
	73.6		75.8		88.3		3067		80.4		0.433		0.404		16.0
73.8	73.1	75.9	76.1	88.4	87.5	3022	3050	83.5	90.2	0.434	0.431	0.400	0.398	25.7	56.4
	74.8		75.8		89.4		2948		80.1		0.436		0.396		4.7
	73.2		81.3		87.8		3040		82.1		0.434		0.403		46.1
73.9	73.7	80.8	80.2	88.1	87.5	3000	3045	85.3	91.3	0.434	0.431	0.398	0.397	51.0	80.8
	74.8		80.9		88.9		2915		82.5		0.437		0.393		26.0
	72.1		74.7		87.4		3098		79.3		0.432		0.406		28.7
73.0	73.3	74.4	74.0	87.7	87.6	3061	3088	82.4	89.1	0.432	0.430	0.401	0.399	37.8	56.7
	73.6		74.3		88.2		2997		78.8		0.435		0.399		28.1
	74.6		76.9		89.7		3054		81.0		0.434		0.404		52.1
74.8	74.3	77.3	75.8	89.7	89.0	2986	3022	84.6	90.5	0.435	0.434	0.399	0.400	57.9	83.5
	75.6		79.3		90.5		2881		82.5		0.438		0.393		38.1
	73.9		80.7		88.5		3003		82.2		0.435		0.401		56.2
74.3	73.5	80.5	81.3	88.4	87.5	2983	3034	84.9	91.5	0.435	0.432	0.398	0.397	55.9	71.4
	75.4		79.4		89.1		2911		81.1		0.438		0.396		40.1

Table 10 (continued). NLPIP-Tested Performance Data: Lamp-Ballast System Performance Sorted by Ballast Model

Ballast Manufacturer	Lamp Model	Light Output (lm)		Lamp Efficacy (LPW)		Lamp Power (W)		Lamp Voltage (V)		System Power Factor		Lamp CCF		Input Current THD (%)	
		GA	LA	GA	LA	GA	LA	GA	LA	GA	LA	GA	LA	GA	LA
Magnetic Ballasts															
	GE		5064		80.6		62.9		87.7		0.830		1.63		33.6
Advance	Sylvania	5234	4850	81.6	81.5	64.1	59.5	91.7	83.1	0.824	0.812	1.65	1.68	33.4	34.9
	Philips		5790		82.8		69.9		104.2		0.830		1.63		31.7
	GE		5622		81.7		68.8		91.5		0.797		1.60		26.4
GE Lighting [d]	Sylvania	5767	5373	82.3	82.1	70.1	65.5	95.1	86.3	0.793	0.782	1.63	1.64	33.1	38.5
	Philips		6307		83.1		75.9		107.6		0.799		1.65		34.3
	GE		5527		80.8		68.4		89.4		0.835		1.58		31.4
OSRAM SYLVANIA	Sylvania	5755	5320	82.0	82.2	70.1	64.7	93.4	84.2	0.830	0.822	1.59	1.62	31.4	31.6
	Philips		6419		83.1		77.3		106.7		0.832		1.56		31.2
	GE		5994		82.4		72.8		90.6		0.832		1.60		19.7
Robertson Worldwide	Sylvania	6179	5705	82.5	82.5	74.9	69.2	95.4	85.5	0.827	0.822	1.61	1.59	19.9	19.5
	Philips		6840		82.7		82.7		110.0		0.828		1.62		20.4
	GE		5537		81.4		68.1		88.9		0.836		1.59		24.6
Venture Lighting	Sylvania	5736	5334	82.1	81.8	69.9	65.2	93.7	85.0	0.828	0.820	1.59	1.60	25.0	24.6
	Philips		6338		83.0		76.4		107.3		0.829		1.57		25.7

GA = Grand average   LA = Lamp average

[a] This ballast model is no longer available.

[b] This ballast model was updated after NLPIP testing began.

[c] This ballast previously was made under the brand name Aromat and is no longer available.

[d] This ballast was made by Universal Lighting Technologies.

System Efficacy (LPW)		Input Power (W)		Ballast Efficiency (%)		CCT (K)		CRI		Chromaticity Coordinates x		Chromaticity Coordinates y		Warm-up Time (s)	
GA	LA	GA	LA	GA	LA	GA	LA	GA	LA	GA	LA	GA	LA	GA	LA
	62.4		81.2		77.4		3275		77.5		0.423		0.408		56.1
63.5	62.0	82.3	78.3	77.8	76.1	3179	3189	81.7	86.6	0.426	0.425	0.402	0.401	50.7	62.8
	66.1		87.6		79.8		3072		81.1		0.429		0.396		33.4
	63.5		88.5		77.7		3192		80.5		0.426		0.404		51.4
64.3	62.7	89.5	85.7	78.2	76.4	3102	3122	84.7	89.4	0.428	0.427	0.397	0.397	61.2	89.5
	66.8		94.5		80.4		2991		84.1		0.431		0.391		42.7
	58.5		94.4		72.4		3179		80.3		0.427		0.404		58.8
59.8	58.2	96.1	91.3	72.8	70.8	3099	3145	84.8	89.3	0.428	0.426	0.397	0.398	59.4	77.4
	62.5		102.6		75.3		2972		85.0		0.432		0.390		42.1
	61.9		96.9		75.1		3093		82.8		0.430		0.400		50.1
62.4	60.8	98.9	93.8	75.6	73.7	3037	3059	87.1	91.4	0.430	0.429	0.394	0.395	56.7	82.1
	64.6		105.9		78.1		2961		87.3		0.431		0.388		38.1
	62.1		89.2		76.3		3191		80.2		0.426		0.404		52.1
63.2	61.6	90.7	86.6	76.9	75.3	3085	3077	85.1	89.9	0.429	0.429	0.397	0.396	59.4	78.8
	65.8		96.4		79.2		2986		85.2		0.431		0.391		47.4

Table 11. Manufacturer Contact Information

Manufacturer	Phone	Web Site
AC Electronics	800-375-6355	www.ace-ballast.com
Advance	800-372-3331	www.advancetransformer.com
DYnamic Ballast	866-816-0303	www.dynamicballast.com
Etlin Daniels	888-762-5384	www.etlin.com
EYE Lighting	888-665-2677	www.eyelighting.com
Fulham	800-238-5426	www.fulham.com
Future Wave Technologies	508-460-3300	www.fwsolutions.com
GE Lighting	800-435-4448	www.gelighting.com
Hatch Transformers	813-288-8006	www.hatchtransformers.com
Halco Lighting	800-677-3334	www.halcolighting.com
Howard Lighting Products	800-956-3456	www.howard-lighting.com
Litetronics	800-860-3392	www.litetronics.com
Lithonia Lighting	800-315-4963	www.lithonia.com
Metrolight	615-771-9609	www.metrolight.com
OSRAM SYLVANIA	800-544-4828	www.sylvania.com
Philips Lighting	800-555-0050	www.lighting.philips.com
PowerSelect	714-901-3900	www.powerselectinc.com
Robertson Worldwide	800-323-5633	www.robertsonww.com
Sage Lighting	604-904-9533	www.sagelighting.com
Sunpark Electronics	866-478-6775	www.sunpkco.com
Universal Lighting Technologies	615-316-5100	www.universalballast.com
Ushio America	800-838-7446	www.ushio.com
Venture Lighting	800-451-2606	www.venturelighting.com
Vossloh-Schwabe	888-427-6628	www.vossloh-schwabe.com
Westinghouse Lighting	888-417-6222	www.westinghouselightbulbs.com

Low-wattage Metal Halide Lighting Systems

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National Lighting Product Information Program Publications

Guide to Fluorescent Lamp-Ballast Compatibility, 1996
Guide to Specifying High-Frequency Electronic Ballasts, 1996
Guide to Selecting Frequently Switched T8 Fluorescent Lamp-Ballast Systems, 1998

Specifier Reports

Power Reducers, 1992; *Specular Reflectors*, 1992; *Cathode-Disconnect Ballasts*, 1993; *Exit Signs*, 1994; *Reflector Lamps*, 1994; *CFL Downlights*, 1995; *HID Accent Lighting Systems*, 1996; *Occupancy Sensors*, 1998; *Photosensors*, 1998; *Lighting Circuit Power Reducers*, 1998; *Screwbase Compact Fluorescent Lamp Products*, 1999; *Energy-Efficient Ceiling-Mounted Residential Luminaires*, 1999; *Dimming Electronic Ballasts*, 1999; *Electronic Ballasts*, 2000; *Parking Lot and Area Luminaires*, 2004

Specifier Reports Supplements

Exit Signs, 1995, 1998; *Energy-Efficient Ceiling-Mounted Residential Luminaires*, 2000;*HID Accent Lighting*, 2000; *Screwbase Compact Fluorescent Lamp Products*, 2000

Lighting Answers

T8 Fluorescent Lamps, 1993; *Multilayer Polarizer Panels*, 1993; *Task Lighting for Offices*, 1994; *Dimming Systems for High-Intensity Discharge Lamps*, 1994; *Electromagnetic Interference Involving Fluorescent Lighting Systems*, 1995; *Power Quality*, 1995; *Thermal Effects in 2' x 4' Fluorescent Lighting Systems*, 1995; *T10 and T9 Fluorescent Lamps*, 1995; *T5FT Lamps and Ballasts*, 1996; *Controlling Lighting with Building Automation Systems*, 1997; *Alternatives to Halogen Torchieres*, 2000; *T5 Fluorescent Systems*, 2002; *MR16 Lamps*, 2002; *Mid-wattage Metal Halide Lamps*, 2003; *Light Pollution*, 2003; *LED Lighting Systems*, 2003; *Adaptable Ballasts*, 2003; *Full-Spectrum Light Sources*, 2003; *Light Sources and Color*, 2004; *T8 Fluorescent Lamps*, 2006; *High-wattage Fluorescent Lamps*, 2006; *Photovoltaic Lighting*, 2006

Lighting Diagnostics

Dimming T8 Fluorescent System Problems, 2006

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Specifier Reports

The objective source of lighting product information

Low-wattage Metal Halide Lighting Systems

Low-wattage MH Lamps with Electronic and Magnetic Ballasts

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