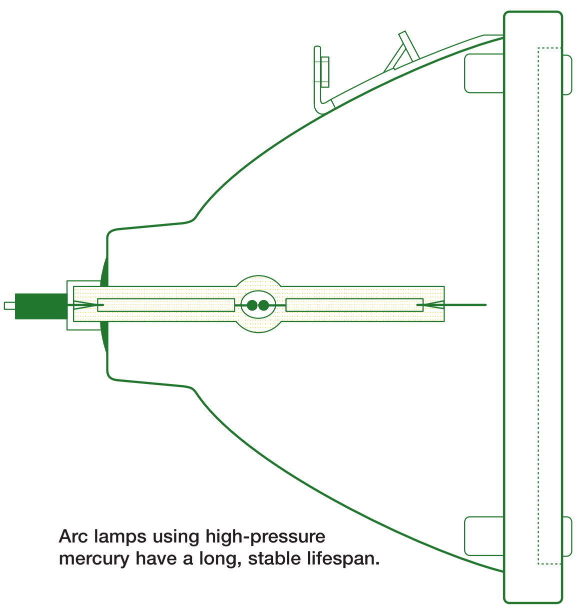
# High pressure mercury lamps

## Planning for maximum application uptime

Many rear-projection displays now use a type of arc lamp incorporating high-pressure mercury within a discharge tube. Philips pioneered this type of lamp technology and markets it under the UHP™ (Ultra-High Performance™) name. Other manufacturers offer similar lamp technology under various names.

There are several advantages to this lamp technology for high-end rear-projection display applications. The arc size is very small, in the range 1.0 to 1.3 mm, and therefore comes close to emulating an ideal point light source. The light output is high for the amount of watts consumed, and the distribution of the light energy is fairly well dispersed across the visible spectrum.



**Arc lamps using high-pressure mercury have a long, stable lifespan.**

Most importantly, this lamp technology exhibits long, stable lifetimes measured in the thousands of hours. This is achieved by introducing precise amounts of oxygen and halogen into the lamp, creating a regenerative chemical cycle that deposits evaporated tungsten back onto the electrodes.[1] Long lamp life is a critical requirement for applications running 24 hours a day, seven days a week.

### Median lamp life

Given the complex chemical process taking place inside these lamps, coupled with the extremely high pressure (200 atmospheres) and temperature (6,000º C) at which they operate, it is truly remarkable that life times in the thousands of hours are achieved. Due to the nature of the failure mechanisms, the manufacturers all specify *median* lamp life rather than *average* life.

Median life is defined as the point in time at which exactly 50 percent of a large sample population of lamps is still operational. For example, starting with a sample population of 150 lamps, 75 will still be operational at the median lifetime.

Average life is calculated as the sum of all individual lamp lifetimes, divided by the size of the sample population. For large population samples, average life is a good figure for predicting failures over a long period of time and the subsequent replacement costs. Unfortunately, there is no exact correlation between median life and average life. Average life can be significantly higher, or lower, than median life.

[1] G. Derra and H. Mönch, The UHP lamp – a shining example of Philips Research, Philips Research Password 7, April 2001.

## An example of median versus average life

Consider the following examples of hypothetical failure distribution curves. In each graph below, the bars represent the percentage of failures occurring at time intervals of 800 hours. In all cases the *median* life, the point at which the remaining population reaches 50 percent of the original sample size, is 8,000 hours. However, the *average* life in each case is markedly different.

Graph 1 follows a symmetrical distribution curve. In this case, the average life is exactly the same as the median life at 8,000 hours. Graph 2 shows a two-stage life characteristic. Half the population still fails before 8,000 hours, but the remaining 50 percent lives quite a bit longer. In this case the average life is 10,000 hours. In addition, 49 percent of the population exhibits a lifetime of 16,000 hours!

Conversely, Graph 3 shows a distribution that exhibits a large number of early failures. In this extreme case, average life is less than the median life.

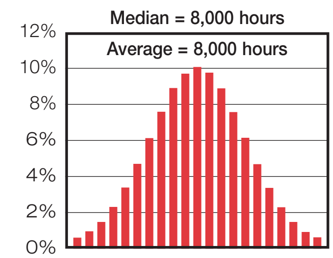
## The application risks of unpredictable performance

There is no direct way to estimate average life from median life, as a result, planning and budgeting for replacement lamps is difficult. If the assumption is made that the average lamp life is the same as the specified median life, an actual failure distribution closer to Graph 3 will result in significantly more replacement lamps needed than planned for. Conversely, assuming a worst-case failure distribution may result in excess inventory of replacement lamps.

For applications requiring high uptime – such as a network operations center digital wall or a flight information display system in an airport – minimizing the impact of lamp failures is particularly important. Organizations planning these mission-critical installations need to factor lamp life into both the displays and the service programs they purchase.

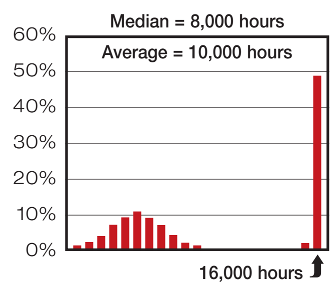
For example, the Clarity Lion digital display features a multi-lamp optical engine that minimizes downtime by providing redundant illumination and stand-by lamps that can be activated without opening the cabinet. Companies should also evaluate manufacturer warranties covering replacement lamps to offset the risks posed by the unpredictable life span of this sophisticated illumination technology.

**Graph 1**



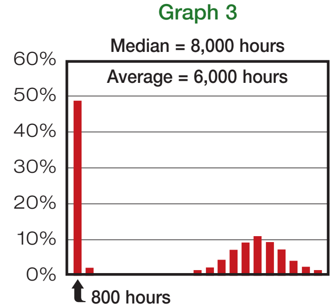

A symmetrical failure distribution has a median life and an average life that are equal.

**Graph 2**




In the failure distribution shown above, the median life is 8,000 hours, the average life is 10,000 hours, and 49% of the population exhibits a life of 16,000 hours.

**Graph 3**




This failure distribution is the mirror image of Graph 2. Median life is 8,000 hours, average life is 6,000 hours, and 49% of the population fails within 800 hours.



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