

## Understanding the Spectral Distribution Chart

Scandium is a typical chemical placed inside a Metal Halide arc tube that contributes to the creation of white light. In its atomic form a scandium atom is composed of a nucleus surrounded by 21 orbiting electrons. **For this demonstration we show only 3 of the orbiting electrons.**

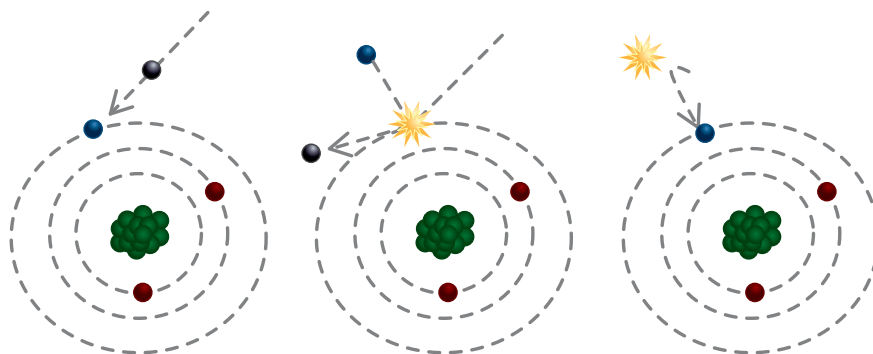
When power is applied to the arc tube, free electrons (not "bound" to an atom) flow through the tube and collide with electrons bound to, and orbiting the Scandium atoms.

During the collision, the bound electron is knocked out of its orbit. When the electron snaps back into its orbit a release of visible energy occurs in the form of a particle of light called a Photon.

Each of the orbiting electrons, when knocked out of their orbit create a Photon at a different wavelength.

The height of the line (Relative Energy) shown on the chart represents the percentage of energy contained in that wavelength compared to the total energy contained in the entire spectrum.

Scandium accounts for only 21 wavelengths of this Spectral Distribution Chart. Additional spectral wavelengths are contributed by Mercury, Argon gas and other chemical additives contained inside the arc tube.

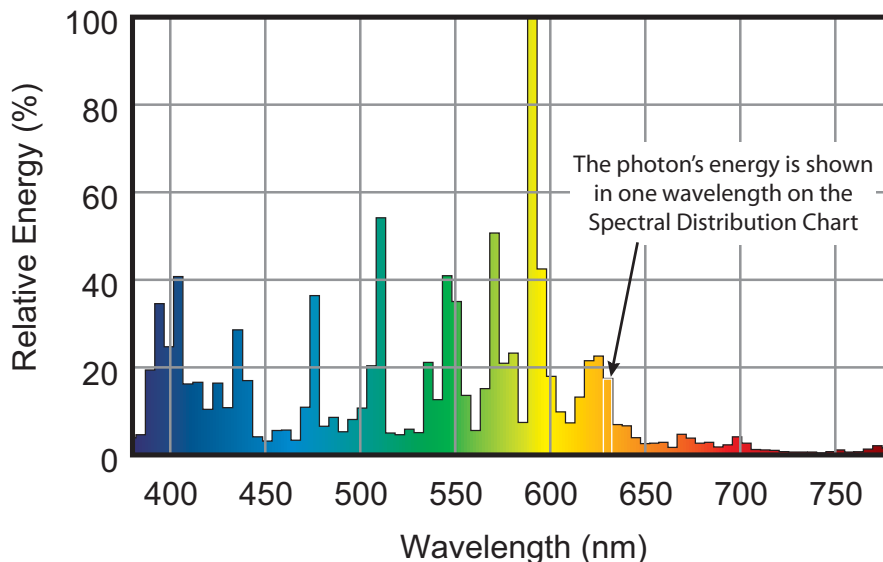


A random electron (black) is on a collision course with an electron bound to an atom.

During the collision the bound electron (blue) is knocked out of its orbit

When the electron snaps back into its orbit, a photon (particle of light) is created

### Typical Metal Halide Spectral Distribution Chart



## Understanding Color Rendering

The eye sees all objects in the form of reflected light. All of the colors contained in the object must also be present in the beam of light to accurately reproduce the image in reflected light. The Color Rendering Index is a numerical scale from zero to one hundred used to rate

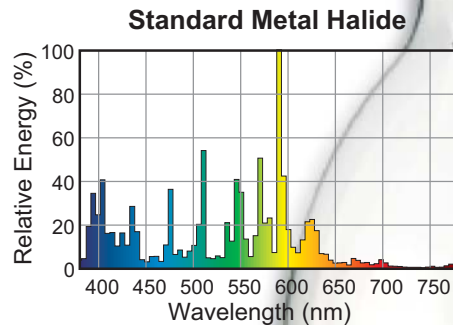
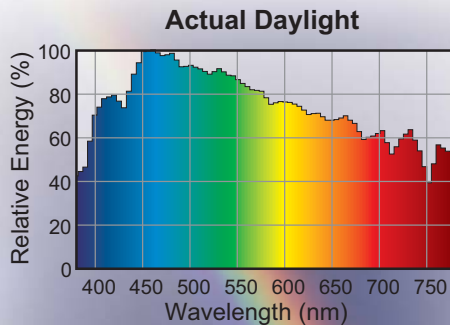
the accuracy at which a light source will render colors. A value of 100 CRI indicates perfect color rendering. There is, however, another factor to consider in the color equation... the amount of light. Low light levels make an object lack color and look dull, or grayish.

### DAYLIGHT

Natural daylight contains all the colors in the visible light spectrum, plus the Power, or Energy Level of the light in each color is nearly consistent across the entire spectrum.

### METAL HALIDE LAMP

A typical Metal Halide lamps does not contain all of the colors in the light spectrum. Additionally, the color power levels are inconsistent.



CRI=100



CRI=65

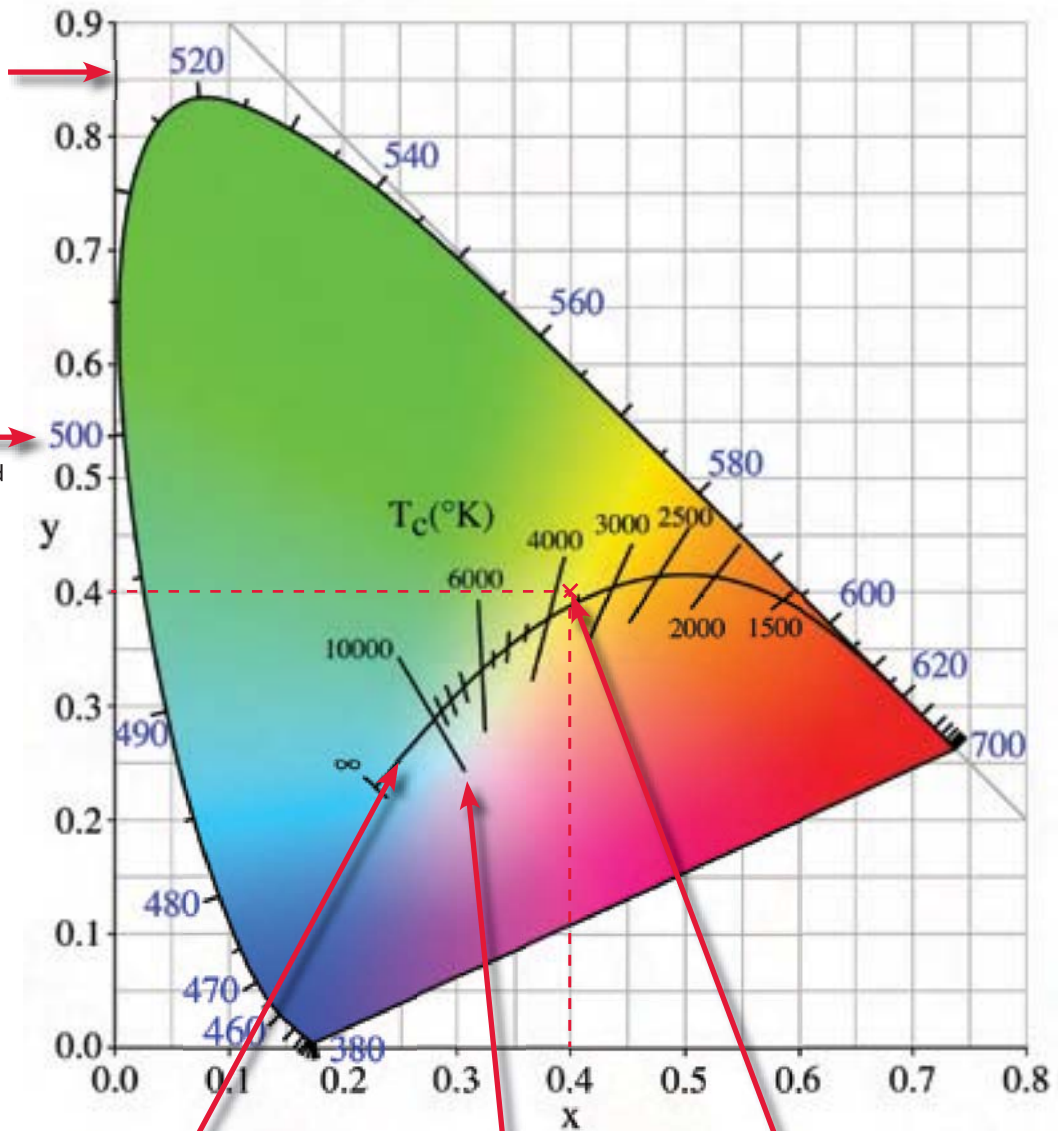
## Understanding Correlated Color Temperature (CCT)

There are a number of color combinations that can be used to create White Light, or a particular Color Temperature. The Chromaticity Chart is used to qualify the color of the light that is produced by a lamp. This is called a lamp's

Color Temperature. This can be seen on the Chromaticity chart. Color temperature is specified in **degrees Kelvin ( $^{\circ}\text{K}$ )**\*

The chart is laid over an X, Y grid with numbers at the left and bottom used to define an exact point on the chart.

The blue numbers surrounding the curved part of the color form represent wavelengths in nanometers in the color spectrum.



The curved line is called the "Black Body Curve" and represents the color temperature of an object (for instance a piece of steel) that is heated until it gives off light.

The curve begins at the extreme right of the of the chart and moves to the left. As the steel is heated, its color (Color Temperature) changes from black to dull red, orange, yellow, white and finally blue, as the heat increases.

The lines intersecting the black body curve represent the range of points on the chart that will result in a specific color temperature.

A Metal Halide lamp with Chromaticity coordinates of  $X=0.396$ ,  $Y=0.402$  shows that the lamp has a 3800K Color Temperature (shown by the red "X").

\*Kelvin is a temperature scale in which zero occurs at absolute zero and each degree equals one Kelvin.

## Understanding the R9 Color Rendering Value

R9 or strong red is one of 14 test colors used to calculate a color rendering index. The higher the R9 number, the more accurate and vivid the illumination (perceived color of the object).

- Color Rendering Index (CRI) is a rating system that measures the accuracy of how well a light source reproduces the (total) color of an illuminated object.
- R9 is one of 14 test colors used in calculating CRI.
- Since some percentage of the color Red can be found mixed into the various hues of most processed colors, the ability to accurately reproduce Red is key for accurately rendering colors of displayed objects.
- Lamps with high R9 values produce the most vivid colors.
- For HID lamps, EYE Cera Arc Metal Halide sets the standard in rendering the color Red.

### Test Colors Used in Calculating CRI



### Color Rendering Characteristics of Common Light Source Lamps

Lamp	CCT (Kelvin)	Ra (CRI)	R9
Tungsten Halogen	3190	100	100
Cera Arc® (Natural Red)	3600	92	-90
Metal Halide	4220	67	-113
Metal Halide Coated	3800	70	-88
Mercury Clear	6410	18	-299
Mercury Coated	3600	49	-68
High Pressure Sodium	2100	24	-197
Xenon	5920	94	-81
Low Pressure Sodium	1740	-44	-492

\* The color reproduction accuracy ratings for R9 for all lamp types range from -492 (Low Pressure Sodium) to +100 (Tungsten Halogen)