

# Quartz-Halogen Lamp Color Temperature Analysis

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This report was prepared to document the findings of a set of measurements taken of the color temperature of a 300 Watt and 500 Watt quartz-halogen lamp. Included is a set of photographic color temperatures at different lamp terminal voltages and corresponding color correction and light balance filter combinations for three different types of film.

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## 1.0 Introduction

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This paper documents the results of an experiment which was conducted to measure the photographic color temperature of a 300 Watt and 500 Watt quartz-halogen lamp under different terminal voltages. This was done to determine the sensitivity of each lamp's color temperature to variations in terminal voltage. Additionally, each lamp was measured for color temperature at each voltage and a corresponding temperature shift in mireds was recorded. Using a Minolta Color Meter III F, the corresponding correction filters for each condition was recorded for three types of film: daylight, tungsten type A, and tungsten type B.

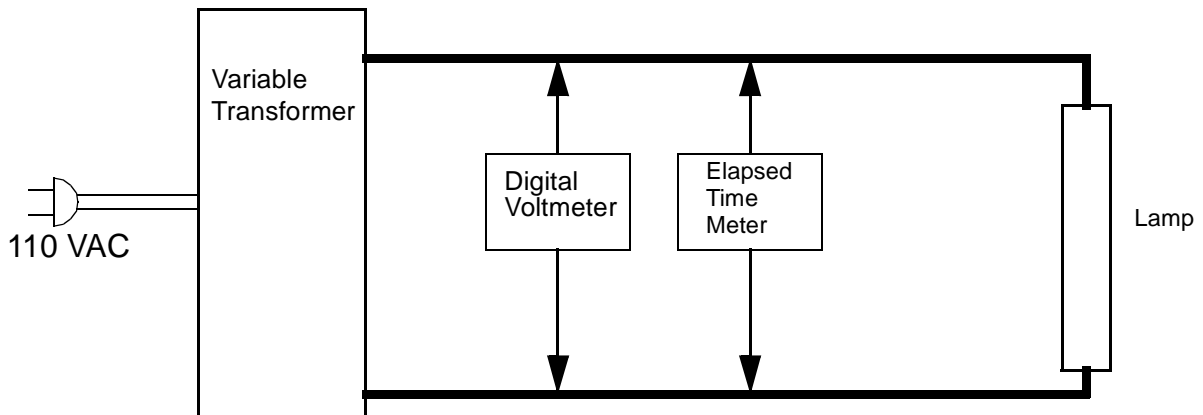
Daylight film is balanced for 5,500° K whereas the type A tungsten is balanced for 3,200° K and the type B for 3,400° K.

## 1.1 Methodology of the Experiment

The experiment was set up as shown in Figure 1. The key features are the incorporation of a variable voltage control and a digital volt meter to set and record the various voltages at which each lamp was measured. After initial application of 90 VAC, each lamp was allowed to stabilize for five minutes at which time the first reading was taken. The voltage was then increased by five volts and the lamp allowed to stabilize at that voltage for one minute. A new temperature reading was taken and the process was repeated until the reading for last voltage had been made.

The terminal voltage was gradually reduced to 90 VAC before removing the lamp's voltage.

Figure 1: Experiment Setup



These lamps are designed for outdoors use as yard lamps, burglar deterrents, etc. The lamps were installed in a Regent Lighting Corporation Model EQ-300-WL which is enclosure intended for outdoors use. The protective weather-sealed glass front plate was removed for the experiment. Additionally, each lamp was installed with the glass seal pointing forward.

## 2.0 Results

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The results of the experiment are shown in Table 1. Each lamp's color temperature was measured at voltage increments of 5 VAC beginning at 90 VAC and concluding at 120 VAC. For each voltage, the lamp's color temperature is shown with the LB and CC filters required to color correct/compensate for each of the three film types.

## 3.0 Observations

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The color temperature of each lamp increases with increasing voltage. The color temperature difference between each type of lamp at each voltage is not significantly different. However, these lamps are not anywhere near proper color balance for either of the two tungsten film types nor daylight film. Furthermore, the amount of filtration to use these lamps with tungsten film will reduce film speed by at least one stop and will affect the speed of daylight film by at least 3 stops. Additionally, the amount of filtration

correction required for daylight film suggests that these lamps are not suitable for use with daylight film. The Minolta Color Meter IIF has a color shift range specification of -500 to +500 mireds. However, for shift values over about 198, the meter will not display a recommended LB filter or combination of LB filters. Consequently, for shift values greater than this amount, the filters were computed by hand rather than directly reading from the color meter. This further suggests that daylight film is not normally associated with this type of quartz-halogen lamp.

While this experiment utilized only one specimen of each lamp type, the results cannot be considered to be statistically significant. However, the specific differences between each of these lamps suggests that there is a strong correlation between these lamps and the data compiled during this experiment.

It was also found that each lamp required a green CC filter at each lamp voltage. This means that these lamps have a magenta color shift. A 5G or 10G green CC filter will further reduce film speed or effective speed by one-third stop. These filters are not rated in mireds as are the LB filters. Rather, the CC filters are rated in density. There is an implicit decimal point two places to the left of the numerical value of the CC filter. For example, the 5G has a density of 0.05 while the 10G has a density of 0.10. Under the most discerning conditions, the effect of a 0.05 density filter would probably be seen. The effect of a 0.10 filter should certainly be seen. However, with these yard lamps, there is so much LB filtration required that it is doubtful whether the effect of a CC filter would be detected at all. Thus, the use of a CC filter with these lamps is probably not required.

**Observations**

**Table 1: Experiment Results**

<b>300 Watt Lamp</b>											
Voltage	Color Temp	Film Type A			Film Type B			Daylight Film			
		Shift (mireds)	LB Filter	CC Filter	Shift (mireds)	LB Filter	CC Filter	Shift (mireds)	LB Filter	CC Filter	
90	2400	-125	80B+82	7G	-106	80C+82A	7G	-237	80A+80B	7G	
95	2430	-117	80B	5G	-99	80C+82A	5G	-229	80B+80B	5G	
100	2460	-113	80B	7G	-94	80C+82	7G	-225	80B+80B	7G	
105	2530	-101	80C+82A	6G	-82	80C	6G	-213	80A+80C	6G	
110	2540	-99	80C+82A	6G	-80	80C	6G	-211	80A+80C	6G	
115	2640	-85	80C	6G	-66	80D+82	6G	-197	80B+80C	6G	
120	2680	-78	80D+82A	6G	-60	80D	6G	-191	80A+80D	6G	
<b>500 Watt Lamp</b>											
Voltage	Color Temp	Film Type A			Film Type B			Daylight Film			
		Shift (mireds)	LB Filter	CC Filter	Shift (mireds)	LB Filter	CC Filter	Shift (mireds)	LB Filter	CC Filter	
90	2440	-116	80B	6G	-98	80C+82A	6G	-229	80B+80B	6G	
95	2470	-111	80B	6G	-93	80C+82	6G	-223	80B+80B	6G	
100	2510	-104	80C+82A	6G	-86	80C	6G	-217	80A+80C	6G	
105	2560	-96	80C+82	6G	-78	80D+82A	6G	-209	80B+80C	6G	
110	2590	-93	80C+82	6G	-74	80D+82A	6G	-205	80B+80C	6G	
115	2630	-86	80C	5G	-68	80D+82	5G	-198	80B+80C	5G	
120	2700	-76	80D+82A	5G	-58	80D	5G	-188	80A+80D	5G	
NOTES:											
1	80B+80B costs 3.3 stops with -224 mireds correction										
2	80A+80C costs 3.0 stops with -212 mireds correction										
3	80B+80C costs 2.6 stops with -193 mireds correction										
4	80A+80D costs 2.3 stops with -187 mireds correction										
5	LB adjusts color temperature										
6	CC adjusts color cast (spatial color)										
7	Green CC filter absorbs magenta										

During the experiment, it was also noted that the color temperature of each lamp type at each specific voltage changed by up to 40° K simply by rotating the lamp around its linear axis. Consequently, the most stable and repeatable temperature is expected to be achieved by positioning the lamp around its linear axis by no more than ± 3°.

#### 4.0 Conclusions

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The color correction filtration required for “yard type” 300 Watt and 500 Watt quartz-halogen lamps has been presented. The next experiment to conduct would be one with physically similar lamps yet ones which are designed to produce light closer to that specified for one of the tungsten films. The suggested lamp is the Calumet 500 Watt WIGDA lamp which is stated as being a 3150° K lamp. This would place it as extremely compatible with type A tungsten film and would not require LB filtration. It is possible that CC filtration might be required.