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## METHOD OF TEST FOR EXPECTED LIFE PERFORMANCE AND LUMENS OF HPS LAMPS

**CAUTION:** Prior to handling test materials, performing equipment setups, and/or conducting this method, testers are required to read “**SAFETY AND HEALTH**” in Section E of this method. It is the responsibility of whoever uses this method to consult and use departmental safety and health practices and determine the applicability of regulatory limitations before any testing is performed. Users of this method do so at their own risk.

### A. SCOPE

The object of this test is to determine Lumen Output and lamp voltage requirements as shown in Appendix Figure 1.

### B. APPARATUS: TYPICAL

1. YEW Yokogawa Digital Power Factor Meter, Model 2524.
2. Magtrol Power Analyzer, Model 4612.
3. Tektronix Oscilloscope Model, 2465.
4. Fluke Digital Multimeter, Models 8050A, 8060A and 8600A.
5. Sylvania variable linear reactor (Type 20758).
6. One Powerstat Variable Autotransformer, 10 Amp.
7. 1.5 m Photometric Sphere.

### C. TEST PROCEDURE

#### a) Stabilized Lamp Operation

1. Connect the primary and secondary leads from the test set-up to the primary and secondary connection points on the ballast under test (See Figure 1). Estimate the approximate current and voltage and set the meter ranges accordingly.
2. Determine input voltage required. If 120 volts is needed, bypass the Westinghouse Transformer (See Figure 4, Power Control Board) by setting S1 and S2 to 120 volts. When 216 volts to 528 volts is needed, the Westinghouse Transformer should be used by setting S1 to primary, S2 to secondary and S3 to 208 volt input. The power cord input should be inserted in 120 volt receptacle for 120 volt testing and in the 208 volt receptacle for voltages above 216.
3. Turn MAIN POWER breaker ON.
4. Turn Magtrol and YEW Yokogawa Meter POWER SWITCHES ON.
5. Determine that meter protection switches are off before turning POWER VARIAC ON. These include the primary side voltmeter and ammeter and the secondary side voltmeter and ammeter. The meters must be protected because a

HPS lamp needs a 2500 volt pulse to start. The testing of starters will not be covered in this Test Method.

6. Turn POWER VARIAC SWITCH ON and adjust the variac to the specified ballast input voltage. METER SWITCHES can be turned ON after the test lamp ignites.
7. Allow lamp to stabilize (approximately 20 minutes) before recording input and output parameters on the HPS Lamp Testing form (See Figure 2). Input current, watts are measured on the YEW Yokogawa Digital Power Factor Meter, Model 2524. The output voltage, current and watts are measured on the Magtrol Analyzer, Model 4612.

#### b) Dynamic Lamp Operation

The arc voltage of a high-pressure sodium lamp depends upon the operating temperature of the cold spot because the sodium-amalgam content is fully vaporized. When the lamp wattage is changed, by varying the line voltage or ballast impedance, the lamp voltage also changes and a plot of these wattage and voltage values defines the **Lamp Characteristic Curve**. The "minimum lamp voltage" curve of figure 6 is such a lamp characteristic curve. The voltage value at which a lamp characteristic curve crosses the 200-watt level is designated as its **Lamp Characteristic Voltage**. When a lamp operates for a ballast that is being held at constant input voltage and constant impedance, any changes in the lamp voltage result in wattage changes. These changes follow the **Ballast Characteristic Curve** for the specific input voltage at which the ballast is operating. Throughout the lifetime of a lamp, the ballast curve shall fall within the lamp voltage and wattage limits specified in figure 6.

1. The lamp manufacturers have established a range of limits within which the HPS lamps must be maintained over the lamp life, to

achieve published lamp performance (See Figure 5). The volt-watt trace is recorded as the lamp warms up to its stabilization temperature. To duplicate further aging of the lamp (1.2 lamp volt rise per 1000 burning hours) the temperature at the cold spot is increased. The volt-watt trace passes thru the trapezoid until the lamp extinguishes at the end of lamp life. Increasing the spot temperature is accomplished by placing the lamp in an aluminum reflector oven with a Quartz Halogen lamp.

2. After the lamps have been seasoned for 100 hours they shall be tested for the electrical characteristics of lamp voltage shown in Figure 7. These characteristics apply to bare lamps operating in horizontal position, in an ambient temperature of  $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ , on a 60 Hz sinusoidal power supply. Measurements are made after the lamp stabilizes (typically about 20 minutes or more).
3. The lumens are measured at nominal lamp wattage after the lamp stabilizes. The testing shall be conducted under the same test conditions discussed in (2) above. The lumens of each lamp tested shall not fall below 85 % of the initial lumens listed in Figure 8.

#### D. ELECTRICAL CHARACTERISTICS AND LUMEN OUTPUT TESTS AND RESULTS

The test lamps will be the same lamps selected for the physical inspection test. The test lamps will be seasoned for 100 hours before they are tested for characteristics and lumens. In addition, the lamps will be measured after the lamp stabilizes (typically about 20 minutes or more). An electrical characteristic failure shall be defined as a failure of a lamp to meet the lamp voltage requirements shown in Figure 7. A lumen output failure shall occur when the lumens of a lamp fall below 85 % of the initial lumens listed in Figure 3.

**E. SAFETY AND HEALTH**

Prior to handling, testing or disposing of any materials, testers are required to read Caltrans Laboratory Safety Manual-Part A, Section 5.0, Hazards and Employee Exposure; Part B, Sections: 5.0, Safe Practices; 6.0, Chemical Procurement Distribution and Storage; and 10.0, Personal Protective Apparel and Equipment; and Part C, Section 1.0; Safe Laboratory Practices.

**F. APPENDIX**

Figure 1. Simplified Ballast Test Setup. - Page 4.

Figure 2. Forms for recording parameters at lamp stabilization. - Page 4.

Figure 3. Test Equipment Layout for Ballast Testing. - Page 5.

Figure 4. Input Power Control Board. - Page 6.

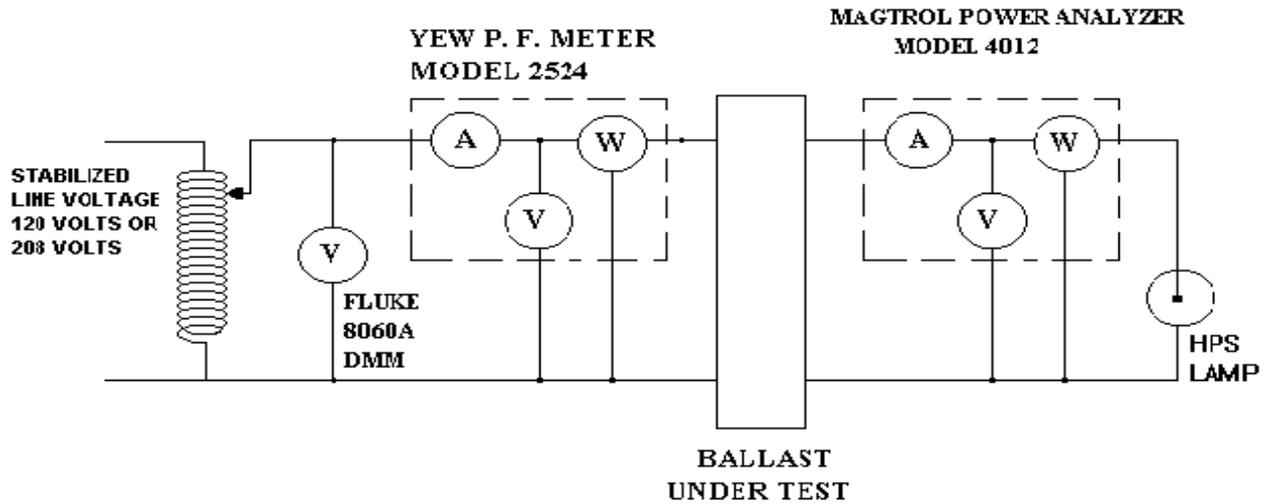
Figure 5. Trapezoid Limits as defined by ANSI. - Page 7.

Figure 6. Lamp Voltage-Wattage limits. - Page 8.

Figure 7. Electrical Characteristics of HPS lamps. - Page 9.

Figure 8. Initial Lumens of HPS lamps. - Page 10.

**End of Test (California Test 610 contains 10 pages)**



**SIMPLIFIED BALLAST TEST SET-UP**

**FIGURE 1.**

**H. P. S. LAMP TESTING**

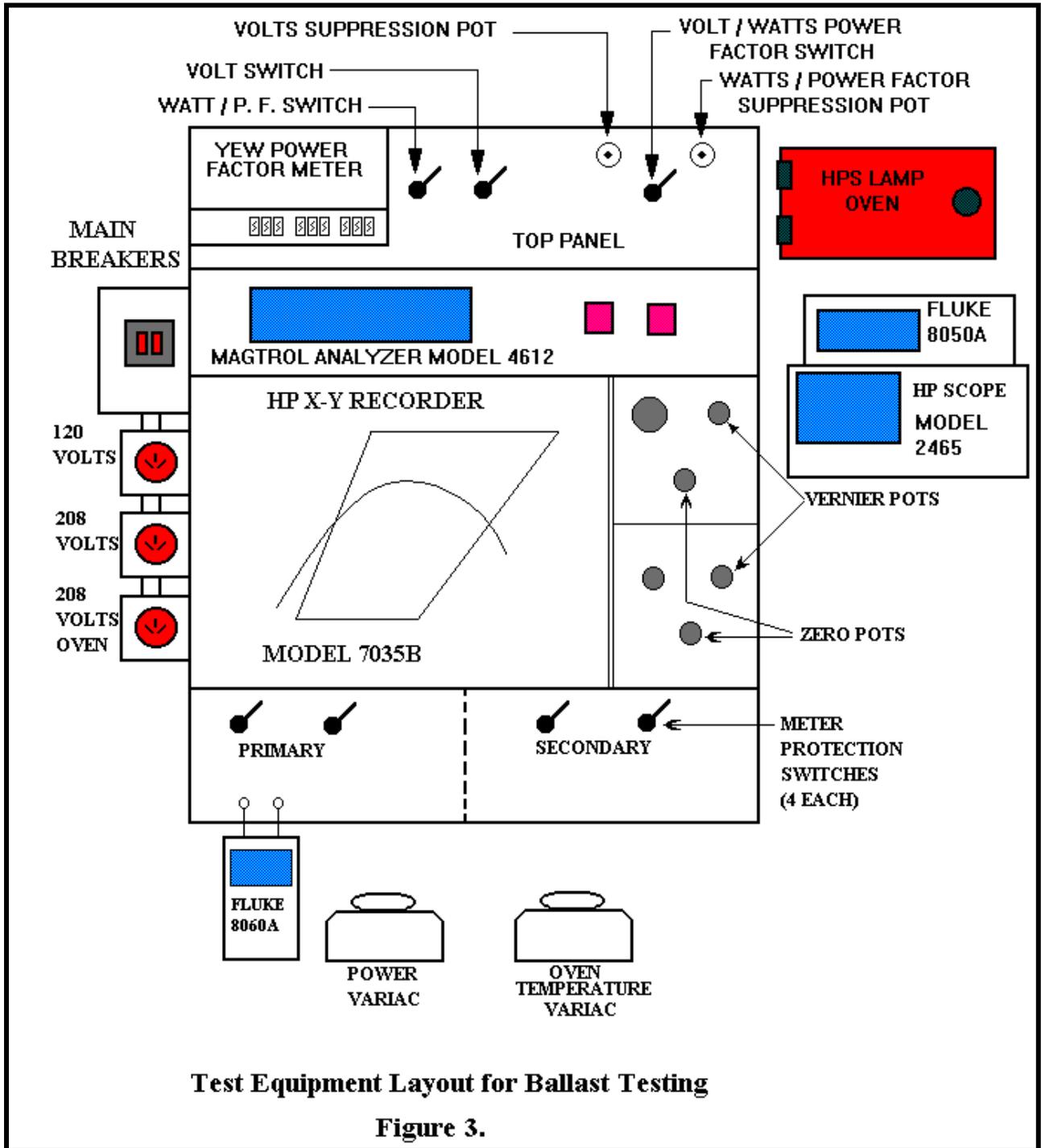
**RATED LUMENS:**  
**LAMP WATTS:**  
**CAT. NO.:**  
**SPHERE CAL. FACTOR:**

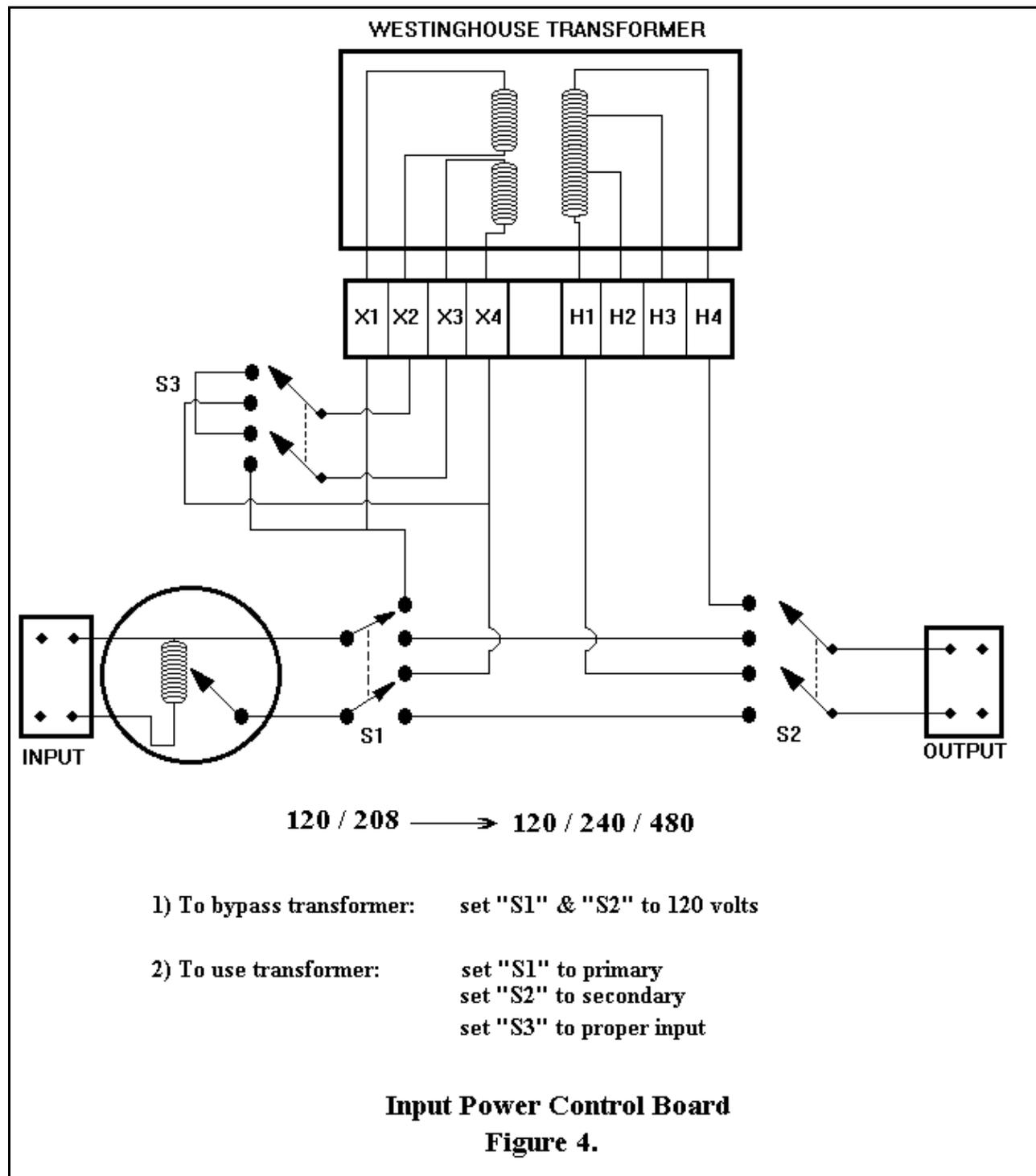
**SM. NO.:**  
**MFG.:**  
**LOT NO.:**  
**DATE:**

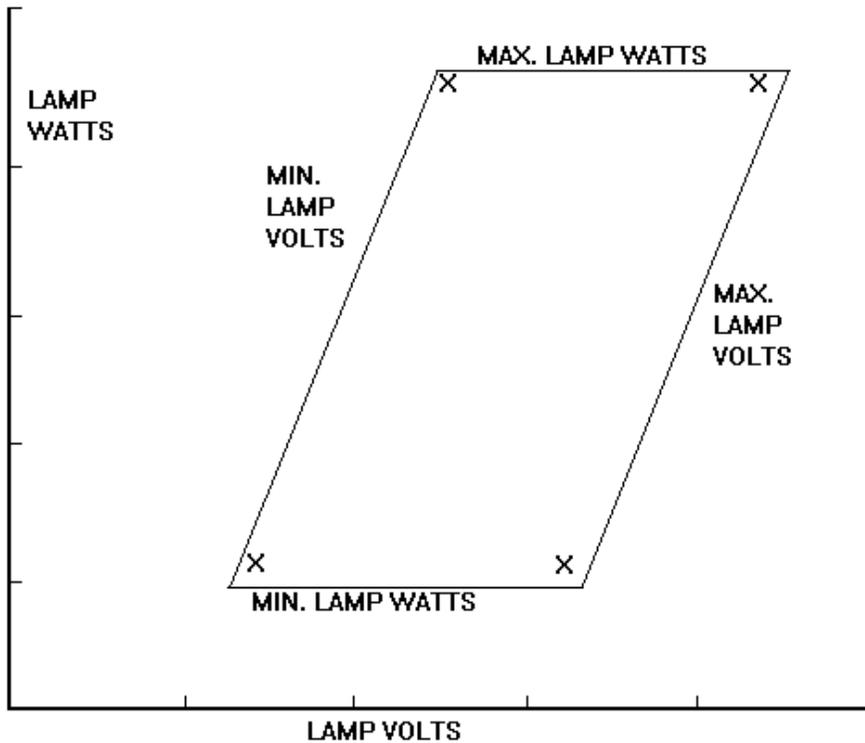
INPUT				OUTPUT			
SR. NO.	INPUT VOLTS	INPUT CURRENT	INPUT WATTS	LAMP VOLTS (Vo)	OUTPUT WATTS (Wo)	MICRO AMPS	LUMENS (m. amps x S.C.F.)
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							

**FORMS FOR RECORDING PARAMETERS AT LAMP STABILIZATION**

**FIGURE 2.**







**Trapezoid Limits for the various wattages**

Rated Lamp Watts	50	70	100	150	200	250	310	400	1000
Min. Watts	38	50	72	110	140	175	210	280	750
Max. Watts	65	90	124	180	260	350	390	490	1200
Min. Volts	46	44	45	48	90	85	90	84	210
Max. Volts	84	84	84	85	160	160	160	152	350
<b>Lamp Voltage Limits to establish the corners of trapezoid (At X Points)</b>									
for Corners of Trapezoid									
At Max. Watts	55/99	50/104	51/96	54/97	105/200	109/194	105/186	97/172	235/390
At Min. Watts	39/72	38/64	38/71	40/69	75/120	67/134	71/128	67/125	175/300

**Trapezoid Limits as defined by ANSI**

Figure 5.

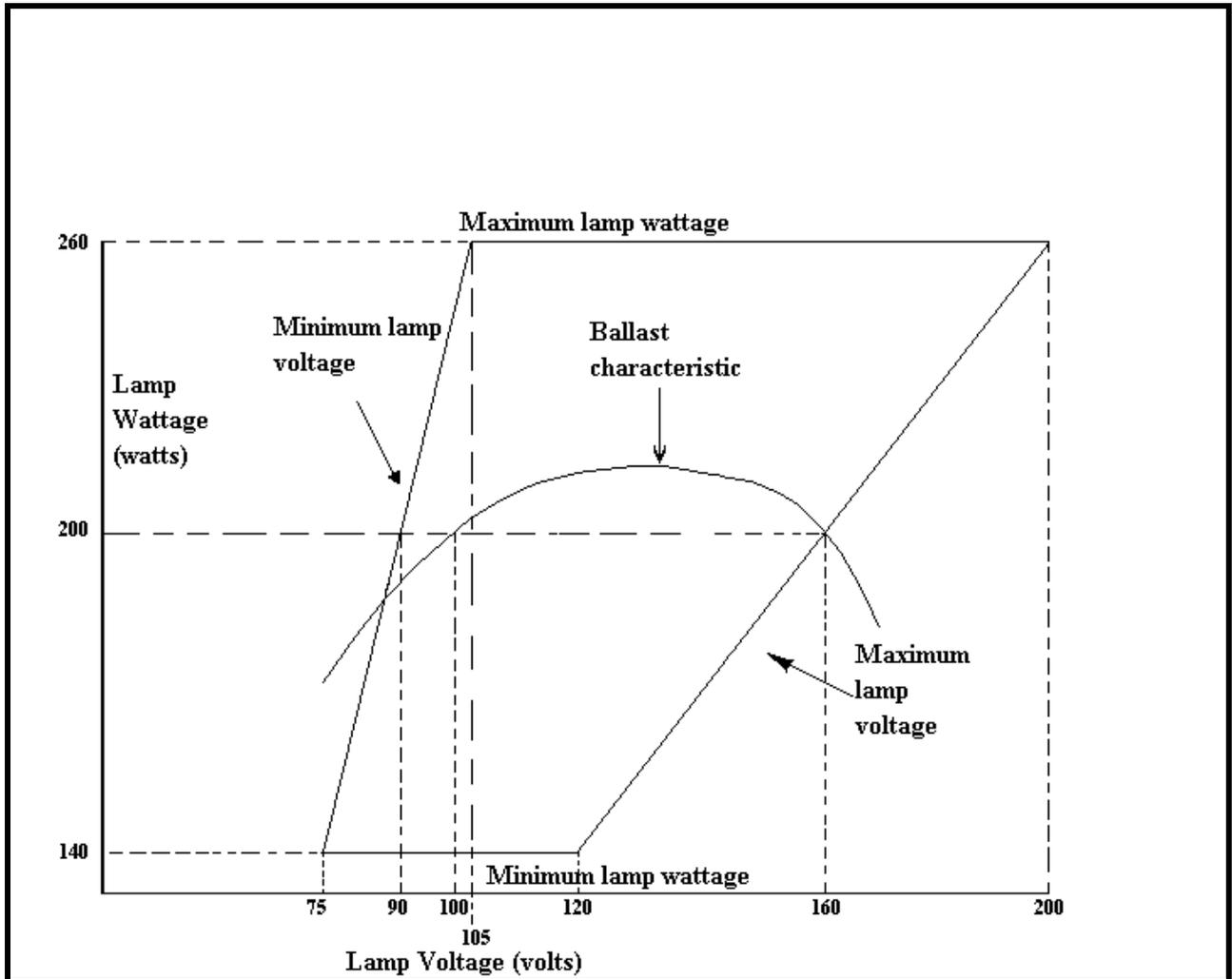


Figure 6. - Lamp voltage - Wattage limits

			Rated Lamp Watts						
			70	100	150	200	250	310	400
	<b>Design Center</b>	<b>Nominal</b>	52	55	55	100	100	100	100
<b>Characteristic Voltage<sup>1</sup></b>	<b>Lamp Volts, rms</b>	<b>Minimum</b>	44	45	48	85	85	85	85
		<b>Maximum</b>	60	62	62	115	115	115	115
<b>Lamp Current, amperes, rms Nominal</b>			1.6	2.1	3.2	2.4	3.0	3.6	4.7

**Note 1:** After 100 hours burning (seasoning)

ELECTRICAL CHARACTERISTICS

FIGURE 7.

Figure 8.

INITIAL LUMENS

Lamp Watts	Initial Lumens
70	5800
100	9500
150/55	16000
200	22000
250	27500
310	37000
400	50000