Massachusetts Institute of Technology
Physics Department

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Problem Solution: Testing The LVPS.

Data Table for LVPS Problem

V_{LVPS} (no load) [volts]	V_{LVPS} (load) [volts]	Light characteristics
1.3 min	1.3	No light
3.0	3.0	Red
5.0	5.0	Orange
7.0	7.0	Bright orange
9.0	9.0	Yellow
11.0	10.9	Bright yellow
12.0	11.6	Bright yellow
12.5	11.9	Bright yellow
13.0	12.0	Bright yellow
13.5	12.0	Bright yellow
14.0	12.0	Bright yellow
15.0	12.0	Bright yellow
15.9 max	12.0	Bright yellow

Questions:

1. What range of no-load output voltages agreed with the load output voltages? This range is the range of output voltages that are well-regulated, i.e. the load does not change the output voltage.

Answer: When the output voltage of the LVPS was set between 1.3 V to just under 11.0 V, attaching the 8 W filament of the #1157 lamp did not change the output voltage of the LVPS. Above 11.0 V, the LVPS output dropped indicating that the internal resistance of the LVPS was increasing as the LVPS voltage increased. The maximum voltage output for the 8 W filament was 12.0 V.

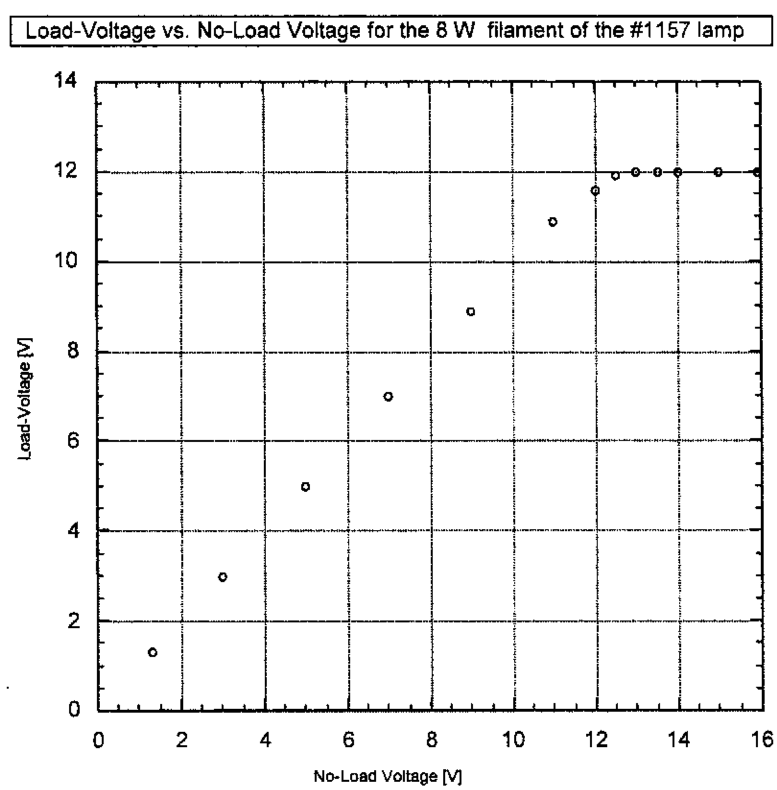
2. Briefly describe how you determined which filament in the lamp was the 8 W filament and which filament in was the 27 W filament?

Answer: At the minimal no-load voltage setting 1.3 V, the lower filament already was a dull red. The upper filament did not show any red until a voltage setting of 2.1 V. The light from the lower filament was much brighter than the upper filament

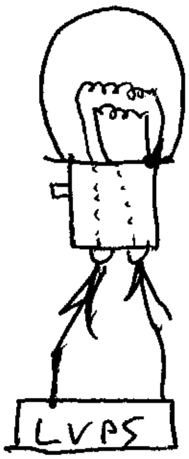
at a no-load LVPS output of 6.0 V, I observed that there was a slight voltage drop down to 5.9 V. (At 10 V no-load LVPS output voltage across the lower filament, the load voltage dropped to 7.5 V.) The upper filament did not show a voltage drop until a no-load settings of 11.0 V. The lower filament is noticeably brighter than the upper filament so I conclude that the lower filament is the 27 watt filament. 27 watts is the power rating of the bulb.

At any given voltage setting the resistance of the bulb is defined to be the ratio R = V / I. This resistance may vary as a function of the voltage and current readings (it does for each filament of the lamp). When I visually examined the two filaments I observed that the lower filament has a larger diameter. This allows more current to flow at the same voltage setting due to a decrease in the resistance of the filament to the flow of current (resistance is inversely proportional to the cross-sectional area of the filament.) The power to the bulb is increased since P == I V (power is voltage times current).

The LVPS is putting out a much greater current for the lower filament accounting for a greater voltage at lower no-load output settings. In order to completely determine the properties of the LVPS, we need to fix a no-load voltage, then vary the current output of the LVPS and determine at what power (power is voltage times current) the LVPS can no longer maintain the same voltage output. Then we rep eat this for a range of no-load settings.



Problem 3: Because the socket was not on the LVPST kit or Red Box, you used clip leads to replace the socket



When you clip the LVPS output leads to the bottom two input leads to the light, the two filaments are in series and there is not enough power to light both filaments, so the 27W filament becomes dull red, and then dark. However the 8W filament still lights. The power is

$$P = \Delta V I$$

when the two bulbs are in series

$$R^{total} = R_{27} + R_8$$

$$\Delta V = I_{new}(R^{total})$$

$$I_{new} = \frac{\Delta V}{R_{total}}$$ decreases so

$$(P_{new}) = (\Delta V) I_{new}$$ decreases and the 27 watt filament will not light.