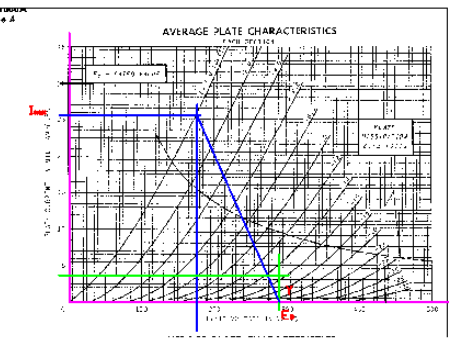


Determine the maximum power available for the 12AU7 tube. From the schematic, the plate voltage is assumed to 294 volts. And the plate-dissipation rating is 2.75 watts. The maximum grid bias is one-half the cutoff voltage of $1.4 \times 294 = 412$ volts. The one-half value is approximately -15.5 volts, close to the value determined in standard calculations. The plate current is 0.0036 amperes. The plate-dissipation is 0.0036×294 volts = 1.05 watts, More wattage could be achieved by reducing the bias voltage, say $294/2.75$ or approximately 12ma.

The $E_c=0$, value at $0.6(294)$ or 176 volts is 25.5ma. a

The power output is $(0.0255 \times 294)/5 = 1.5$ watts.

The resistance calculated is from the load formula Plate-to-plate load (R_{pp}) = $4 \times (294 - 176)/0.0255 = 18500$ ohms.



The AX84 website, discussions state the higher plate to plate impedance used in the firefly was selected because the amp sounded better.

More power could be achieved through selecting a lower primary impedance. The output tubes have room to provide more power.

Example: Determine the load resistance, power output, and distortion of a triode having an amplification factor of 4.2, a plate-dissipation rating of 15 watts, and plate-characteristics curves as shown in Fig 41. The tube is to be operated at 250 volts on the plate.

Procedure: for a first approximation, determine the operating point P from the zero-signal bias formula $E_{c0} = -(0.68 \times 250)/4.2 = -40.5$ volts. From the curve for this voltage, it is found that the zero-signal plate current is 0.08 ampere and, therefore, the plate-dissipation rating is exceeded ($0.08 \times 250 = 20$ watts). Consequently, it is necessary to reduce the zero-signal plate current to -0.06 ampere at 250 volts. The grid bias is then -43.5 volts. Note, that the curve was taken with a dc filament supply; if the filament is to be operated on an ac supply, the bias must be increased by about one-half the filament voltage, or to -45volts, and the circuit returns made to the mid-point of the filament circuit.

Point X can then be determined. Point X is at the intersection of the dc bias curve at zero volts with I_{max} , where $I_{max} = 2I_0 = 0.12$ ampere. Line XY is drawn through P and X. E_{max} , E_{min} , and I_{min} are then found from the curves. When these values are substituted in the power-output formula, the following is obtained

$$P_0 = \frac{(0.12 - 0.012) \times (365 - 105)}{8} = 3.52 \text{ watts}$$

The resistance represented by load line XY is $\frac{(365 - 105)}{(0.12 - 0.012)} = 2410\Omega$

When the values from the curves are substituted in the distortion formula, the following result is obtained:

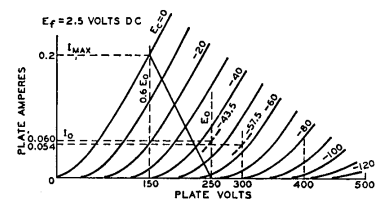
$$\% \text{ distortion} = \frac{0.12 + 0.012}{0.12 - 0.012} - 0.06 \times 100 = 5.5\%$$

It is customary to select the load resistance so that the distortion does not exceed five percent. In the example, the distortion is excessive, therefore, to use a slightly higher load resistance. A load resistance of 2500Ω will

provide a distortion of about 4.9% The power output is reduced only slightly to 3.5 watts.

Operating conditions for triodes in PP, depend on the type of operation. Under class A, conditions, distortion, power output and efficiency are all relatively low. The operating bias, can be anywhere between that specified for a single valve operation, or that equal to one-half the grid bias voltage required to produce plate-current cutoff at a plate voltage of $1.4E_0$, where E_0 is the operating plate voltage. Higher bias, requires higher grid-signal voltage, and takes the amplifier into Class AB.

Graphic calculations for push-pull class A amplifier using a power triode.



Maximum Power Output, given the P/T

Procedure: (1), Erect a vertical line at $0.6 E_0$, (See Fig 42), intersecting the $E_c=0$ curve at point I_{max} . I_{max} will be used in the following formula to determine power $P_0 = (I_{max} \times E_0)/5$ where I_{max} is in amperes, E_0 in volts and power output in watts.

The method used to determine the proper load resistance for triodes in PP is: Draw a load line through I_{max} on the zero-bias curve, and through E_0 at the zero current axis. Four times the resistance represents by this load line is the plate-to-plate load (R_{pp}) for two triodes in a class A PP amplifier. Expressed as a formula: $R_{pp} = 4 \times (E_0 - 0.6E_0) / I_{max}$, where E_0 is in volts, I_{max} in amperes, and R_{pp} in ohms.

Example: Assume the plate voltage (E_0) is 300volts, and the plate-dissipation rating of the valve is 15 watts. Then, for class A operation, the operating bias can be equal to, but not more than, one-half the grid bias for cutoff with a plate voltage of $1.4 \times 300 = 420$ volts (since cutoff bias is approximately -115 volts at a plate voltage of 420 volts, one-half of this value is -57.5 volts bias.) At this bias, the plate current is found from the plate family to be 0.054 ampere and, therefore, the plate dissipation is 0.054×300 or 16.2 watts. Since 57.5 is the limit of bias for class A operation of these tubes at a plate voltage of 300 volts, the dissipation cannot be reduced by increasing the bias, and it becomes necessary to reduce the plate voltage.

If the plate voltage is reduced to 250 volts, the bias will be found to be -43.5 volts. Then, following the method for calculating power output, erect a vertical line at $0.6E_0=150$ volts. The intersection of the line with curve $E_c=0$ is I_{max} or 0.2 ampere. When this value is substituted in the power output is $(0.2 \times 250)/5 = 10$ watts. The resistance is determined from the load formula: Plate-to-plate load (R_{pp}) = $4 \times (250 - 150)/0.2 = 2000$ ohms.