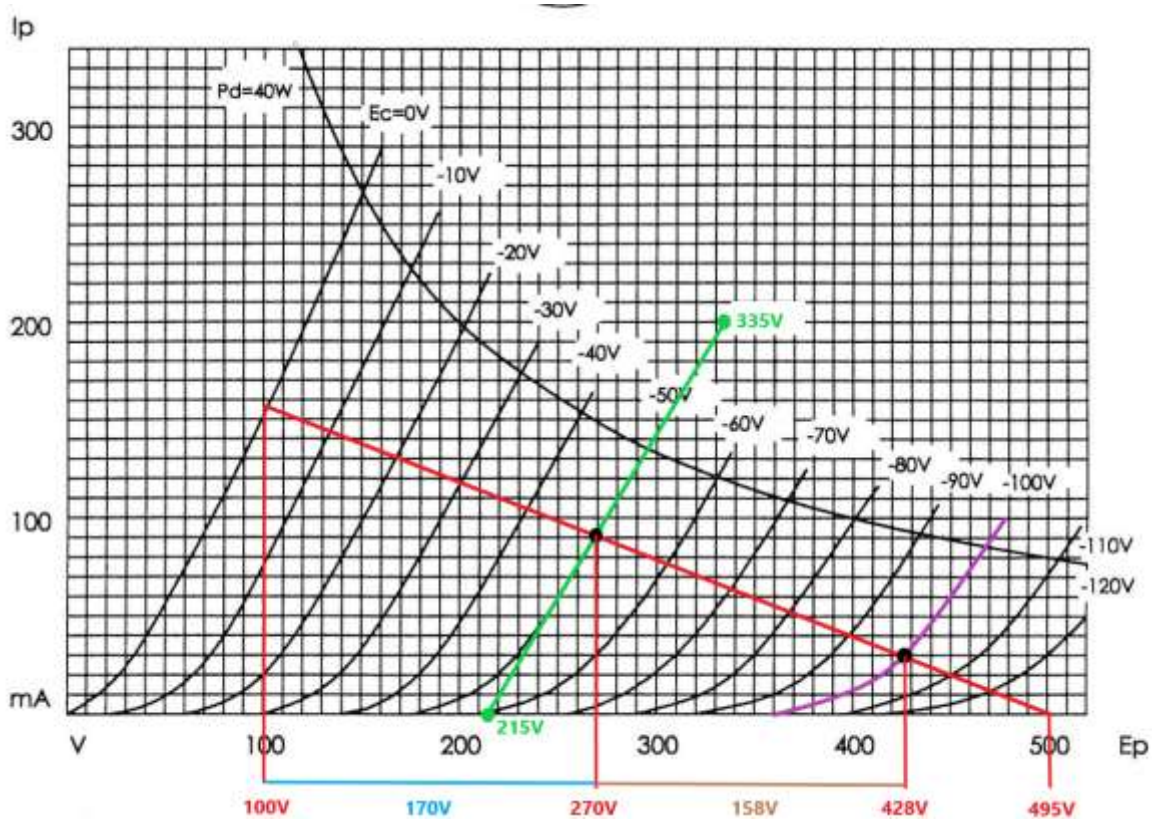
Calculation of power Tube SE (Triode Mode)



Given:

B+ = 270 V
Idle current (I_p) Tube = 90mA.

Anode Dissipation:

P_d = U * I =270 V * 90 mA = 24,3 Watt

This is within the limit, **$P_{d(max)}$ = 40 Watt**)

Chosen Bias Current = 90 mA at 270V

Z_a = Primairy impedance of output transformer = 2,5 KΩ

A key characteristic of a transformer is that it can briefly store energy, allowing it to deliver a higher voltage than the supply voltage **B+.**

Load line calculation:

$U = I_p * Z_a$ = 90 mA x 2,5 KΩ = 225 V

Draw a line from the **chosen idle current** to **Ec=0 V.**
Thus:
E_p= 270 V+225 V=495 V

Starting at **495 V**, these two points define the slope of the load line.

We calculate the **usable power** because the full load line (due to curvature at the bottom of the graph) introduces too much distortion.

In this example, the maximum drive level is at **Ec = −100 V** (**purple line** with **black dot**), just above the curvature.
This corresponds to **50 V from the bias point Ec = −50 V**.
Extend another **50 V** to the other side from the bias point.
Here, this happens to reach **Ec = 0 V**, but this is not always the case.
With these three points, we can calculate the **usable power**.

Usable Power Calculation:

$$P_{out} = \frac{1}{2} * \Delta V * \Delta I = \frac{1}{2} * 170V * (157\,mA - 90mA) = 5.6\,Watt$$

$$P_{out} = \frac{1}{2} * \Delta V * \Delta I = \frac{1}{2} * 158V * (90mA - 30\,mA) = 4{,}7\,Watt$$

The output power will therefore be approximately:

$$\frac{5,6W + 4,7W}{2} = 5,1W\ per\ channel$$

Distortion Calculation:

You have a voltage of:

- **100V at Ec = 0V**
- **270V at Ec = −50V**
- **428V at Ec = −100V**

E_p= 270 V - 100 V = 170 V
E_p= 428 V - 270 V = 158 V

$$THD_2 = \frac{1}{2} * \frac{170V - 158V}{170V + 158V} * 100 = 1{,}82\%$$

Internal Resistance of the Tube:

$$R_i = \frac{V_a}{I_a} = \frac{335V - 215V}{200mA} = 600\ \Omega$$