

INVESTIGATION TO INCREASE LIFE EXPECTANCY OF POWER TUBE RS 1084 CJ

J. Buttkus

The minimum guaranteed life expectancy for the power tube RS 1084 CJ will be 5000 hours if the tube operates within the ratings. Operation below the maximum ratings will considerably increase the life expectancy of the tube¹⁾²⁾³⁾ A factor in tube life is the temperature of the thoriated-tungsten cathode. As in our application, the required peak cathode emission is much less compared with peak cathode emission available at nominal rated filament voltage. The possibility to increase the tube life through proper adjustment of filament voltage was investigated.

It is common practice to determine the necessary cathode temperature compatible with the application by measuring some important parameters of performance, such as plate current, power output or distortion in actual tube operation while filament voltage on the power tube is reduced until a "noticeable" degradation occurs.

The difficulty to do so in our case is that no strong proton beam is presently available from the Booster; the worst case conditions for the new accelerating system are therefore simulated as follows :

To get the maximum available plate current of 10 amps which the plate power supply can deliver, the cavity was completely detuned, and in order

to avoid an overloading of the tube, it was driven by pulses of 1 msec length. Fig. 1 shows a plot of the peak DC plate current pulse vs the driving voltage with the filament voltage as parameter. It can be seen that by decreasing of the filament voltage down to 11.5 V no noticeable reduction of the plate current will occur.

It should be pointed out that the measured limitation seems primarily not to be a saturation effect due to reduced emission of the cathode, but due to a general shift of the tube characteristics; with somewhat reduced transconductance, the required peak cathode current of about 35A necessitates an increased grid drive exceeding 0 Volt at its peaks, thus drawing grid current and loading down the driver (see enclosed tube characteristics).

A further reduction of the cathode temperature might be possible, but in this case the increase of grid voltage swing causes a heavier excursion to positive grid region and hence a grid current will flow with some change in phase. Theoretically it can be shown³⁾ that a 6% decrease in filament voltage will result in a 100% increase in tube life. As under these conditions no excessive grid current will flow and life expectancy can be increased by a substantial percentage, this adjustment of the supply voltages will be recommended :

V_H	11,8 V
V_{g2}	1500 V
U_{g2}	- 280 V
expected increase in tube life time	100 %

References

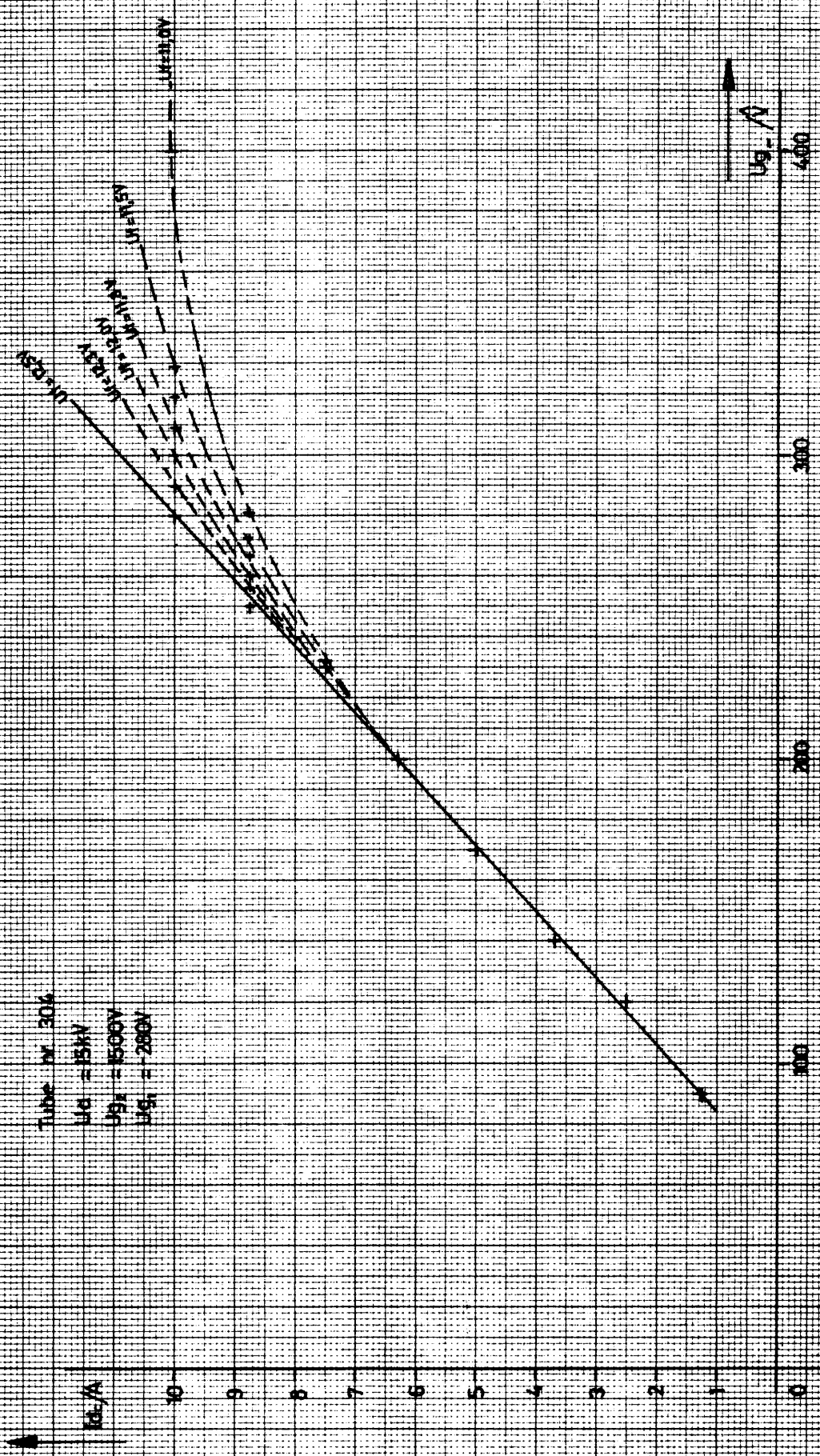
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2. Sutherland, R. : Care and feeding of power grid tubes.
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J. Buttkus

Distribution :

J. Jamsek
W. Pirkl
G. Plass



Tube nr. 304
 $U_a = 15kV$
 $U_{g_1} = 15.00V$
 $U_{g_2} = -280V$

FIG. 1

RS 1084C

$U_{g_2} = 1500V$

