INTRODUCTION

It is with considerable reluctance that I attempt to write this note. At various times over the passing years, I have attempted to relate some aspects of uniform water breakdown to the streamer velocity relations originally measured by George Herbert in "Velocity of Propagation of High Voltage Streamers in Various Liquids", SSWA/4GH/66l0/104.

I have recently hand written a note "A Possible High Voltage Water Streamer Velocity Relation" which attempts to combine George's measurements for plus and minus points at voltages below 1 MV to give a relation applicable to rather higher voltages. This relation is shown as Figure 7c-1.

This reluctance is partly because I think the integral relations are significantly uncertain and hence the differential ones even more so. In addition any attempt to use the differential relations to calculate the propagation of a streamer from a very small projection, or gas bubble formed from it, has to make a staggering number of uncertain or indeed unlikely assumptions. Hence while being prepared to play around in private, I have been very reluctant to commit the results to paper (even hand written).

However for what its worth (and that's very little) here goes.

* Letter
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Fig 7c-1 Mean streamer velocities.

DIFFERENTIAL RELATION FOR A LINEAR VOLTAGE RAMP

Let $V = kt$ as shown in Fig. 7c-2.

Put $\frac{dx}{dt_+} = At^{-0.5} k^{0.6} t^{-0.6}$, $\frac{dx}{dt_-} = B t^{-0.5} k t$

$$d_+ = \left(\frac{A}{1.1}\right) t_m^{0.5} V_m^{0.6} = 8.8 t_{\text{eff}}^{1/2} V_m^{0.6}$$

$$d_- = \left(\frac{B}{1.5}\right) t_m^{0.5} V_m = 10 t_{\text{eff}}^{1/2} V_m$$

i.e., $A = 5.8$ \hspace{1cm} $B = 9.0$.

Thus $\frac{dx}{dt_+} = 5.8 t^{0.1} k^{0.6}$ and $\frac{dx}{dt_-} = 9 t^{0.5} k$.

These become equal when $V_s^{0.4} = 0.65$, $V_s \approx 0.35 \text{ MV}$.

In the "Possible High Voltage Streamer" note the voltage at which the velocities are equal was given as $V_s \approx 0.7 \text{ MV}$. This applies for square pulses. If the reader wants to work this out he can think about what the old $t_{\text{eff}}$ definition has done, it gave me a