WEIGHT SAVING AND DURATION

By G. Mansfield

Published in the August 2008 Issue of Scale Staffel, Gerry Sullivan, Editor

We've all heard the old weight saving dictum for our often tail-heavy models: "Saving a gram at the tail, means saving two grams of ballast, for a net benefit of three grams overa!!."
Here's a closer look at the increase in flight duration that you can expect by reducing weight in any component, anywhere from nose to tail. First some math. Start with the theoretical "Still-Air Duration" formula:

(1)

$$T = \frac{K * Wr * \sqrt{Aw}}{(Wgross)^{1.5}}$$

Where: T = duration (seconds), K = constant = 285 for scale rubber, Wr = rubber wt (gm),
Aw = wing area (sq.in), W gross = total model wt, including rubber (gm)

Next, after a bit of moment balancing, we do some calculus on equation (I) to get an approximate linear expression for "%change in duration" **- *versus* -** "change in component weight as a % change in gross weight":

%change inT=-1.5 * (%change in Wgross) * (1+Lcomponent/Lballast) **(2)**

Where: **Lcomponent** = distance from model cg *aft* to cg of the component (use negative number for component cg forward of model cg)

Lballast = distance *forward* from model cg to nose weight.cg .

Here is an example:
60 gram model, 20 gram motor: Wgross = 80 gram, Aw = 140 sq. inches,

Component for weight reduction: **Tail***:* Lcomponent = 11.5", Lballast = 6.2"

Thus: Lcomponent/Lballast = 1.85

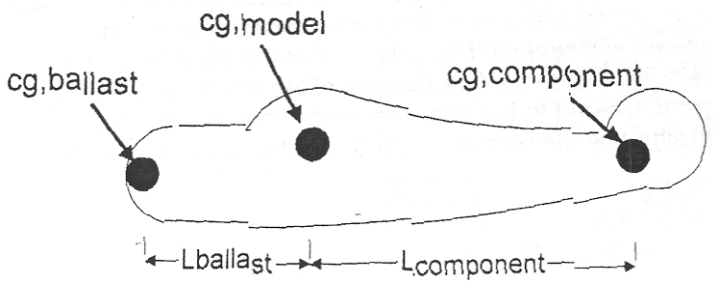
Assume a Tail weight savings = *-2.0 gm; or:* **-2.5 % *of Wgross***:

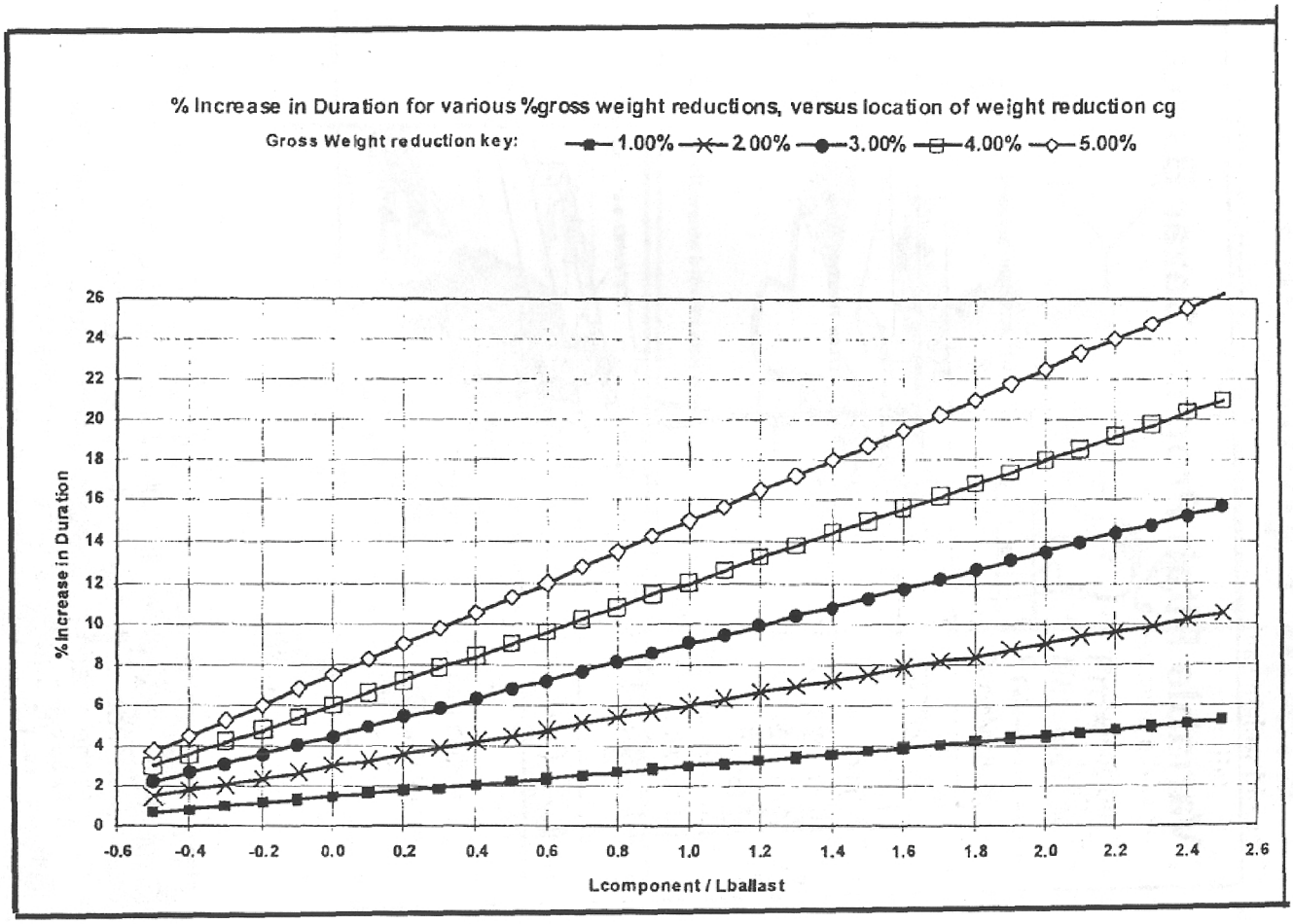
Now, substituting given values in equation I, **Tinitial** = 94.3 *sec*

Substituting above data in equationn (2): **% change in duration** = -1.5*(-2.5)*(1 + 11.5/6.2) =**+ 10.7 %**

Then, Change in duration = 0.107*Tinitial = 0.107* 94.3 = + 10.1 seconds
Adding change in duration to initial duration, **Tfinal** =**104.4** seconds

Try equations (I) and (2) out on one of your models. The graph on the next page eliminates some of the number crunching. Our example is shown as dotted lines on the graph. A hidden side benefit of saving weight is a reduction in glide speed and kinetic energy when your plane *crashes*, whoops, lands softly after a glorious flight. **Thermals!**




% Increase in Duration for various %gross weight reductions, versus location of weight reduction cg
Gross Weight reduction key:
1.00%
2.00%
3.00%
4.00%
5.00%
% Increase in Duration
Lcomponent / Lballast
26
24
22
20
18
16
14
12
10
8
6
4
2
0
-0.6
-0.4
-0.2
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6