UNEQUAL CROSS SECTION MOTOR LENGTH

By Stew Meyers

Published in the September 2013 Issue of MaxFax, Stew Meyers, Editor

Rubber motors are made up of loops of rubber, the number of strands therefore, is always even. The sizes currently available from FAI are 1/16, 3/32, 1/8, and 3/16. 1/4 has been discontinued. Braiding a motor is simplified if an even number of loops are used. There is a discrete jump in cross section as we add loops. Some times the desired cross section lies between these values. Of course you can haul out your $200 Rubber Stripper and custom cut a rubber width. There is another approach however, use a motor made up of different widths.

Sometimes it appears that a little more torque would help. Perhaps the model has gotten heavier or there is no lift in the air. Since torque is a direct function of cross section, we need a little more. Usually an additional loop of the same size rubber would just be too much. The solution is to add a "helper Loop" or as Pat Daily calls it a "supercharger loop" of a smaller cross section. The question arises how long should it be?

To be efficient you would like to be loading up all the loops the same extent on their torque/turns curve. Lets look at a specific case. On my NIT embryo, two loops of 3/32 just isn't enough and two loops of 1/8 results in a shorter rocket like climb that is not efficient. A loop of 1/8 and a loop of 3/32 wold appear to be ideal. Obviously, the same number of turns will go into each loop. Their torques will be additive.

The safe number of turns you can put into a motor is proportional to the length and inversely proportional to the square root of the total cross section area. ie: width times number of strands, assuming a constant thickness.

$$T \propto L / \sqrt{W*N}$$

where T=turns, L=Length, W=Width of each strand in the loop, N=number of strands.

Set the number of turns for each loop equal to each other and the proportionality constants cancel out. Then solve for the length of a second loop.

$$L2 = L1 * \sqrt{W2*N2/W1*N1}$$

For our case ***L1*** is the 1/8 loop and ***L2*** is the 3/32 loop.

N 1 = *N2* = 2, so these cancel out (Since both loops have the same number of strands in this example). (Therefore:)

$$L2 = L1*\sqrt{W2/W1}$$

W2=3/32 and ***W1***= 1/8
Then **W2/W1**=3/4 or 0.75

The square root of 0.75 is 0.866. If the 1/8 loop is 20 inches long the 3/32 loop should be 20*0.866 or 17 inches long. Not too much difference here, but if it was a 3/32 helper loop on a four strand 1/8 motor, the number of strands is obviously not equal between the two sizes, so the ratio is 3/8 and the factor becomes 0.61 and rather more significant.

Simply put, the length factor is the square root of the ratio of the total width of the loops. The larger the difference in total cross section of the loops the more pronounced the length difference. If you braid, each loop should *have* the same number of braiding turns.