# LOW CEILING TRIMMING – PART 1

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## INTRODUCTION

The term ‘Low Ceiling’ applies to a site in which the models flown can exceed several times over, the height available in which to fly. The problem then becomes that of height control which is very important when flying in sites where the ceiling has many obstacles such as wires and girders on which models can easily hang up.

Models which can easily exceed the height available usually, but by no means always, have a Fixed Pitch (FP) prop as dictated perhaps by the rules for that class.

This article is aimed at trimming models with FP props and not at ones with Variable Pitch (VP) for which the procedure is very different.

It is assumed here that the objective is to attain maximum duration, ideally without the model touching the ceiling. Achieving the ‘no touch’ is the greatest challenge.

## EQUIPMENT

The items essential to achieving maximum duration are:

1 A torque meter. This should have, for most purposes, a range of up to 50 gram cm which is the unit used by most, if not all, European fliers. Basically, it consists of a wire which is twisted by the rubber whose torque is to be measured; a pointer shows the deflection.

2 A long support typically of wood which holds the winder at one end and the torque meter at the other. This can be mounted on a workbench or tripod. The set up enables the flier to hook the motor to the torque meter and stretch the motor for winding. When winding is complete, the winder can then be mounted on the stand to enable the flier to have both hands free for holding the model and transferring the motor either to or from the model.

## KEY FACTORS

1 As most indoor modellers know, a typical rubber torque curve gives a burst at the start of the run, followed by a relatively flat portion where the torque

changes slowly as the motor unwinds. The curve is usually at its flattest when about half of the turns applied have been unwound. Use of this characteristic is key to maximum duration.

2 The next point to remember is that the rate of climb or descent depends primarily on the actual torque being delivered. At one point on the curve, the torque delivered is precisely that which is needed to keep the model at a constant altitude. For greater torque, the model will climb, for less torque, the model will descend. The rate of climb or descent will depend mainly on the propeller ie its pitch and how easily the blades can twist during flight.

3 In order to achieve maximum duration, we wish, in general, to minimize the climb and descent rates. This usually means that the burst from the motor is unwanted since the model will climb too quickly and reach the ceiling far sooner than it should.

4 In order to prevent the model from climbing too fast, flyers have tried to compensate by reducing the elevation from the optimum point near the stall ie. by making the model fly fast and flat. This may work OK for the climb but the descent rate is too high and duration suffers. Not the way to go!

RUBBER SELECTION

The key to getting maximum duration is selection of the motor weight and thickness (usually the rules impose no restriction) such that the motor delivers just the right amount of torque to sustain altitude when the torque curve is at its flattest, usually when about half the turns have been unwound.

Three points arise:

a) Cold and damp conditions require more torque than do hot and dry.

b) The heavier the model plus motor, the more torque is required.

c) More torque means thicker rubber required.

1 Initial Motor Selection

In order to perfect the art of choosing the right motor which is matched to the model, it is essential to use a reliable torque meter to enable you to measure motor torque, as described above.

Let us suppose that you are flying a class of model eg F1L or Living Room Stick (LRS) with which you are not familiar.

First, weigh the model without rubber and make up a motor which weighs about ¾ of that of the model. For an F1L, the motor thickness will be between 50 and 60 thou, for a LRS, between 25 and 30 thou. These thicknesses will form a reasonable starting point; from then on, all will depend on how good the model is, particularly the prop. A badly made prop will gobble up a lot more torque than will a good one!

Set up the model with the wing at zero incidence relative to the fuselage and with next to no downthrust on the prop. The tailplane will need to have at least 2 degrees negative incidence for stability otherwise the model won't recover from a stall or a dive.

When winding, you will note that the torque climbs quickly to a level at which it changes quite slowly. This value is close to the mid range torque for that motor. You have sufficient turns to enable you to check the elevation trim of the model. The objective is to minimize the power needed to keep the model at constant altitude. This condition usually occurs near the stall.

If the model is flying unsteadily and very nose up, ie more than about 5deg to the horizontal, it is too close to the stall. Bring the tail TE down a bit – typically 30 thou or less. If the model is flying with the fuselage horizontal, do the opposite. Observe the change. Repeat the process in each case as necessary.

When you feel the adjustment cannot easily be improved, wind the motor sufficiently to allow the model to fly at constant altitude. Catch the model and hold the prop to prevent the motor from unwinding.

Unhook the motor to transfer it to the torque rig. The torque value observed is termed the cruise torque. This value should be the same to within about 10% of that to which the motor torque settles as you start winding the motor. If so, you have a reasonable estimate of the optimum motor thickness for that model.

If you need to change the motor thickness, do so in not more than in 5% increments, keeping the motor weight about the same. The torque delivered is very sensitive to changes in motor thickness and a 5% change is a large one in this context. Repeat the process as necessary. This will give you a suitable starting point for the next stage.

**When you have a reasonable match, measure the length and the weight of the motor to give you the rubber thickness measured in eg grams per metre. These are the units used by European fliers.**
**Using the width of the rubber strip is obviously easier but is only a quick guide and not as reliable as weight per unit length.**

2 Secondary Adjustment

The next stage of adjustment requires the motor to be wound to at least ¾ maximum turns. At this point, the motor will have on a torque that is several times the cruise torque. With the motor at the correct length for hooking on to the model, <u>unwind the motor until the torque is about twice the cruise torque.</u> This process, called 'backing off', is a vital part of the flying process. Backing off removes the burst which will give far too quick a climb, just what we don't want! **Note the number of turns backed off.**

Hook up and launch the model and examine the climb angle. Generally speaking, this should not be more than 10 – 15 degrees. This may seem very modest but you should find that the model will climb slowly and sedately, cruise around for a while at constant altitude and then descend slowly.

You will have found that:

a) The model has climbed up to the ceiling and is still trying to climb. It may or may not have hung in the structure!

b) The model levelled out below the ceiling at a reasonable height before descending.

c) The model levelled out at a much lower altitude.

In case a) the motor is probably too thick. Try another motor about 5% thinner **from the same batch of rubber if possible** and repeat the process. If you change batches, you may find that you have to start again!

For cases b) and c) unhook the motor and transfer it to the torque rig without losing any turns. **Count the number of turns left on the motor**. This number should be about the same as that backed off before launching.

If the number of turns left is up to about 30% greater than that backed off, shorten the motor by about 5% and try again.

If the number left is somewhat more than this, the motor is probably too thin.

If the number left is somewhat less than that backed off, the motor is too short, so try a longer motor of the same thickness if you can.

You have now started on the fine tuning process which yields the significant increases in duration. This process is described in more detail in Part 2 of this article.