"Rara Avis and The Crazy Rubber Band"

It is probably true that people who fly eight ounce Vintage Wakefields on full chat are wired directly to the moon! To illustrate the point, this brief examination of the techniques involved in the preparation, treatment and (ab)use of rubber motors may encourage readers to join "The Crazy Rubber Band" in pursuit of aerodynamic perfection! On the other hand it may cause you to shake your head in amazement that such foolhardiness exists inside the safe haven of a gentle pastime.

Two Vintage Wakes are referenced in this essay. The "New Look" by Jacques Morisset, Champion of France in 1950 and the legendary 1949 "Voodoo" by Ron Warring, perhaps the greatest British Wakefield flier of the post war period. The motors used to power the reproductions of these two models consist of 14 strands of 1/4" Tan II FAI rubber strip with a total weight in the region of 3.5 to 4 ounces. But how is this determined?

A useful approximation for calculating the unwound length of a Vintage Wakefield motor is to multiply the distance between propeller hook and motor peg by 1.5. So! For the "New Look", where hook-to-peg distance is approx 31", a motor length of 46" is indicated (i.e.:- 31 X 1.5 = 46). The shorter hook-to-peg length of the "Voodoo" requires a 36" motor. The weight of rubber and the number of strands needed to power a model efficiently is partly determined by the finished airframe weight. Generally, for an 8 ounce Wakefield, the airframe weight is in the range 4.5 to 5.5 ounces and motor weight 3.5 to 4 ounces. A 12 strand motor is sufficient to produce a sedate flight performance but for heavier airframes or competition performance, more rubber with 14 or even 16 strands may be required. A competitive Vintage Wakefield must continue to climb for the whole of its motor run, if not, the number of strands should be increased. Once a model is trimmed for a particular motor weight, it is vital to make up all new motors to the same weight otherwise the centre of gravity (CG) and trim of the model is affected. Maintaining the same motor weight and number of strands incurs small but unimportant variations in length for motors made up from different batches of rubber. Even changing the number of strands of a particular motor will make no difference to glide trim because the weight distribution around the CG not affected. Changing the weight however will make some difference because the CG of the motor is not always at the CG of the model.

If new rubber is used directly to make competition flights then the first time a motor is wound-up the number of turns may be restricted but the initial torque increased by its “newness”. It’s a trade-off which can be eliminated. Ideally, a rubber motor needs to be "broken-in" before it can deliver “full” power on “maximum” turns and a good way is to pre-stretch it to 4 or 5 times its natural length for about 10 minutes whilst wetting it thoroughly with diluted rubber lubricant (e.g.:- green soap/glycerine/water mixture) which will penetrate right into the micro-structure of the rubber. It is extremely stressful to perform this job without proper equipment and the pre-stretching process calls for a pair of strong builder's hooks securely fixed to substantial supports and is best carried out prior to pre-tensioning. My technique is to stretch half a motor at a time. That means that the stresses involved in stretching only 6 or 8 strands are much easier to control. Also, the

exercise will demonstrate the immense power involved in dealing with these motors, and demands great care to avoid damage or personal injury! Foretaste of rigours yet to come!

A Vintage Wakefield motor is pre-tensioned (braided) to ensure it distributes itself evenly between motor hook and rear peg during and after it unwinds. There are several methods of braiding but an easy way when (say) making up a 12 strand motor is to produce two 6 strand loops to the calculated length joined together with a bobbin fixed to a secure anchor point (door handles are not recommended as they can fly off with disastrous results). Wind half the tensioning turns clockwise onto each half motor before bringing the two ends together with a motor hook. The full 12 strand motor is then lightly wound and allowed to unwind, to produce a neatly braided motor. A 14 strand motor is similarly made, but needless to say, the 6 and 8 strand loops must be of the same length.

A simple estimate for the correct number of tensioning turns is to multiply the un-tensioned length by a factor of 2.6. So, for a 31" motor, 80 pre-tensioning turns will be needed (i.e.:- 31 X 2.6 = 80), 40 on each half. Similarly, for our 46" motor a total of 120 pre-tensioning turns are required, although, to equalize the tensioning effect on (say) 14 strands, it is necessary to slightly reduce the number of turns on the 8 strand portion to (say) 55, and wind the remaining 65 turns on the 6 strand portion! This is an empirical differential and will vary a little for different motor lengths. Without equalized tensioning effect the final result is lumpy and simply looks wrong. If the overall result is a smoothly braided effect then it is OK. Going to 16 strands makes for easier pre-tensioning but it has to be said that the “fear factor” involved in putting on maximum turns is greatly increased and the trimming issues are more difficult to overcome.

A complex alternative is to individually pre-wind each pair of strands using a long adjustable jig made up with an anchor point at one end and 7 or more cup-hooks at the other end. So! For our 46", 14 strand example above, 60 turns (Yes! Think about it?) are required for each pair of strands. All the pre-wound pairs are then brought to the motor hook and (again) the whole motor lightly wound and unwound to produce a delightful "Rastafarian" braid. A distinct advantage of this method of pre-tensioning is that the motor generally distributes itself more evenly between motor hook and rear peg after it unwinds with less risk of bunching and consequent shift of CG for the glide phase of the flight. I have found this to be an distinct advantage when using a folding propeller arrangement such as with the “New Look” because these models appear more sensitive to a slight rearward CG shift resulting in a severe hammerhead stall developing during the glide phase. Adjusting the number of tensioning turns slightly will result in a tighter or looser result and is a useful adjustment to minimize the “Whiskering” effect when the motor is fully unwound. The aim with any tensioning method must always be to get the pre-wound turns “Just Right” to minimize any CG shift from flight to flight.

As a point of interest, when bringing each half of the tensioned motor to a “Tim Grey” motor hook, put half on one arm and half on the other arm and lock them together with a small rubber band. This has the effect of preventing the motor from climbing up the hook because each half tries to climb in opposite directions.

When the time comes to generate full power and efficiency from a Vintage Wakefield motor, then winding to maximum turns requires a keen appreciation of the forces involved, strong equipment, considerable attention to detail, and a total lack of fear! These days, models are mounted in a strong winding jig secured to terra-firma by guy-ropes. A stout metal rod passing through a hollow rear motor peg restrains the fuselage, whose front-end is horizontally supported by a forward extension to the jig. A winding tube encloses the motor preventing damage to the model in the event of motor breakage and involves clever use of an extension winding rod (often incorporating a Torque Meter) facilitating removal of the tube prior to flight. A strong winder can be made from a modified double geared hand-drill with grip handle and cam-operated counter!

Be warned! It is wise to double-check the soundness of all hooks and connections! There is no forgiveness when part of a winder detaches from the rest and smashes into the front of the fuselage from a great distance energised by 14 strands of 1/4” rubber. More so if the motor happens to be half wound at the time because the twisting effect of the detached item will shred everything within reach, to the point where you could start you own splinter group.

In preparation for winding any rubber motor, it is important to have some idea of the maximum possible number of turns and the associated torque it will produce in order to bring about a satisfactory flight. A reasonable "maximum turns" guide for 14 strands of 1/4" Tan II FAI rubber is about 23 turns per inch of un-tensioned motor. So for a 46" motor something like 1050 turns will be the upper target. However with variable rubber quality these numbers are only a fair guide and over time it is wise to maintain accurate records to establish safe maximum limits for each grade of rubber encountered. The resultant torque generated may be in excess of 80 inch-ounces and this is a key factor in ensuring a reliable flight pattern. Whilst this essay is not a guide to trimming it is a guide to safe technique and exceeding the torque level for which a model has been trimmed can cause deadly flight problems such as looping or power stalling. Both maximum turns and torque may vary between motors so be prepared to modify the winding target as the process develops. With the propeller disconnected from its hook and placed conveniently near to the model nose together with a six inch rod or screwdriver, the motor is pulled through the winding tube by the extension rod or combination torque meter which is then connected to the mechanical winder. Let's say the target is 1000 turns?

Commence by zeroing the turns counter, taking up the motor slack and gently winding on a few clockwise turns, walking slowly backwards away from the model whilst continuing to wind on about 50 turns until the motor is stretched out 3 or 4 times its original length. This means that for a 46" motor the winder/winding extension rod is now 15 to 20 feet from the model nose and everything has come under very considerable tension! It is interesting to note at this point that any nearby spectators always take two involuntary steps away from the model in a nervous gesture of self preservation! This is a rich luxury denied to the modeller, who remains directly aligned with the whole kit n’ kaboodle for the next few minutes and who may feel it is an appropriate time to offer quiet prayers to a chosen Saviour! Without pausing, the motor is slowly wound up until

half (500) of the target turns have been delivered and continued by winding on the remaining 500 turns whilst walking slowly in towards the model judging the motor hook's arrival at the nose to coincide with the last few of the 1000 target turns. The motor is now as hard as iron and glistening with expelled rubber lubricant! Checking the torque meter during the last 200 turns will reveal if the desired torque is being achieved. If too little, then a few more turns will satisfy the need. If too much, then backing off few turns will reduce the torque to a safer level if required. (Deep breathing is generally a good idea at this point!)

The winding technique described above is very easily disrupted by inquisitive onlookers who may choose a delicate moment to enquire “how many turns” you have just put on. Ignoring such requests for information may appear rude but, believe me, this is no time for idle chatter. Also, it is often the case that the process of walking towards the model whilst completing the application of turns happens too fast. If so, this will induce rearward bunching of the motor as it unwinds with a resultant critical (stalling) CG shift. Alternatively it’s possible to reach maximum turns before making the full distance coming in. In this case, closing the gap without applying any more turns will result in horrendous front bunching, making it near impossible to remove the winding tube let alone stuffing this complete mess into the front of the fuselage. Technique is everything!

Holding the winder securely in the right hand (for right hander's), gentle sliding of the winding tube from inside the model all the way up the extension rod towards the winder cleverly exposes the motor hook just poking an inch or so from the fuselage nose! Again, left handed, pick up and insert the nearby rod/screwdriver through the motor hook and grasp both motor and rod very firmly indeed. Assume that life itself is dependent upon this grip! Now discard the disconnected winding rod, winder and tube to the fall of gravity, pick up the propeller mechanism which lays nearby (doesn't it?) and with the right hand, fiddle it's hook onto the motor hook and engage any free wheeling clutch or other mechanisms to prevent the motor releasing all it's power in an instantaneous "shaft run" that can totally destroy anything within reach.

One thousand turns unwinding in just a few seconds is a pretty spectacular event, and if the palm of you hand is close by, expect to be making a hospital visit quite soon and it won’t be to see an aging relative. Ensuring that the propeller nose-block is correctly inserted into the model's nose set the prop stop mechanism or use the left hand to prevent the propeller from rotating, remove the stout metal rod which restrains the model in the winding jig and with both hands steady the airplane against the breeze which always gusts at this exact time.

The moment draws near! Checking rigging angles to be sure that nothing is mis-aligned at nose, wing, tail or fin, setting the de-thermaliser, walking to a chosen launch area, simultaneously sensing the strength and direction of the breeze, patiently awaiting that remote but detectable puff of warmer air signaling a passing thermal. Alternatively, watching a pole mounted thermometer and the curvaceous undulations of a Mylar streamer will indicate the exact moment to launch. Bending knees and spine to touch wheels and sub-fin on the tarmac, releasing propeller micro-seconds before letting go the

fuselage whilst facing the breeze head on, the model is freed to demonstrate the world's greatest ever aerodynamic experience! Greater even, than the launch of a Saturn 5B moon-rocket or the majestic flight of Concord. Why, because not only does this event have no pilot, it is also soundless?

Our Vintage Wakefield leaps from the ground and screams silently upwards, spiraling in right-handed flight, almost vertical for about 10 seconds; then, with climb angle gradually reducing, continues inexorably upwards for another minute, maybe more, to become a mere dot in the sky as the power of the rubber motor exhausts itself through the 18" diameter propeller, with blades large enough to veil a newborn babies' arms! Now the model airplane mutates into a soaring buzzard, wings outstretched, floating higher on currents of warm air and would, if not checked, shortly meet the same God prayed to only minutes earlier!

Yet trickery is at hand. Time passes! Then, by lighted fuse and burned rubber band, or by clockwork motor from a child's toy, the dethermaliser is triggered and the soaring buzzard reduced to an aerodynamic enigma! A model airplane that cannot fly, yet will not crash like a bag of hammers, emulating a graceful sycamore seed which slowly turns and gently falls through the rising currents to alight undamaged on mother earth. Now the hunt is on! By ancient or modern means! By old fashion navigation or new fangled technology! By hook or by crook from tall tree or river wide, or by a fortuitous phone call days later, that errant "Rara Avis" will be found. But that's another story.

Gratefully retrieved, our Vintage Wakefield returns to nest in its favored winding jig to re-absorb the latent power of the rubber motor and try once more for freedom! All this from 4 ounces of pure rubber, a few sticks of balsa wood, some wire, tissue and silk, a little patience, a measure of courage and the conviction that all aeromodelers will someday become truly liberated and join "The Crazy Rubber Band"!

And what of the spectators? How do they react to this remarkable spectacular event that even an uninitiated person should behold in awe? Well, not always, as the following anecdotal romance will demonstrate.

A Wakefield flyer of singular ability visited his local field for a serious final trimming session on one of those balmy summer evenings that never occur over long grass. Watched by a knowledgeable looking, tweed clad lady who was out walking with her dog, he prepared very much as previously described. Waiting for the right moment he launched his bird into a warm puff carrying a five minute DT on its clockwork timer. The model powered skyward in the gentle evening air, settled into an immaculate glide pattern at a phenomenal height and mooched overhead for the next four minutes. Dead on time the DT popped and the model alighted after another minute just 50 yards away. It was, without doubt, the perfect Wakefield flight. Totally fascinated the lady asked "Is that it? Is that all it does?" But the dog knew better. It wagged its tail in appreciation!

Ramon Alban SAM35/1066