

Update bulletin January 2004

Sources of parts and tools

[Magnets for the USA version of the plans \(2" x 1" x 1/2"\) only \\$6.75 each for 25 pieces](#)

[drawknife source A](#)

[drawknife source B](#)

[resin in the USA](#)

Summary

Two problems have arisen with a small number of machines built to the design as published.

- The alternator speed is sometimes too low for the blades and so the machine stalls, giving low output.
- [In two cases, blades have struck the tower and broken.](#)

Problem 1

The alternator is very efficient compared to previous homebrew designs. This means that its rpm does not vary so widely as others do between cut in speed and full power. The speed remains rather constant. But the speed of the blades needs to vary much more widely if they are to work aerodynamically at their best. The result is that the alternator runs too slow for the blades at full power or too fast for the blades at cut-in, or both.

I instinctively prefer to optimise performance in low winds. I therefore opted for low speed when I designed the alternators. They do sometimes stall the blades as the wind increases. This means that the windmill works well in low winds, but as the wind increases, the current does not rise beyond a certain point. The machine is slow and quiet, but the output is seriously disappointing. (It levels off at about 120-150 watts.) This occurs mostly in the case of 24 or 48 volt systems with short, thick cables, when the battery voltage is low. The problem is less likely to arise in the case of the US 12 volt model.

Solutions to 1

There are several types of solution.

1. One is to increase the alternator rpm. This can be done by increasing the space between magnet rotors so that there is a larger gap each side of the stator. Or wind the stator with fewer turns in each coil. This prevents stall but it will also mean a higher cut in rpm, resulting in some slight loss of performance in low winds (around 3 m/s or 7 mph). These are both good, simple solutions.

2. You can also increase the range of speed of the alternator, by increase the circuit resistance. Using a longer or thinner cable is one way to do this. This allows you to put the machine further away without excessive cost. Choose cables sizes (on page 40) for 30% loss at 500 watts. Or use a resistor (12V=0.15ohms, 24 volts=0.6 ohms, 48 volts = 2.4 ohms). These values are only suggestions. The resistor needs to be able to handle 500 watts when the machine output is 700 watts. Maybe you could use it to heat water? It may seem crazy to burn off power, but it improves the blade efficiency over the whole range, has very little impact on efficiency in low winds and is a relatively simple solution too.

3. Or you can put a larger diameter set of blades on the machine say 2.7 metres/9 feet. Scale up all the dimensions (length, width, drop and thickness). Or use the dimensions lower down this page. I only recommend going up to 9 feet if you seriously want a larger wind turbine. I have tried it and it seems to work well. But there may be extra loads on everything due to the larger rotor.

4. Finally you can use some sort of electronic voltage converter between the input from the windmill and the battery. This is only for electronic wizards. this promises to be the only 'real' solution but it is still under development and I worry about the consequences for cost and reliability.

In reply, "Nando" <nando37@comcast.net> writes:

The solution is to allow the mill to generate the highest possible voltage and do a DC/DC conversion at the battery with MPPT, this way maximum power is transferred without the need to add un-necessary loses, reducing the capacity and/or efficiency of the wind mill, of course you may need to have a dump load if the mill is not self RPM regulated.

The ideal set up is to have a mill that produces a voltage around 2 times the battery voltage at the lowest wind regime and a DC/DC with MPPT converter capable of accepting the voltages from low to highest wind regimes to attain around 92 to 97 % conversion efficiency, MUCH greater than the 70 % you are suggesting with the changes.

>this promises to be the only 'real' solution but it is still under >development.

Are you doing the development ?. I could assist in this matter, now that I will have more time available..

I am open to all suggestions. I have several people helping me with ideas for this, but thus far I have not seen a nice simple solution with good reliability.

If you want a clear directive, then:

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Use these coil turns specifications:

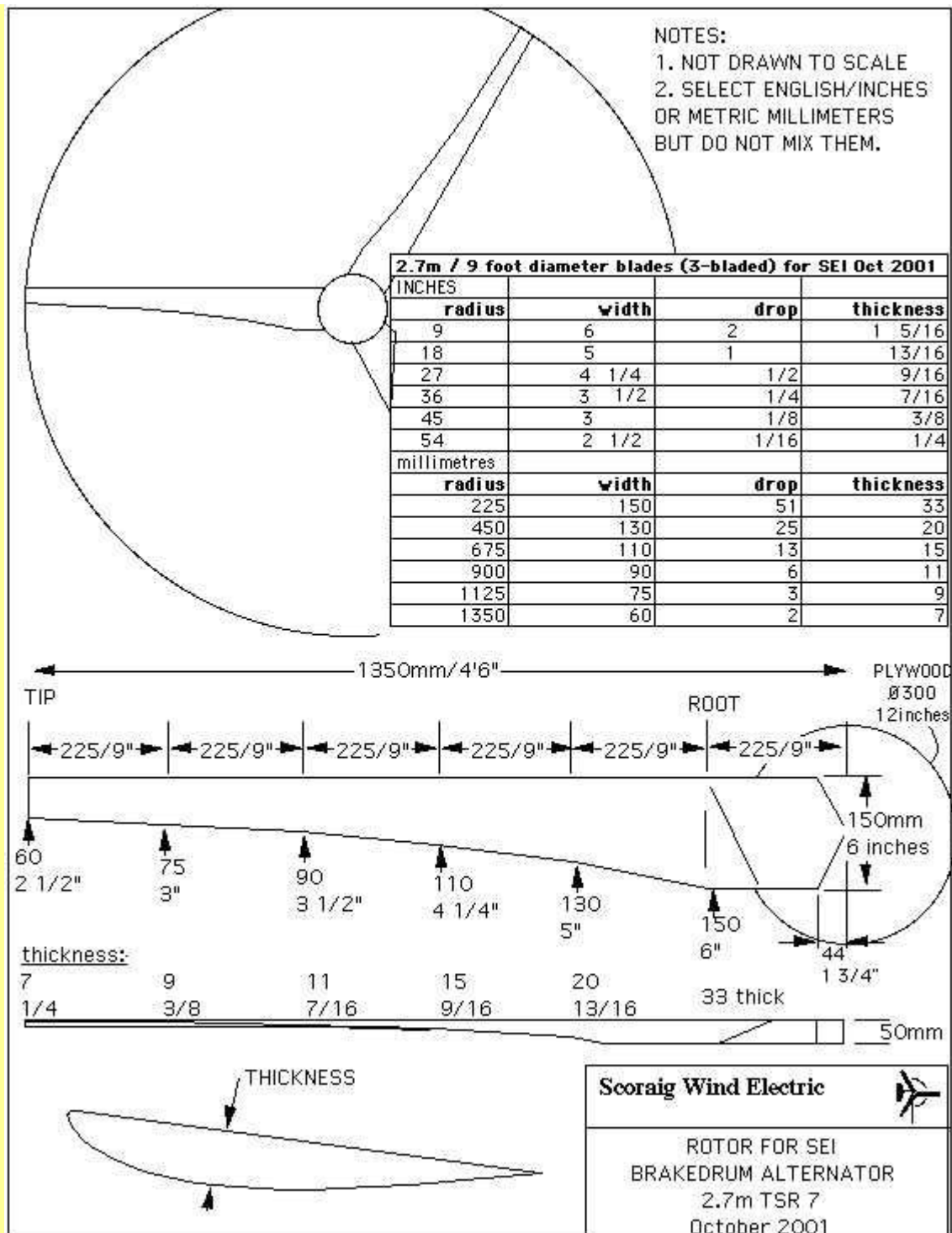
Voltage	Old	New	Wire
model	number	number	size
12V mm	90 TURNS	70 TURNS	1.6mm
24V mm	180	125	1.18mm
48V mm	360	250	0.8mm
12V US	80	80	#15 (or 2 x #18) AMERICAN WIRE GAUGE
24V US	160	150	#18 AWG
48V US	320	290	#21 (or 2 x

If it is too late, then you can use the stator you have already made, but increase the clearance between rotor and stator a few mm each side, to avoid stalling. I suggest about 4-6mm clearance for the 48 volt metric version.

Choose cables sizes (on page 40) for 30% loss at 500 watts. You can try using thicker cables if you like but check to see if it causes reduced output.

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9 foot blades



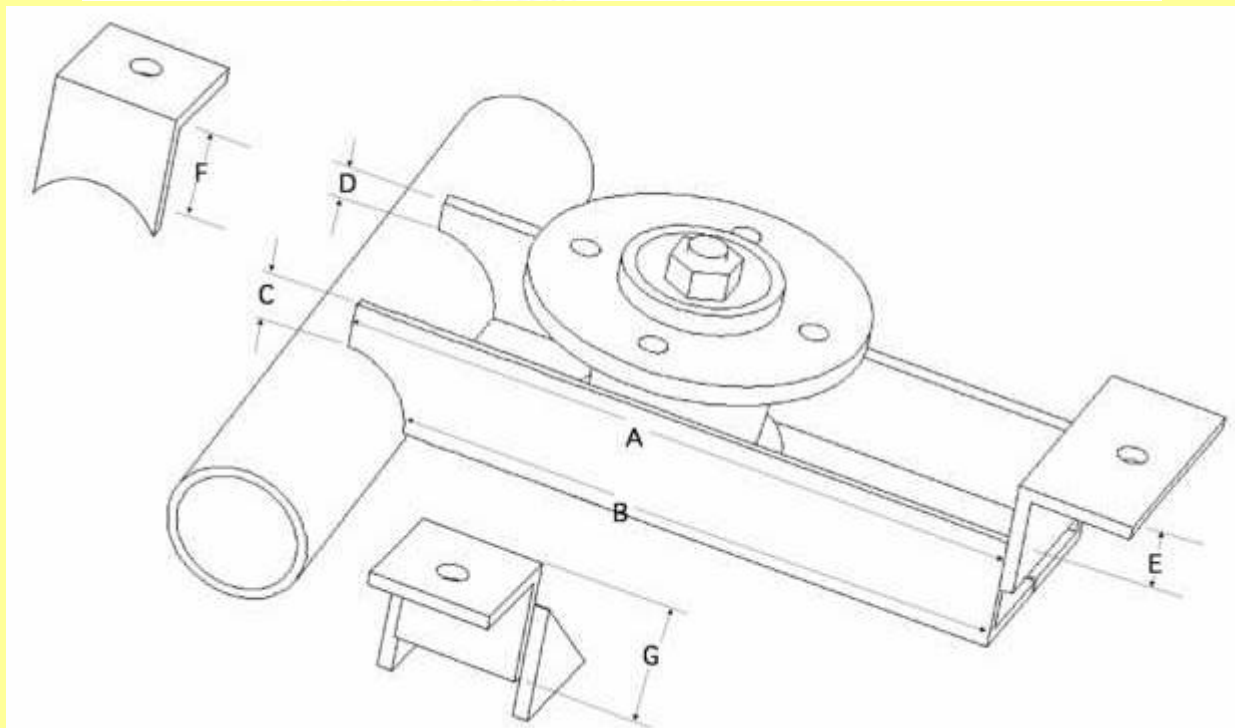
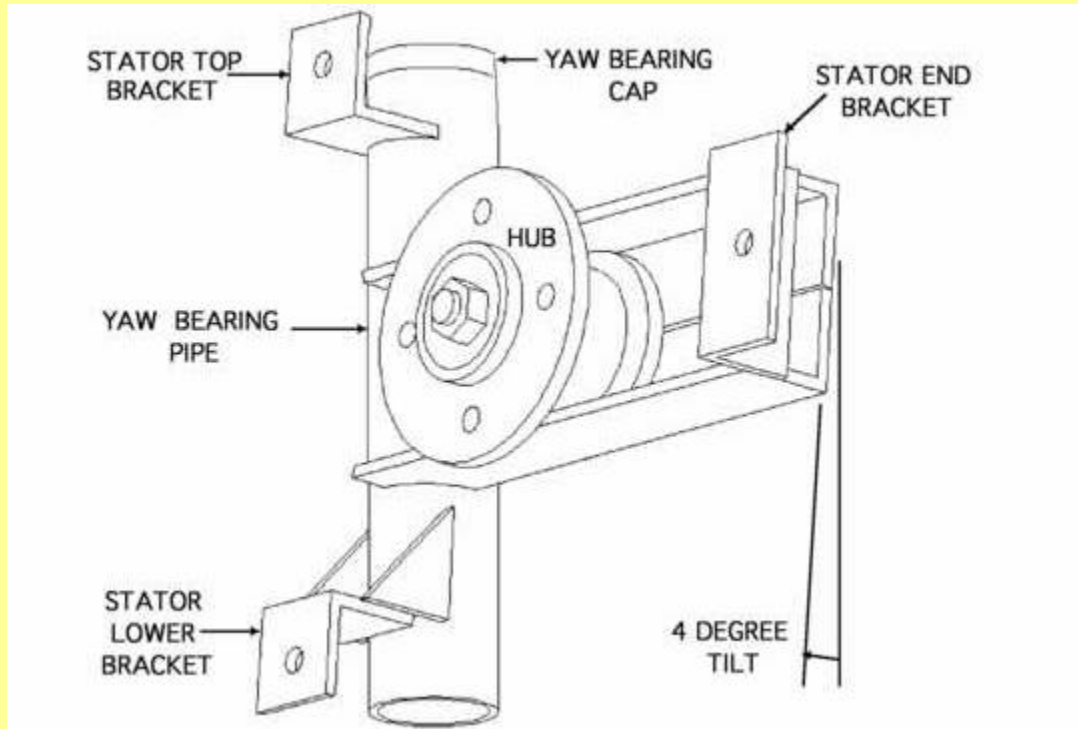
Problem 2

I have one of these machines sited on the north side of Scoraig where the wind comes down the hill in sudden squalls and hits with a punch. The machine has a tendency to smash its blade tips against the tower in these weather conditions. I believe this happens because of the sudden yawing of the rotor. Gyroscopic forces push the blades backwards. I have also recently had reports of another machine in Ireland with this problem.

Solutions to 2

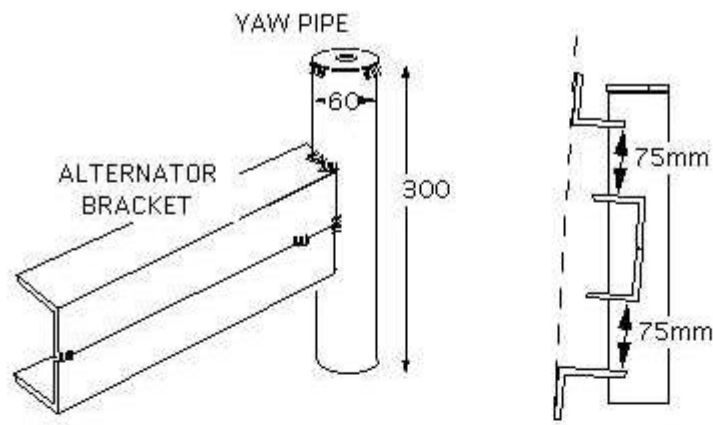
The first solution is fairly simple. I would normally tilt the axis of the alternator slightly so as to increase the tower clearance of the blade tips. The reason why I did not design the machine with a tilt in this case was to try to make the welding simpler. I regret that now. On good sites with clean winds the machine works without problems, but I'd rather it were foolproof and so I'll be adapting the drawings to include a tilt of about 4 degrees in future editions. Here are some drawings.

There is another solution though...

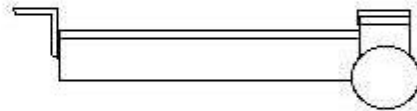


Frame dimensions	UK version	USA version

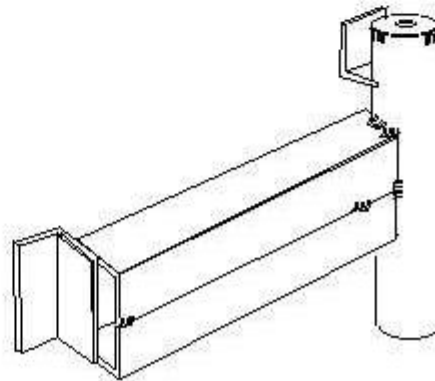
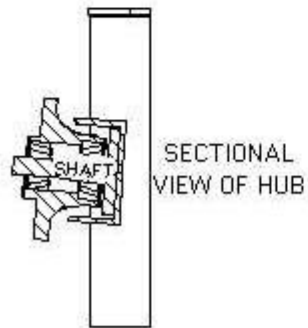
A length of angle	293 mm	11 1/2"
B length inside notch	263 mm	10 3/8"
C width of end of lower steel angle piece	C = 98 - X = 20 mm	C = 3 7/8" - X = 1 1/4"
D width of end of upper steel angle piece	D = 91 - X = 13 mm	D = 3 5/8" - X = 1"
E upstand of end stator bracket	26 mm	1"
F upstand of top stator bracket from pipe	36 mm	2 3/8"
G upstand of lower stator bracket	51 mm	2"

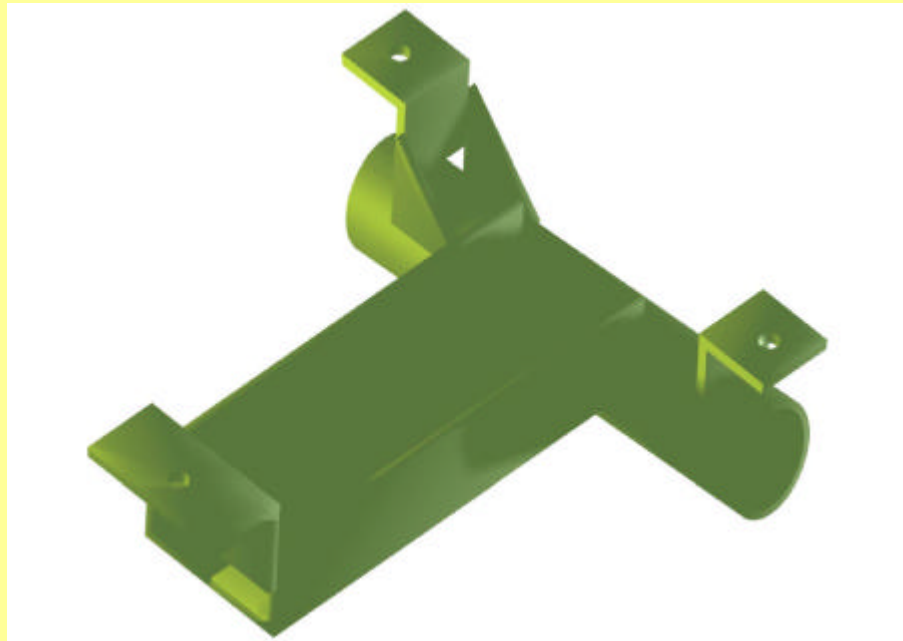
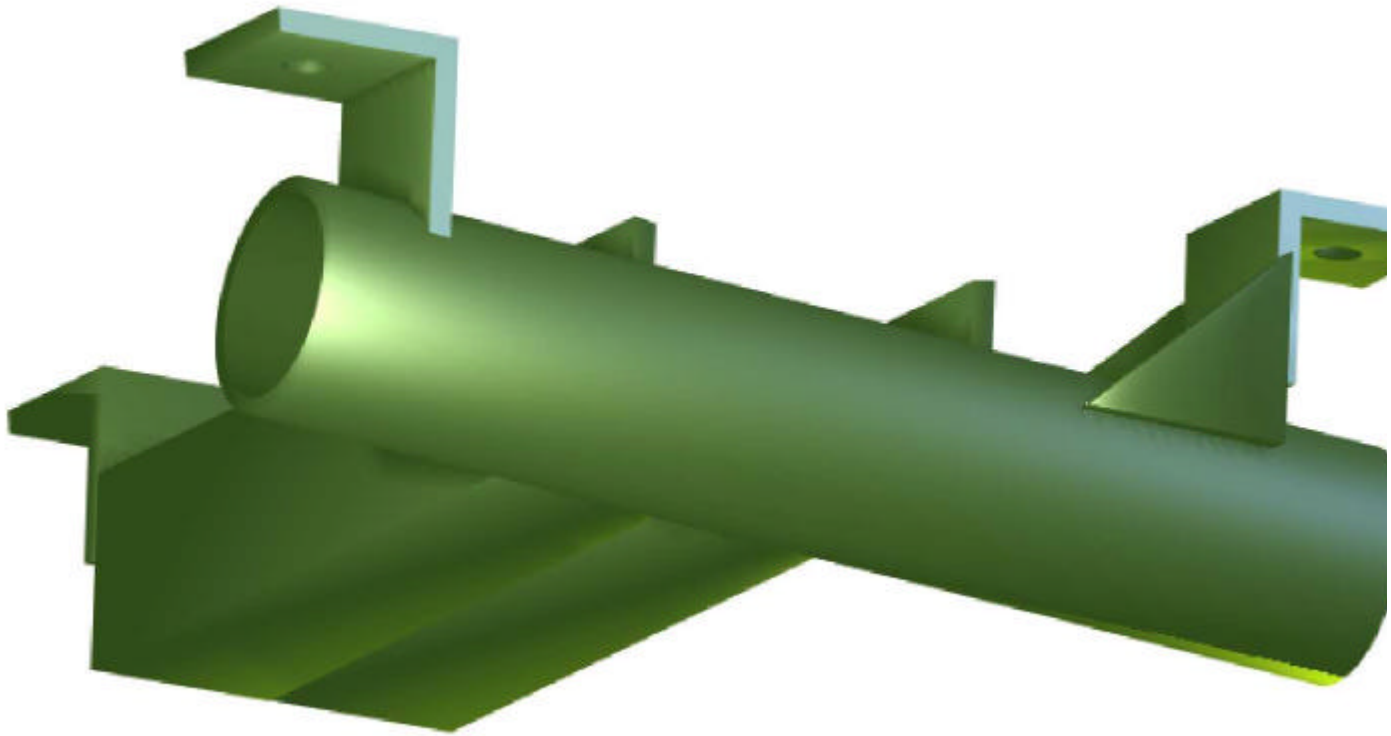


STATOR BRACKETS
IN PLANE WITH
EACH OTHER



BRACKETS FOR
TILTED METRIC
ALTERNATOR





I am indebted to **Tod Hanley** for the following alternative solution . It's so simple I wish I had thought of it. The gyro forces are probably only a problem when the machine is yawing away from the wind (spinning fast and kicking away). The direction of gyroscopic deflection depends on the rotation of the blades and the direction of yaw.

Hi Hugh,

I have a bit of a suggestion, may mess things up.

I am not sure, but it looks like you might want to solve the blade tip whacking by reversing the rotation, such that as the machine furls the clearance increases. I hate all of the right hand rule stuff, so I take a bike wheel hold it by the quick release, then spin it in one direction while "furling" it to the side. If it whacks you in the knees, try spinning it the other direction. If it puts tread marks on your forehead, as you "furl" it that's probably the best rotation.

**Best regards,
Tod**

There you go :-)

More ideas will appear on this page as they come...

Back to my [home page](#)