Want a tiny, HIGH PO[W...
Start with an old CD[...

Did you know that you can convert the flea-power motors from old CD or DVD-ROM drives to high-power operation – eg, for model aircraft or other demanding uses? While it may seem improbable it is relatively easy to do, the main change being to fit Neodymium 'Rare Earth' magnets. Oh, you also need to find some suitable motors.

I've been interested in aeromodelling for many years. When I heard whispers a while ago that I could make my own high-performance brushless model aircraft motors using parts salvaged from an old floppy disk or CD-ROM/DVD drive, at first I was sceptical.

But after doing a little research, I found that it was indeed possible. It seemed that all that was basically required was to place some so-called "super magnets" inside the motor and to replace the windings to enable higher current flow.

However, as with many projects, when I looked further into it I discovered it wasn't going to be as straightforward as I'd imagined.

I would need to find a good source of old drives, locate the required type of neodymium 'rare earth' magnets, suitable ball-bearings and would need access to a lathe.

The lathe wouldn't be a problem because my dad recently gave me his old Emco on permanent loan. Finding the right bearings also wasn't much of an issue; the types required are used extensively in the likes of model helicopters and cars and are sold in most model shops (and are also widely available online).

The magnet hurdle also proved easy enough to overcome since I soon found a source on the web prepared to ship as many as I wanted and so I promptly sent away for a couple of sets. The next big problem was impatience; the magnets would take a couple of weeks and I wanted be up and running today!

Sourcing parts

Since I own a computer repair company, finding old drives is not a problem; most workshops like ours have a healthy stack of them until periodic clean-outs mean we get to start on a new stack. It is worth ringing around to see what repair shops have available – and avoid those who'll want to charge you for taking away what is essentially rubbish.

One of the bigger problems you'll face is that many optical drives don't use what has become the standard-sized motor; a roughly 25-27mm diameter can/bell with an overall thickness or bell depth of around 6mm. While you can theoretically make your brushless motor from any old drive motor you salvage, many are not particularly suitable for the job, nor are they physically compatible with the standard sizes of available magnets, the majority of which have been designed to fit the 25-27mm motor mentioned above.

I stripped half a dozen old drives to get a couple of decent bells. So get

Here's a typical (if a little ancient these days!) CD-ROM drive, shown in its "as-removed-from-old-PC" state at left. The centre photo shows the controller board removed, revealing the motor in the centre (circled). Finally, the photo at right shows what we are after: the motor removed from the CD-ROM drive (via those three Phillips screws on the bracket in the centre photo) and held in the hand to show just how small the motor actually is. Despite its tiny size, it's quite a powerful little beast and, just as importantly, is very reliable (when CD-ROM drives fail, it's very seldom the motor that has given up the ghost). But even more importantly, this motor can be modified to give significantly more power output – enough, in fact, to power an electric model aircraft. And that's what we are doing in this feature.

VER brushless motor?
/DVD-ROM drive!

By Dave Thompson

At right: an assortment of motors pulled from various surplus drives. Note the variety of styles and sizes; while you can fashion your motor using any sized 'donor' motor, most builders use the 26mm model because the majority of available jigs and magnets are designed for this 'standard-sized' body.

as many old drives as you can while you're on the scrounge.

If you're wondering why I didn't simply work out which make and models of drive contain the right motors and look for them, rather than go through all this rigmarole, it isn't that simple.

You can take two outwardly-indistinguishable models and find they have significantly different mechanisms. The chipset and firmware might be the same but the cradle, motor and laser assemblies vary greatly from drive to drive, even within supposedly "identical" models.

Useful bits and pieces

Regarding other parts in your optical drive, there are several parts which could come in useful.

Retain the chromed shafts the laser assembly runs on, as you can use these for prop shafts. They are usually high-quality chromed steel and well worth saving, though as they are often coated with grease, you'll probably have to clean them before use.

Also take care with the laser. If your donor unit is an 8X or faster DVD drive, the laser diode is a sought-after component for optics experimenters who want them for match-lighting and balloon-popping laser projects so careful extraction is well worth-while.

I suppose you could even sell the laser for a few dollars to cover any costs you may have incurred obtaining the drive, or save it for your own evil-genius laser projects.

Then again, anyone who wants one of these has probably scrounged it themselves (and possibly discarded the motor!).

If you do decide to salvage it, take great care as I've discovered these laser diodes to be extremely static-sensitive and physically easy to damage and they are usually solidly fastened to the head assembly.

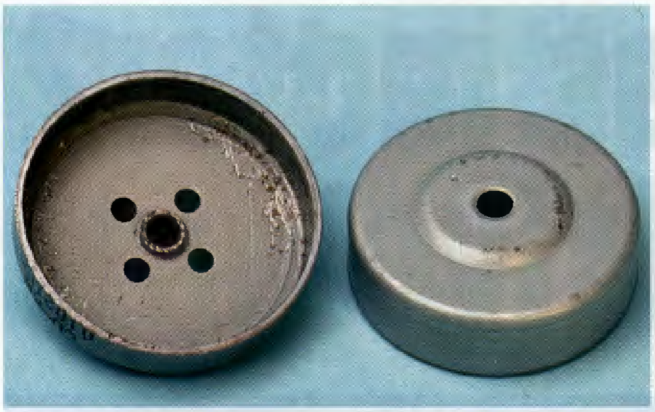
While you are breaking the drive down, there may also be many little gears, switches, bearings, belts and other bits and pieces that always come in handy so get as much as you can from each drive.

Even if the motor is not a suitable donor there are plenty of other goodies worth salvaging or passing on to someone who will use them.

Which motor type?

There are two basic configurations: in-runners and out-runners. An example of an in-runner motor is your typical DC brushed unit, in which the

A small selection of the thousands of commercial brushless motors available. They're easily distinguishable from standard (ie brushed) motors because invariaby they will have three wires – brushed motors have just two.



Standard sized bells ready for modification. Note the difference in heights. As long as you have enough material to safely glue the magnets to, any sized bell can be used. Also note the lip on the inside of the centre hole – this must be removed as described in the text.

body of the motor remains static and the armature or rotor spins – your car's starter motor is a classic in-runner type. An out-runner motor on the other hand has a fixed stator and the outside or motor body rotates instead, typically with a drive shaft connected to the rotating body to which gears or in our case, propellers are connected.

Out-runners are very efficient, which is why motors like these can deliver a surprising amount of power for their diminutive physical size. Our motor will therefore be an out-runner.

The first thing to do is break down your acquired motor. Sometimes the two halves are only held together by the existing magnet's magnetic field so pulling this type apart is very easy.

Some will have an 'R' clip, circlip or similar device holding things together. If you strike a clip version, easing the clip free will allow the two motor halves to be parted (if you get the clip off in one piece, save it for optional use later).

If in doubt, a good pull should separate the motor without breaking anything. If you find yourself reaching for a screwdriver in order to lever things apart, be very careful as it doesn't take much to ruin either component and we need both bits completely intact.

Once the outer bell is removed, you'll see it contains a ceramic magnetic ring. Also note the exposed stator remaining attached to or pressed onto the motor's circuit board (unless you've already stripped that part away).

Put the stator part to one side for the moment and let's look at the bell. Your bell may already have a shaft fixed in place, running down the centre through the stator. If so, count yourself lucky because very few do these days, however, this pretty much shoehorns you in to what style of motor you will be building; more on that later.

When the plastic disc holder, which is typically mounted to the 'top' of the bell assembly is removed (it should pry or break away reasonably easily), you should see a small-lipped hole in the centre. This will later be utilised to house our prop-shaft. Take the bell and using a small jeweller's screwdriver or similar tool carefully pry the magnetic ring out.

Take care not to distort the bell doing this; they are reasonably strong but can be easily bent out-of-round if you are too vigorous. It doesn't help that the ring usually doesn't come out easily; though it may seem like it, most are not actually glued in place, relying instead on a very tight interference fit and they sometimes take some removing.

The material the magnetic band is made of is similar in consistency to a ferrite rod, meaning they are very strong but quite brittle.

I usually just break the ring in order to remove it by using an automatic centre-punch; the type you set by turning the end to adjust the spring tension/impact energy and then push down on until it 'hammers'.

Start with a lower tension setting before cranking things up to 11 as this method seems to shatter the ring easily and a higher setting may end up ruining the bell.

Unless you really want to retain the ring for other experiments, I suggest you do the same; removal without breakage is possible but usually difficult. Once broken, the bits fall out easily.

Check the now-empty bell for any remaining debris and if necessary clean it out with some methylated spirits on a rag; we will soon be gluing to this inner surface so it needs to be as clean and contaminant-free as possible.

If your bell is one of the rare types that doesn't already have a hole in the centre of it, you'll have to make it. The hole can be drilled by hand with a suitable drill press or hand-held drill, though if you have access to a lathe, this will make the job easier and far more accurate.

If you drill by hand, be very careful to get things perfectly centred. If you don't, even by the tiniest amount, your motor will likely shake itself and anything attached to it to bits.

The hole should be the size of the intended prop-shaft and if you have retained the chromed shafts the DVD drive's laser-head assembly was running on then you already have the best item for the job. These are usually 3mm in diameter, so use a suitably-sized drill to make the hole in your bell a tight fit for the chosen shaft.

Once the hole is made, clean it up by using a counter-sink bit or a larger drill to ensure there are is no swarf left behind.

If the bell already has a hole, chances are it has a lip on the inside edge as shown in the picture. This lip will need to be removed. Again, if you have a lathe this is relatively simple, though it can also be done by hand using a larger drill bit, something in the order of a 9mm (3/8th inch).

Proceed as if you were countersinking the hole and carefully take the lip down until fully removed. The bell material is not hardened so going should be quite easy. I shouldn't need to stress that going too far will ruin things, so take it slowly.

Motor styles

At this stage you'll have to decide on what style of motor you will build, taking into account how you will ultimately mount it in your model and how you fit the prop shaft to the bell.

One configuration has the bell at the back with the prop shaft running forward through the stator/body assembly. This configuration suits bells with a built-in shaft, as mentioned above.

The second configuration is more common because more donor motors come without embedded shafts and this is the type of motor I built. This type has the bell at the front and the prop shaft runs forward through the bell to the propeller as well as back through the stator/body assembly and anchors with a circlip at the rear bearing.

The bearings are tiny – and they are also one of the most important parts of the motor, given the high speed at which it spins. It's always wise to replace any bearings with new ones – they're not particularly expensive and are available at all good model shops.

In either type of motor, the bell is fixed to the prop shaft via either two nuts or a brazed-on brass fitting and grub-screw assembly – the latter is this type I describe here.

You also have a choice of propeller mounts. You can use two nuts on a threaded portion of the shaft or you can use any of the "propeller-saver" fittings commonly used on electric model motors (refer images).

Propeller savers have the advantage that they mount using two opposing screws, meaning you don't have to thread the shaft and the prop is held on with an O-ring that loops over the prop and around the mounting screws; should you hit the ground, the prop simply flexes out of the way and hopefully doesn't break.

My advice is to avoid hitting the ground!

Mounting the prop shaft

Methods of mounting the propeller shaft requiring heat (brazing or soldering fittings onto the bell) must be done before the magnets are fitted. Some people might want to braze or solder the prop shaft directly onto the bell and this is fine, as long as it is centred and straight.

However, we have a chicken and egg scenario; fitting the shaft or shaft holder now will make placing the magnets much more difficult, especially if you don't have a jig, whereas heating the bell after the magnets are placed will ruin all your hard work.

I suggest not fixing the shaft to the bell permanently, instead using a removable system such as a brass shaft retainer. This enables you to use the same prop shaft on a variety of bells and motor bodies.

If your shaft is to be cold-fitted, that is, mounted with a couple of nuts either side of the bell, you can proceed with placing the magnets. If you want to braze a shaft-holder to the bell, you can do that now.

Using a lathe, turn up a suitable shaft holder from brass or steel and drill and tap the retaining grub-screw hole(s). Using the prop-shaft as a guide, carefully position and braze the shaft holder in place. Mount the whole bell assembly in a lathe, drill-press or even an electric drill and spin it up, checking to see everything is nicely aligned.

These motors rev like you wouldn't believe and if your alignment is out, the whole thing will vibrate badly and cause problems so you'll need to either tap it into round or re-do it until you are satisfied everything is perfectly centred and running true.

Once the shaft holder is fitted, you can now remove the prop shaft and proceed to assemble the magnets.

There are many sources on the web for the right-sized rare-earth magnets. Most of these accept Paypal or similar online payments and fire your magnets out in a small envelope as soon as payment clears.

I began buying my magnets from a US source, though this worked out to be quite expensive due to the hammering our NZ dollar was taking at the time.

I ended up importing magnets made to my own specifications and while this was an expensive exercise, I have since sold many sets to other enthusiasts at about half the price others were charging and this has helped recoup some of the costs.

There are two main types of magnets used in our motors; flat and curved.

Flat magnets tend to be cheaper and can be fitted into a wider variety of bells; curved magnets are usually designed to fit the more standard 1 inch/25-27mm diameter bell and while slightly more expensive (due to the manufacturing process), they are also more efficient.

If you are aiming for maximum performance from your motor, curved magnets provide the best possible efficiency and power output.

Whatever magnets you use, you'll need twelve of them per motor and since they are very small, things can get a bit fiddly.

Refer to the images and note how the twelve magnets are placed; they are equally spaced around the circumference of the bell and their poles are reversed in alternate order, so you have, facing inward (or outwards) a north-south-north-south-north-south configuration.

It is vitally important you observe this same configuration, otherwise your motor will not run properly, if at all.

When you buy a 'set' of 12 curved magnets, you should receive six polarised one way and six the other.

(Left): they're sometimes called "scary magnets" because they are so powerful (don't get your fingers caught!). In fact, they are "rare earth" (or Neodymium) types and getting them apart can be rather tricky!
(Right): here's the little plastic jig I made up to allow accurate magnet placement inside the motor bell.

These two pics show how the new magnets are glued inside the motor bell.
At left, spacers hold the magnets at the right distance apart, immediately before glueing in place. They do have a tendency to move of their own accord without the spacer.
At right, this part of the job is finished, with all the magnets glued in position. Take care not to get any glue on the face of the magnets: clearances are rather tight!

Whichever magnets you use, figuring out which way they go is critical.

You don't need to know north from south, just that this side of the magnet is one pole and the opposite side the other pole, meaning the next magnet in the bell must be the reverse of the previous one.

I figure it all out during assembly by putting two magnets together; if they stick, then they are facing the same way; if they try to push apart, that's how they should be placed in the bell.

I originally placed all my magnets by hand and if you are adept at small, somewhat fiddly tasks this will not present a problem.

However I have since created a simple plastic jig which has made things easier (see the photo overleaf). If you are serious about making more than a few motors or have fingers of butter and fists of ham, I suggest a jig may be the best way to go, although it is by no means mandatory to have or use one.

I have also used spacers made from either card or plastic to separate the magnets before and during gluing, however you need to be careful you don't glue the spacer in as well as these can be difficult to remove without damaging the magnets and bell assembly.

Those wanting a jig can also approach me for this item.

Super glue

At this point we should have a quick look at the types of glues used in our motors.

Hobbyists would know about so-called 'Instant' or 'Super' glues, which are thin, fast-setting cyanoacrylate-based adhesives, marketed under a wide variety of names.

However, many people are unaware there are also gel-style cyanoacrylate glues which are much thicker in consistency and take a few seconds longer to cure then their water-like cousins.

It is this type of instant glue I use to cement my magnets in place. Not only does this give me a little more time to ensure I have things in the right position before the glue sets, I also end up wasting a lot less because it doesn't run everywhere or create problems.

Another very useful-but-optional addition to my glue tool-kit is cyanoacrylate accelerator which is used to decrease glue curing time. It usually comes in a pump-type applicator or small spray bottle and can be directed onto the area, instantly curing any cyano-based glue it touches.

A tube of thin instant glue, one of gel-style instant glue and a bottle of accelerator will suffice for all our motor gluing needs.

The magnets stick to the metal side of the bell quite well by themselves (duh) so it is relatively easy to place the first one, hit it with a spot of instant glue and when set, carefully place the next one, spot glue it and so on until all are placed.

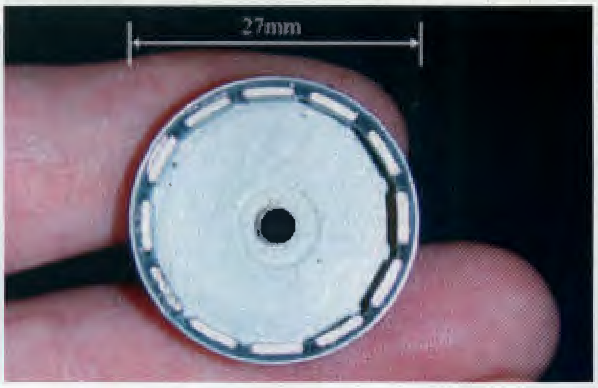
Trying to put all the magnets in and align them before gluing usually ends up like a comedy skit, with your magnets suddenly jumping about before clicking together to form a single column stuck to the bell and all facing the same way.

Keep in mind that these magnets are unbelievably strong for their size and given any chance at all will move just where you don't want them to. If you do happen to end up with a magnet "stick", pulling them apart is virtually impossible – they need to be "slid" sideways off each other.

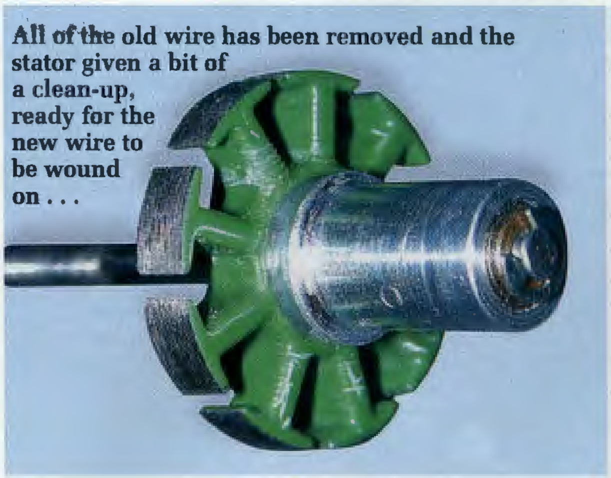
Just be careful that you don't get any flesh between them if they snap together or you might be tempted to say some very naughty words (like bother, crummies, oh dear, etc).

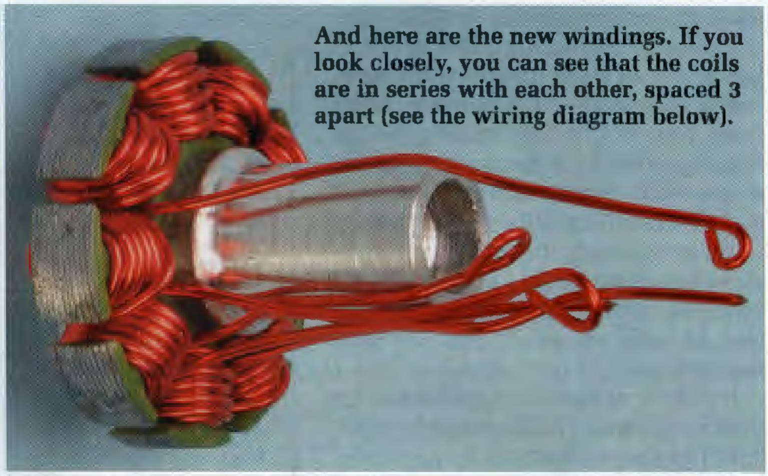
I found that carefully placing and securing each magnet before moving on to the next is the best way to proceed as it keeps everything under control and also allows me to get my magnet positioning right.

Once you've done this a few times, it gets a lot easier and having a jig to hold things in place as well is a definite advantage. Keep in mind that while magnet spacing is not hyper-critical, (it really doesn't matter if you are off a half a millimetre here or there), performance can suffer if the magnets are too far out of line so try to be as accurate as you can. Again, a jig helps here.



Here's another view of the completed motor bell and magnets sitting on the author's fingers . . . giving a good idea of just how small these motors are!


All of the old wire has been removed and the stator given a bit of a clean-up, ready for the new wire to be wound on . . .


And here are the new windings. If you look closely, you can see that the coils are in series with each other, spaced 3 apart (see the wiring diagram below).

When you have all twelve magnets tacked in place, go around and if necessary add another spot of glue under and between each one to be sure everything is well-anchored in.

Flat magnets will usually have a slight gap under their middle, with only the ends touching the bell and this gap should be filled with a drop of gel glue as well.

Once done, run the thin glue all around to fill in any gaps and hit the whole thing with your glue accelerator. This should set things nicely and result in a solid mass holding the magnets in place.

Just make sure you put all the glue drops in before giving it a spray as the accelerator will instantly cure any liquid glue it touches, even that coming out of the tube or on your fingers! (You can also buy cyanoacrylate solvent if the worst comes to the worst).

Also make sure no glue encroaches past the inside-facing surface of the magnets as things run very close and the rotor binding on the stator is one sure way to damage your motor and potentially burn out your speed controller. By now your bell should have all the magnets glued in place and be ready for the shaft to be assembled.

Mounting the prop-shaft is one of the critical parts of the job because it must be centred and dead straight. If you brazed a shaft holder as described earlier, yours is already done, however if your bell has room and you are taking the locking nuts route, then you've a bit more to do.

Find some appropriate low-profile nuts and thread the back end of the prop shaft you are going to be using to suit.

Mount the bell using one nut on the inside and one (preferably a "Nylock" or similar locking nut) on the outside. Tighten fully and spin up the assembly as described above.

It should be nice and balanced with no wobbling or wandering out of round. If it is out, tap the high side gently with a light (rubber) hammer and try again, repeating the process until it runs true. Once done, put it to one side as you are now ready to wind the stator.

Important note

The prop shaft will be exposed to some very high stresses and possibly temperatures as well. Do not just glue it in place because this can only end in tears – very likely your own – when it flies off and hits you.

As mentioned, these motors are surprisingly fast so whichever method you use, the prop shaft must be mechanically very well secured to the bell.

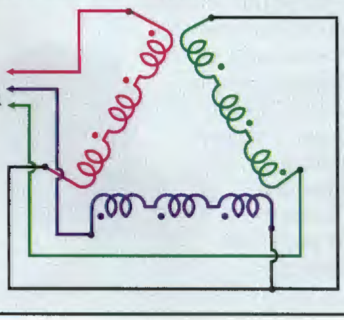
The motor body

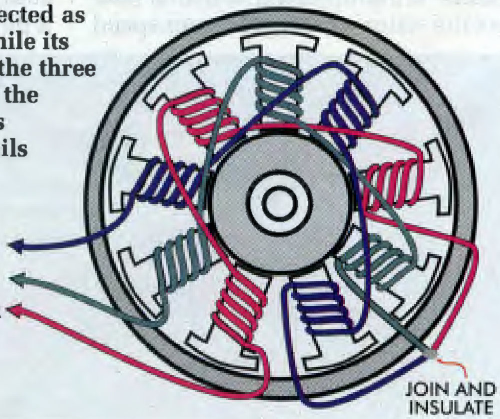
Now is the time to decide on the body style and mounting configuration you will use.

Both use the same simple turned aluminium body, though the Top Hat/bulkhead mounting method requires more lathe work than the other clamp-style mounting system so it is up to you which one you use.

Both methods require an aluminium cylinder, turned from 10mm or similar aluminium stock, which will become the motor body.

The body must be fabricated so that it press-fits into the hole in the centre of your stator. Make it about 30-35mm long and if you use a standard stator, it should be about 8mm in diameter to





Here's how to re-wire the motor – there are nine identical coils, each connected as shown here with three in series. The dots indicate the "start" of the coil while its end connects to the start of the next coil and so on. The "starts" of each of the three sets of three coils then connect to the motor controller, while the "ends" of the three sets all connect together, as shown here. Always wind the coils in the same direction, starting at the outside and working towards the middle of the stator. Wind as tightly and as neatly as possible for maximum power.

ensure a perfect interference fit.

Each end of the shaft then needs to be turned to fit your choice of bearing. If you retained the chromed shaft from your donor CD/DVD drive, the bearings should have a 3mm inside diameter to accommodate the shaft and about a 6mm outside diameter.

As mentioned, these are standard-sized bearings as sold for replacement parts for model cars and helicopters and as such are easily sourced and inexpensive.

If you chose something different for your prop shaft you'll need to source bearings that will suit it.

This is where engineers can have a lot of fun making their motor bodies from whatever material and parts they may have lying around in their bits boxes.

The only considerations are strength and weight – we want to make the motor strong enough while keeping it as light as possible.

Winding the stator

Now take the stator an push out any centre and strip any PCB or other mounting material from it along with the existing wire until you are left with a naked unit.

It is best to start with known working configurations and if you want to experiment from there, fine.

I recommend starting with 10 to 13 turns of 0.4mm enamelled copper wire, wound as neatly as possible. You can use more turns of a lighter wire or less of a heavier wire (anywhere from 0.25 to 0.5mm or larger).

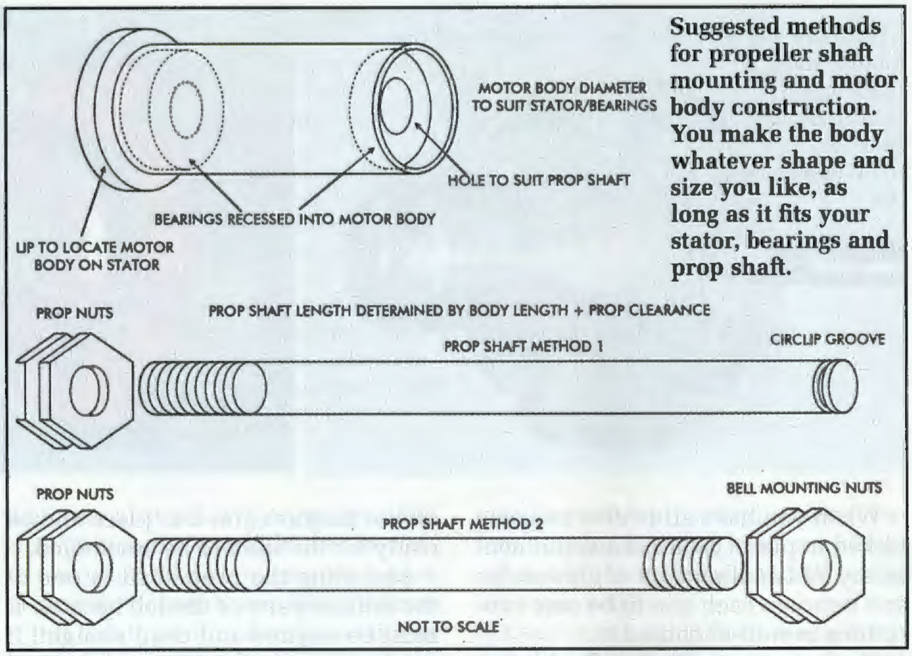
It is essential you follow the winding directions exactly and wind the same number of turns in the same direction on the correct arms of the stator; any discrepancies here are as potentially damaging as mechanical imbalances.

Once wound, you'll need to connect the stator windings to your speed controller. There should be three free 'ends' that will need connecting and the easiest way to do this is with a strip of Veroboard with the appropriate tracks drilled.

Simply cut a piece wide enough for your motor body with a track to spare each side and make sure the strips run length-wise. Drill a hole closer to one end big enough to fit your motor's body and break the tracks where required with a 3mm drill bit to create three separate connections near the other end of the board.

Make the hole a reasonably tight fit for your motor body; while there are usually no significant stresses or strains on the connector board, gluing should not be necessary but if you do encounter movement, a spot of instant glue should suffice.

Carefully cut your windings wires to length and scrape the insulation using a hobby knife or similar. Tin the bare leads well before soldering to your connector; high-resistance joints here will cause problems.



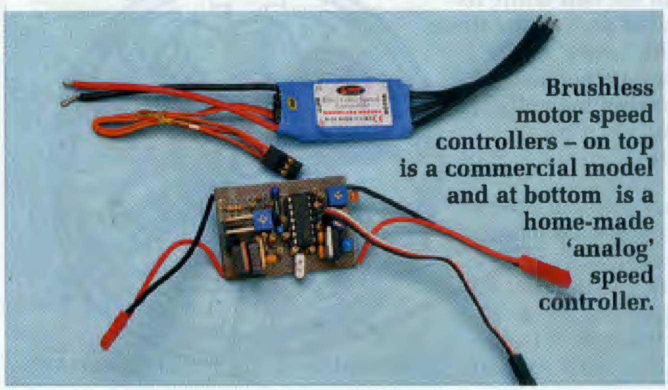
Suggested methods for propeller shaft mounting and motor body construction. You make the body whatever shape and size you like, as long as it fits your stator, bearings and prop shaft.

Setting it all up

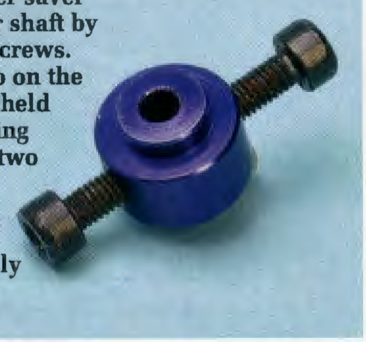
By now your motor body should be complete; the windings wound, connector board fixed and the leads nicely soldered. All that remains is for the magnet/bell/prop shaft assembly to be sized and fitted.

This is how I set mine up:

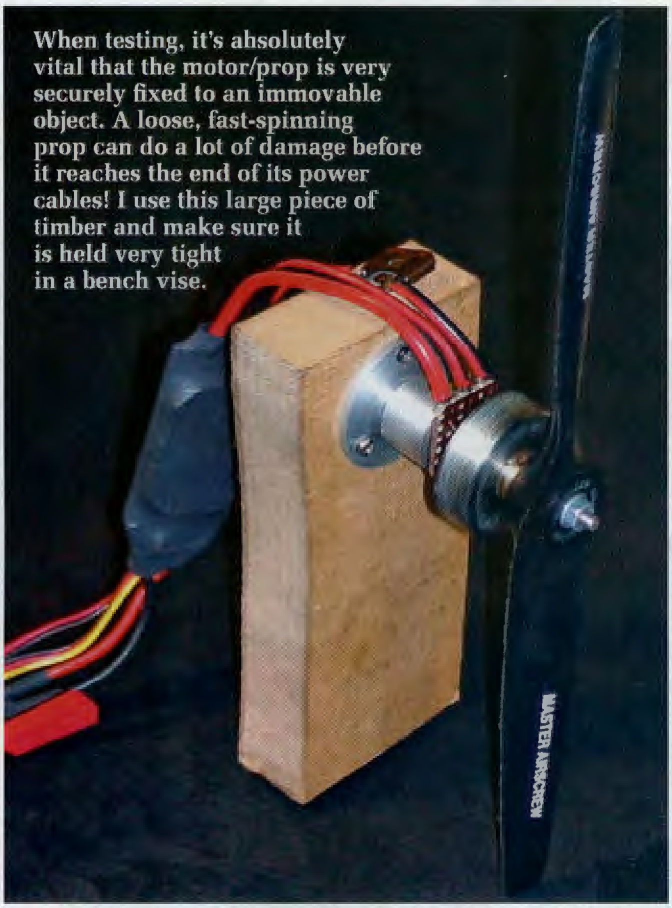
- I fit the prop shaft loosely through the brass shaft holder and feed enough of the shaft through the bearings in the motor body until it clears the end of the back bearing.
- I have already turned a groove into the end of the prop shaft in order to accept the circlip and I then fit the circlip.
- I push the shaft toward the front of the motor, (the prop end) until the circlip is flush with the back bearing.
- I then push the bell/magnet assembly down the prop shaft until it sits nicely over the stator but doesn't rub against it.
- I nip up the grub screws holding the prop shaft and give the bell a turn. It



Brushless motor speed controllers – on top is a commercial model and at bottom is a home-made 'analog' speed controller.



This commercial 'propeller saver' mounts onto the propeller shaft by tightening the two Allen screws. The propeller locates onto on the saver's centre boss and is held in place by a suitable O-ring looped around it and the two Allen screws. In a crash, the O-ring flexes or lets go altogether, releasing the propeller and hopefully saving it from damage.



When testing, it's absolutely vital that the motor/prop is very securely fixed to an immovable object. A loose, fast-spinning prop can do a lot of damage before it reaches the end of its power cables! I use this large piece of timber and make sure it is held very tight in a bench vise.

should feel totally free but magnetically 'lumpy', the lumpier the better.

Any rubbing must be investigated and dealt with before applying power. Fine tune the bell position on the shaft if necessary. The bell should definitely NOT rub on the windings.

- I then measure how long I want the prop shaft to be and mark it – you can make it any length to suit your models and mounting methods (within reason of course). I remove the shaft from the motor, cut it to length and then thread it for fitting the prop nuts.

If you are using a propeller saver device, simply cut the shaft to length and then round the end of the shaft using a file or sander.

You can now mount the propeller. Your motor is finished and ready to mount and test.

Testing

If you are using a metal clamp style arrangement to hold your motor, take care you don't squeeze too hard or short the connector board. If you are using a 'top hat' bulkhead mounting system, make sure the grub screws are tight and evenly clamping the motor body.

Over-tightening either mounting system may damage the aluminium motor body so take care not to overdo it.

Wire up your speed controller, R/C receiver (or servo simulator) and LiPo battery as you normally would.

For safety, I always mount a 15A miniature car fuse in one of the speed controller's lines to the motor. LiPo batteries as used in models like this can pump out some astonishing currents and a simple 50c fuse can save a lot of grief!

Mount the motor solidly in a vise, test rig or your model and switch on all your R/C gear.

Plug in the motor's LiPo battery, making sure you keep well clear of the propeller.

Most modern speed controllers have a protection feature built-in which won't allow the motor to run at all until the throttle is set to absolute zero, (check your trims as well) but some older speed controllers do not have this facility.

If all looks good, slowly apply some throttle and your brand new motor should leap into life. If you want to get serious about experimentation, a full test rig with a tachometer, voltmeter and ammeter installed is the only way to really fine tune your propeller, wire gauges and number of turns combinations.

Typically, though, you'll just want to get the motor into a plane and go flying and trim it out from there. Whichever way you do it, you have just created a well-performing brushless motor out of junk and that is a satisfying achievement!

Propellers

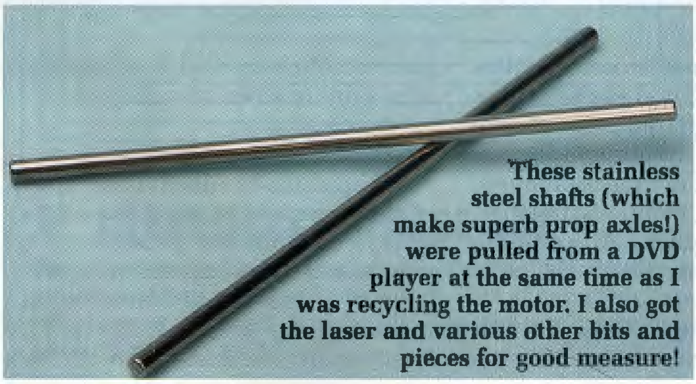
Propeller size depends greatly on the size of the motor you've made, the number of windings and the gauge of the wire used.

If the prop is too small, the motor may rev too high; too big and it might not rev enough and a heavy prop may cause electrical overloading and overheating.

Either condition may damage the motor, especially if you run it at high speed in a test rig without adequate cooling.

Note that the prop blast is *not* usually sufficient to keep things cool when the motor is static at higher revs so take care when giving it the beans on the bench.

I started with a couple of props, one a 6 x 3 (6 inches diameter and 3-inch pitch) and the other a 7 x 4. On my motors, the smaller prop allowed for very high revs but not a lot of performance in my model. The 7 x 4 suited it much better and the model flew very well with it while keeping the revs and temperature down. SC



These stainless steel shafts (which make superb prop axles!) were pulled from a DVD player at the same time as I was recycling the motor. I also got the laser and various other bits and pieces for good measure!

And here's the completed assembly, ready to go flying . . . oh yeah, you might also need a plane, a controller, a battery, a radio control unit and a nice large field . . .