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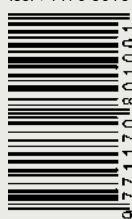


Supply and Maintenance Supplement Edition

Robinson R22 Overhaul

A Taste of Venom: Flying the DH 112

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Robinson Helicopter Overhauls

The story of an R22 overhaul by Heliflite Pacific at Ardmore

ONE OF the good things about Robinson helicopters is that there is comparatively little scheduled maintenance required until 2200 hours of engine time is reached or until 12 years has passed. One of the bad things though, is that pretty much everything then gets attended to at once. Depending on how carried away an owner gets with options such as cosmetics and avionics upgrades, etc., the bill could well nudge \$200,000 just for an R22. That said, if you do opt for a 'factory quality' overhaul with 'new everything' then you will fly away in the equivalent of a factory new helicopter. Given that it should have been reassembled with New Zealand conditions and corrosion protection in mind, you might even convince yourself the result is better than factory new.

Overhauling an R22 is similar to an R44, although there are some components that are lifed differently. In both cases, there are a variety of options to take and decisions to make along the way. Aside from all the cosmetic choices, an R22 Beta can be turned partly or fully into a Beta II model, and an R44 Astro can be 'hydraulised' and turned into a Raven. (Heliflite are one of only two companies worldwide who are sanctioned by the factory to convert Astros to Ravens.)

This article follows an R22 Beta (ZK-HII) overhaul by Heliflite Pacific Limited at Ardmore. This particular example was for a customer who wanted the aircraft returned to factory-new condition, based on a philosophy that the additional expense of doing so was a relatively small burden in the overall cost of overhaul and ownership. This approach ultimately results in savings throughout the life of the overhauled aircraft as unscheduled maintenance costs will be kept very low.

Such an approach also fits the philosophy of Heliflite. Manager Brett Sanders says that as a Robinson Distributor and also because of the standards that their staff apply, Heliflite "will always favour quality over price and are unlikely to ever be the cheapest option. Our approach is to keep prices reasonable and still do a job that looks as though it came straight out of the factory. The factory quote for labour in a typical overhaul is 220 hours but the reality is that the potential is there for that amount to be doubled. That said, we'll always try to accommodate a reasonable deal for the owner depending on their requirements and timeframe." Brett did also say that Heliflite will tend to be choosy about what overhaul jobs they do accept, simply because of the commitment that is also required from the owner in order to achieve a 'factory' result.

An R22 going through a Robinson factory overhaul would by default get virtually 'new everything', including plastics and wiring loom. They are effectively a new helicopter which is why the process at Robinson costs as much as it does (actually not all that much less than a new aircraft).

In Heliflite's case, Brett says generally they would go as far as to fit new plastics except for the door windows (which can't be replaced independently of the doors) and would also fit a new loom. The owner of HII recalls looking at the cabin when it was fully stripped except for the loom and thinking "I probably should replace that. It's the only thing that will be left that could ever cause any trouble." However it looked to be in good condition and cleaned up nicely, so it stayed. And caused

trouble later, or at least a diode did. The point remains that it is a 'now or never' decision and the cost of troubleshooting electrical gremlins later might easily have covered the cost of a loom replacement when you had the chance.

The overhaul process begins with the aircraft being stripped essentially down to the last nut and bolt. All that will remain is a bare cabin on a portable undercarriage or cradle. Various components are scrapped by default, many are inspected/tested and/or overhauled, and many are set aside just for cosmetic attention and later reassembly.

Lifed and on-condition components

There are a variety of components that are multiple lifed (within limits) or that run on-condition, but it would be an optimistic owner that thought all such components would be able to be refitted to an overhauled machine. New Zealand is a harsh environment for corrosion and it's only at overhaul time that most owners realise just how much more effort they should have put into preventing corrosion during the life of the aircraft.

For example, on an R22 all of the undercarriage except the aft cross tube is on-condition, but it is very rare not to have to scrap out some parts and in the case of ZK-HII it was more economic to simply buy a whole new undercarriage as a kit from Robinson and then keep the one remaining good component as a souvenir of the additional costs involved. All the scrapped parts were due to corrosion pitting. From an owner's point of view it has to be said that the quality of the paint ex-factory isn't conducive to a life beyond 12 years and some owners may like to consider

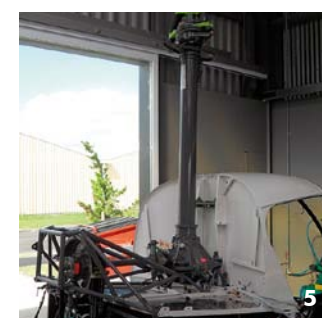
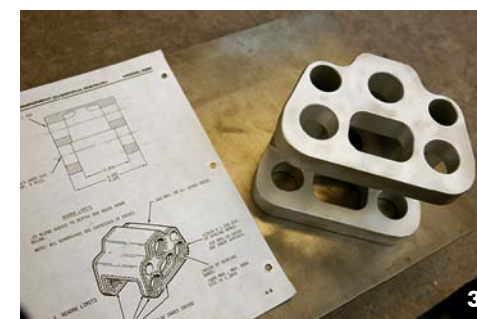
stripping it all and starting afresh before their expensive new undercarriage is re-assembled.

Frames are mostly double life items, though 50% of those tend to be scrapped due to corrosion and fretting issues. In some cases, stretched drive belts may have rubbed on the frame when un-tensioned and left wear marks that are beyond limits. (ZK-HII's frames all made it to a second life, thankfully.) It's a good idea to protect these areas of the frames for the future. And to always look under the aircraft when you clean it and attend to any areas needing regular corrosion protection.

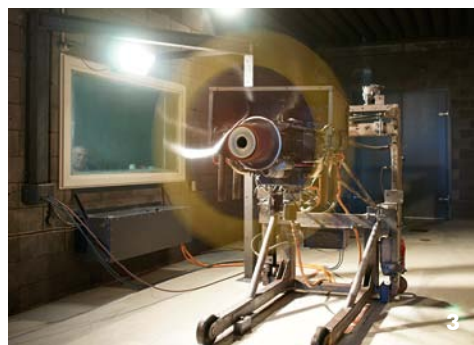
Frames, undercarriage, and control components are all stripped, inspected and crack checked using magnetic particle and fluorescent dye testing. In the case of HII, these components were sent to Rotor and Wing Maintenance at Taupo for 'overhaul' and to Fieldair Engineering for NDT. (See separate articles on both companies in this issue of KiwiFlyer.) These parts are then re-protected using a variety of methods, including powder coating, primer fill and drain for some tubes and 2-pot epoxy painting. Assembly involving a series of sealants and jointing compounds further reduces the likelihood of corrosion attack in future service. These processes should often exceed the original assembly standard and provide the extra protection required in the NZ environment.

Most tailbooms are double life items, but the forward section(s) can be prone to internal corrosion pitting damage beyond repairable limits. Replacing a skin is not approved by the manufacturer and requires an approved repair scheme certified by a design organisation. Rotor and Wing Maintenance have such a scheme and may be able to save owners the significant cost of a full tailboom replacement. It is also a good time to make sure the quality of the internal painting and corrosion protection is up to a good standard. In ZK-HII's case, two forward sections had to be replaced, but this was substantially less expensive than replacing the whole boom and also provided the opportunity to fit an additional boom antennae mount which needed to be done anyway.

R22 rotor hubs are double lifed but usually fail at the first 12 year inspection due to corrosion pitting. Limits are as low



Captions: 1: Before the big project, with just enough hours left to fly down the road to Heliflite. 2: Checking undercarriage components for corrosion limits. 3: Rotor hub ready for inspection. 4: Main transmission under inspection. 5: Mast reassembled. 6: Starting to look like a helicopter again as the tail goes back on. 7: Engine in and Powerflow exhaust fitted. 8: The loom was cleaned and retained rather than replaced, but all new terminal caps and P clamps were fitted, one of many finishing touches to make the aircraft look brand new again. 9: Overhauled tail rotor assembly. 10: Cowlings going on. Note the quality of the internal paint work. There's no chance of corrosion in the next 12 years. 11: The view between the fuel tanks. They are only partially visible when cowls are open, but received the same degree of preparation and paint finishing from Pacific Aero Coatings as the rest of the aircraft.



as just 10 thou (~0.25mm) within 300 thou of any edges, and just half a thou (~0.01mm on the inside of any bearing bores). By the time that bubbling of the paint is found in service it is probable that the resultant pitting from the corrosion is beyond limits. This was the case for ZK-HII's rotor hub and its clean, bare, bead-blasted self now sits on the corner of a desk as a \$2000 paperweight.

Transmissions are a mandatory return to factory overhaul item at 2200 hours, but can have a 12 year inspection if they are not in sync with rest of helicopter. 12 year inspection of the main rotor gearbox requires substantial disassembly and removal of the drive shaft for replacement of a sealed greased bearing located at the top of the mast. Also replaced are all seals and 'O' rings. Located in the top of the output gear carrier is a pocket prone to accumulating condensation and therefore corrosion. This area is protected by injecting a quantity of gearbox oil through a vent hole after installation. In the case of HII, both transmissions were inspected by Rotor and Wing Maintenance and returned to service.

Rotor blades and tail rotor blades are mandatory 12 year items regardless of hours. Those associated with the industry will know that a few years back Robinson stopped making stainless steel skinned blades and reverted to aluminium. This no doubt resolved any bonding difficulties but opens the door to corrosion issues instead, unless the blades are well cared for. During the years of stainless blades, many operators will have developed habits that could be considered neglectful in the case of alloy blades. The requirement for regular washing and salt removal is obvious, but it's also good practice to regularly wipe an approved corrosion preventing compound on the blade tips and especially right along the trailing edges.

The only items that must be returned to Robinson for factory overhaul aside from transmissions are clutch actuators, hydraulic equipment and engine tachometers. All other items can be attended to within NZ.

Captions:

- 1: Engine reassembly commences.
- 2: John Williams torquing cylinder heads.
- 3: The first start in the Aeromotive Test Cell.
- 4: Looking like brand new again, about to have its first (installed) start on the ground at Ardmore.
- 5: A new interior including new paint and a fully refurbished instrument panel, with GPS, PCAS, Spidertracks, and a Beta II cyclic installed.

Avionics

The engine and rotor tachometer is a mandatory overhaul item, but all other items are at the discretion of the owner. It may be time to consider trading in old radios and transponders and/or designing a new panel. That was the case in HII, which acquired a host of 'nice to have' extras such as touch screen GPS with integrated PCAS traffic, a phone kit, and spidertracks. Gyro instruments were overhauled. Given the radio display didn't work properly, the transponder was very old, and the A/H had ceased functioning, these decisions were reasonably easy to make. The result is that the panel looks and functions like brand new, helped by also opting to replace many of the actual panel components themselves. They are surprisingly inexpensive and Heliflite will nearly always take this option, especially for the circuit breaker panel which tends to get scuffed. Brett says they are even inclined to replace any circuit breakers that aren't visually up to standard, though they are always mindful of the costs involved. In the case of ZK-HII, new avionics were supplied and wired by Hawker Pacific at Ardmore, with final panel manufacture and fitting by Heliflite.

Whether replacing avionics or not, an overhaul is the best time to run some extra wiring for future purposes such as radios, antennae, hooks, GPS, charging sockets, etc. (On the subject of hooks, undercarriage reassembly time is the best time to provision for that too if there's ever a chance of wanting to fit one.)

The engine

HII's engine was overhauled by Aeromotive at Hamilton. The engine overhaul process is a standard one, although Aeromotive have several 'extras' they include under their Signature engine brand.

Stages of the process are: Receipt at Aeromotive with careful noting of all components and brackets received. Then the engine is stripped and de-greased. Relevant parts are magnaflux and fluorescent dye tested, and inspected in accordance with the manufacturer's data. Service bulletins and A/Ds are reviewed, then (if not a fixed price job), pricing is finalised and agreed upon. The engine is then overhauled (see separate Aeromotive article in this issue of KiwiFlyer) and reassembled. Aeromotive returned HII's engine looking like brand new, with high quality paint and very tidy assembly work clearly evident. Owners should consider

whether to paint inlet manifolds and ceramic coat or paint exhaust manifolds at this point too. Now is the chance and it can be done for a very small marginal cost to the project. In fact, Aeromotive do now paint inlet manifolds but Greg Mundell at Aeromotive says that hardly any customers bother with exhaust manifold coatings.

Aeromotive will then run the engine in their test cell for at least 2.5 hours in accordance with the manufacturer's data, before undertaking a final inspection and handing the engine back to the customer.

Well prior to this however, owners should have given consideration to how long the engine will sit for before running again, as Aeromotive can inhibit it per manufacturer's recommendations if required. For long term storage this may involve running on inhibiting oil in the test cell, then applying a wax substance to the cylinders (which owners should reapply every month), using silica gel plugs, and

potentially filling the engine with 10 litres of oil and storing it upside down to keep the camshaft immersed.

Running in is next and should follow the manufacturer's service instructions. As a rule of thumb, owners should fly above 75% power and not let the engine get hot or sit on the ground idling, which should be at a minimum of 1000-1200 rpm. Time on the ground should be kept to a minimum, but following the proper warm-up procedure and care must be taken to avoid shock cooling. Greg Mundell at Aeromotive says to go for long flights for the first 25 hours and to avoid circuits, minimising starting and stopping. It's actually a great excuse to get in the aircraft and go somewhere without thinking about the cost because – you have to do it for the sake of the engine and you can't trust the job to anyone else. That's what Mr. KiwiFlyer told Mrs. KiwiFlyer anyway.

Other considerations

There will always be other considerations to talk through at the time. For example, Heliflite prefer to replace all rod end bearings (which don't come in the Robinson overhaul kit from the factory), because the old (serviceable) ones likely won't last another life and controls will end up getting looser over time.

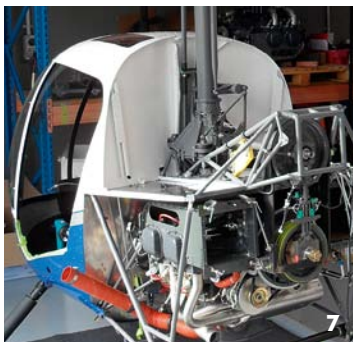
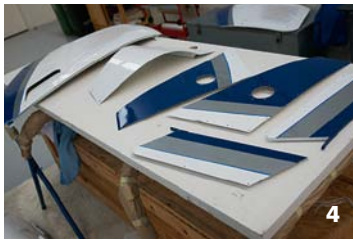
John Hobday at Rotor and Wing was able to supply a Beta II cyclic control for fitting to ZK-HII instead of its original Beta version. That and a Beta II new paint scheme make the helicopter visually indistinguishable from a Beta II unless you happen to notice the different engine or that there's no automatic carb heat system installed.

Also worth considering (and added to HII) is an aftermarket exhaust system, especially given that in the case of the R22, this must be replaced anyway. For a relatively small marginal cost, a Powerflow



ZK-HII looking and flying like brand new, over the Hauraki Gulf near Ardmore.

Gavin Conroy



Captions: 1&3: Cabin stripped to bare metal and fiberglass.
2&7: The back of the cabin is hardly visible once reassembled and even Robinson only undercoat it, but Kim fully prepped and then finish painted it.
4&5: The stripes weren't painted over the top, they are all individually laid on to the primer. **6:** On the way back to Heliflite from Pacific Aero Coatings.
8: The fan shroud was fully prepped, colour matched, and repainted too.

system from Performance Aviation in Wanaka was fitted. In the case of the R22, this is expected to provide the helicopter with hot and high performance equivalent to the Beta II (which has a larger capacity engine). It also looks and sounds rather good indeed.

Lastly, what seemed like a 'no-brainer' decision for HII was to fit a throttle switch, again from Performance Aviation (see separate article in this issue). This simple and inexpensive device prevents the engine being started unless the throttle is closed, eliminating the risk and huge expense (\$15k+) of an accidental start-up over-speed if the engine was ever to be started on an open throttle.

Paint and Cosmetics

Having spent a small fortune on everything mechanical and electronic in your helicopter, or plane, it seems a travesty not to make it look like new with fresh paint and upholstery. Heliflite's standards dictate that unless the paint is really very good, then it should be stripped and redone, inside and out. This is also a chance to do a much better job of corrosion protection than the factory ever would. Be aware though that there are paint jobs, and there are paint jobs. ZK-HII was completely stripped to bare metal and fibreglass by hand using friendly chemicals (with no mechanical sanding or blasting) and repainted using Superflite aircraft paint by Kim Thompson at Pacific Aero Coatings in Tauranga. You won't find anyone to apply more attention to detail or to do a better job.

Aircraft preparation and painting is not the same as car painting (even European car painting) and specialist aircraft paint products are not the same as automotive paint products. ZK-HII has been seen by many critical eyes post its overhaul and without exception, they all marvel at the quality of the paintwork. It looks a lot better than a new one. Fortunately for the owner, it was painted before Kim's reputation started spreading. Testament to that are several significant helicopter jobs that Kim has attended to since, including taking over part completed work from other painters that owners have been dissatisfied with – realising too late the false economy they had attempted to work within.

There are a multitude of parts that can be painted off the helicopter (Kim couldn't believe just how many for such a small aircraft as the R22), such that all surfaces and edges can be fully protected against future corrosion. Again, the standard if this approach is adopted, will likely well exceed that of a factory machine. Literally hundreds of screw heads and fastenings can also be attended to separately as well – and it's a worthy consideration to replace a lot of these with new. For the sake of a dollar each, it's another step towards making the aircraft look like brand new when the project is finished.

Heliflite prefer to refit overhauled helicopters with new factory interiors (perhaps excepting seats which may be covered locally), simply because then if the overhauled helicopter were to be parked alongside a new one, it would look exactly the same.

There's also the consideration of what to do about plastics and windows. Robinson front screens can be replaced, though it's not the easiest task. And door windows can only be replaced if the whole door is replaced too (there is a mod available to cut out the windows and bond in new ones but they won't look like new afterwards). If the plastics aren't too bad then most marks will be able to be carefully polished out, though don't expect this with actual scratches unless you're willing to risk distorting the view. Kim Thompson polished all of the plastics on ZK-HII and admittedly they were in good condition to begin with, but some who viewed the aircraft after Kim's efforts thought they were all new replacements.

Reassembly

It's in the reassembly process that attention to detail becomes most evident, and arguably where a lot of the aforementioned costs can get turned into additional value. Chief Engineer at Heliflite, Zack Erdos says that when they reassemble any aircraft, they are always thinking about how to make it last and always considering the future from a preventive maintenance point of view. Heliflite will always do more than the minimum, and be very conscious of attention to detail not only to make it look like new, but also to make it last even better than new. That was certainly the case with ZK-HII. Much of its assembly and the associated attention to detail was in the care of Engineer Dan Sumner at Heliflite, and he and the rest of the Heliflite team who all participated at some stage, are owed a big thanks from the owner for a job to be very proud of.

For more information

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 Contact John Hobday at Rotor and Wing Maintenance on 07 378 8688 or rotorandwing@xtra.co.nz
 Contact Greg Mundell at Aeromotive on 07 843 3199 or greg.mundell@aeromotive.co.nz
 Contact Kim Thompson at Pacific Aero Coatings on 07 378 8688 or kim@pacificaerocoatings.com
 Contact Matt Bailey at Performance Aviation on 021 744 588 or matt@performanceaviation.co.nz
 Contact ZK-HII's owner at rotorflight@xtra.co.nz

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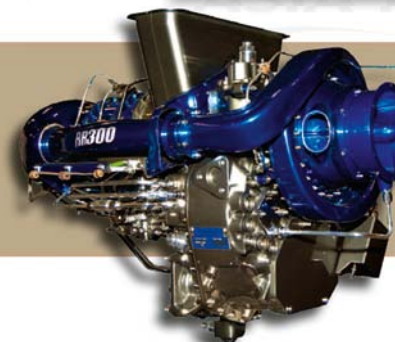
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