

LAST MONTH NIGEL EXPLAINED WHY HE CHOSE THE SERVICES OF RPI ENGINEERING TO HANDCRAFT HIS CW460'S BESPOKE POWERPLANT, AND ALSO GAVE US AN INSIGHT INTO THE EARLY STAGES OF ITS CREATION. THIS MONTH THE BUILD CONTINUES THROUGH TO ITS CONCLUSION; THE END RESULT LOOKS ABSOLUTELY ASTONISHING, IN FACT LIKE NO OTHER ROVER V8 THE KIT CAR OFFICE HAS SEEN. AS FOR THE V8'S TRUE POTENTIAL, THIS WILL HAVE TO WAIT UNTIL THE RUSH VENTURES ONTO THE HIGHWAYS, BUT ONE THING IS FOR SURE: OUR TECH' ED' WILL REPORT HIS FINDINGS IN HIS USUAL INFORMATIVE MANNER. SO LET'S GET DOWN TO BUSINESS AND ONCE AGAIN JOIN HOLLY FROM RPI AND THE RAPTOR F85 ...

# RUSH

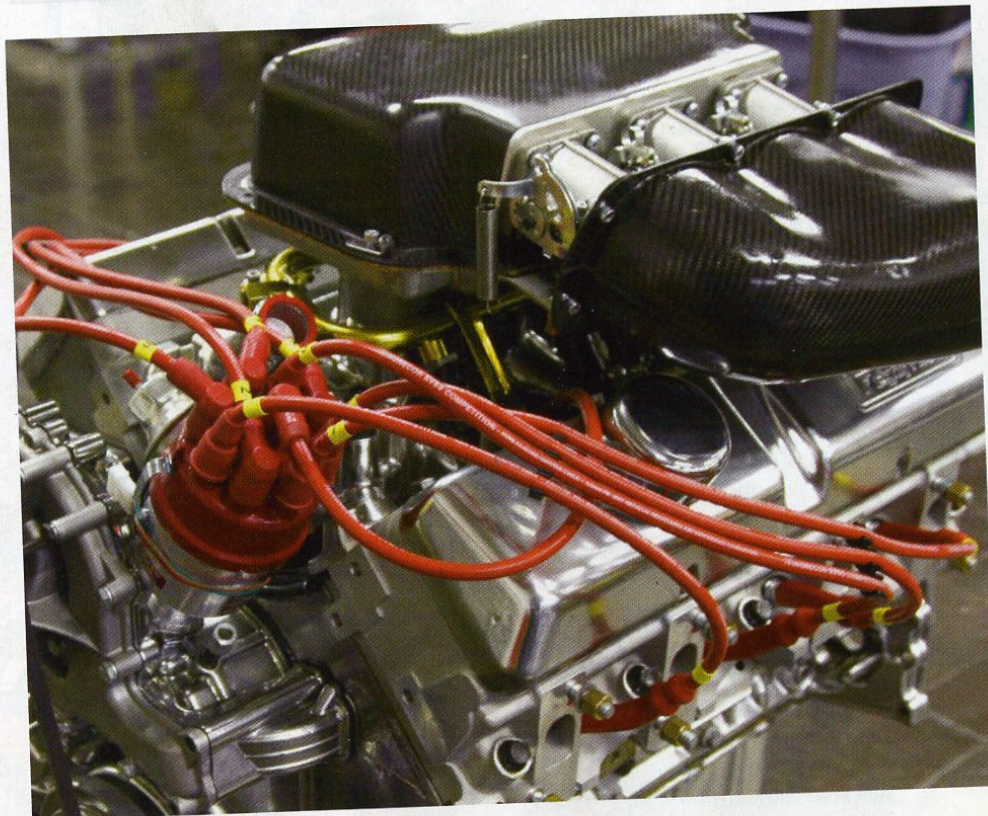
## CW460

CHAPTER

# 6



*Nigel, Kit Car's Tech' Ed' and in-house builder.*



*The Raptor F85 - fuel-injected 4.6 litre V8 capable of delivering over 330 bhp and 350 ft/lbs of torque.*

**W**atching a craftsman at work is one of those humbling experiences, especially when they make it look so incredibly effortless. I guess it's a complex combination of the correct tools, huge experience and, more importantly, that unquantifiable 'magic' touch. Holly, RPi's master engine builder, is a perfect candidate for such an accolade: witnessing the man assemble my Rush CW460's powerplant was an experience I will not forget in a hurry. I'm sure if you too are a petrolhead you will appreciate where I'm coming from. As initiated last month, my aim over the following pages is to share the remainder of the two-day V8 build at the RPi premises. Flick to the end of this feature and you will see the final result. Not your usual run-of-the-mill Rover V8 is she? In fact, if you ignore the front pulley set-up, few would recognise the humble Buick origins. The secret behind this amazing transformation, both in looks and potential, is because many of the Raptor F85's components fitted this month are far from your standard fare, one example being the cylinder heads ..



## HEAD SELECTION

Speak to any engine builder and the one key component in producing usable horsepower and torque is head selection. Where the short block is specified and built primarily for strength and durability, the heads are more concerned with the dynamic flow of the intake and exhaust gases. Even though numerous components influence this critical parameter (such as inlet manifold, headers, carburettor venturi etc.) head design in isolation has the largest influence. Since the earliest Rover V8s, the standard head design has changed very little over the years and this is where the fundamental problem lies. Initially manufactured for low down torque, the head design seriously struggles to provide adequate gas flow at higher rpm, especially on larger capacity V8s. In the past the only viable solution has been to modify the standard offering, with the net result being countless upgrades from specialist companies such as RPi Engineering. Head work includes porting, increased valve size, valve seat width reduction, narrowed valve stems and far more besides. It is truly a black art and an expensive one at that but, regardless of how much effort and hard currency invested, the limiting factor is still the original seventies castings.

Many think larger valves alone equate to more power. In fact this is not necessarily true. As valve diameter increases, so does weight, limiting high rpm operation unless you invest in exotic materials. Oversized valves also have to operate in close proximity to the cylinder walls, potentially causing airflow disruption - not good news either. Add to this the potential of losing air flow velocity as port size increases and you can understand that bigger is not necessarily better for all engines. This explains why companies such as RPi offer various stages of head upgrades: 1, 2, 3 and even wilder depending on application. However, in the last few months a brand new head has come onto the market known as the Merlin F85. Supplied exclusively by Real Steel, dyno testing has shown this brand new design can outperform practically all current modified offerings. Dyno figures are simply staggering. Running a stroker kit and a basic four barrel carb, a Rover V8 with these heads delivered a heady 353 ft/lbs

of torque at 6,000ish rpm! That's well beyond standard Chevy and Ford small block territory! Even more amazing is at a mere 2,500 rpm the dyno needle nudged 321 ft/lbs of torque, at which point it continued to deliver a steady increase in torque all the way up to the 6,500 rpm red line. It is this availability of immense torque throughout an entire rev range that pins you against your seat, not peaky horsepower as experienced in turbocharged engines or highly tuned 4 pots. The Merlin F85's specification is as follows:

- Aluminium stiff-cast construction
- Stainless steel valves
- 1.73 inch inlet valve diameter
- 1.45 inch exhaust valve diameter
- Two extra rocker pedestals to increase rocker shaft rigidity
- Manganese bronze valve guides
- Raised exhaust port profile
- State-of-the-art gas flow

Chris (RPi MD) openly admits the Merlin F85 is the best performing fast road head he has seen, hence the logic behind earmarking a pair for my Raptor. As explained last month, Chris is not ashamed to use the best others have to offer if it means he can deliver the ultimate powerplant to his own customers.

Inspecting the heads as they lay patiently on Holly's bench immediately highlighted the amount of effort invested in their design and fabrication. Superb casting and machining quality was immediately apparent, including a delicately textured finish uniformly applied to all internal runners. The ports are not too large and are exquisitely profiled, including a small lip on the lower intake port to direct charge around the valve guide, minimising turbulence. As for the rocker shafts, the additional supports at either end clearly give the whole assembly more rigidity, a failing of the standard set-up at higher rpm.

The talent behind the creation of these remarkable heads is Pete, of Real Steel fame. Without question this man is renowned as being one of the most knowledgeable and talented Rover V8 gurus on the planet. In fact, 25 years back, he was Chris Crane's mentor. Small world!

Utilising composite head gaskets, Holly positioned the heads on the COSCAST block with relative ease. Using brand new high tensile head bolts, the tightening sequence commenced. In only a matter of five minutes the short block suddenly grew in stature and



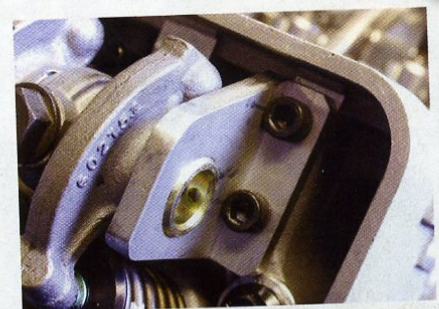
Head gasket in place.



On go the Merlin F85 heads, one of the secrets to the Raptor's astonishing capabilities.



Rocker shaft assembly being bolted to the merlin head.



This is a close-up of the additional rocker shaft supports.

the Raptor F85 was taking on its own unique presence thanks, in part, to the distinctive Merlin rocker covers.



## FOLLOWERS AND PUSHRODS

As with other components residing in my Raptor, the conservative approach regarding cam profile negated the need for extreme hardware such as billet rocker shafts, solid lifters, roller rockers and double valve springs. However, Holly recommended the use of upgraded pressed steel rocker arms rather than the potentially troublesome standard aluminium alternatives. Even though the latter have less inertia, the steel inserts required to sit on the valve springs can occasionally become detached, with undesirable results.

The assembly of the rocker shafts seemed a relatively simple exercise, after which attachment to the heads left one in no doubt the assembly could withstand significant rpm. Holly then opened a box of Piper Cams hydraulic followers and, after the application of a small amount of lubricant, inserted all sixteen into the V8's gleaming valley.



*Hydraulic followers being inserted into the V8's valley.*

As regards pushrods, the F85 heads demanded the more fiddly adjustable variants since pre-load could not be adjusted by shiming the rocker assembly as on the standard Rover heads.

Setting pre-load is a rather time-consuming process but is essential to ensure the valves work in harmony with the cam lobes. If the pushrods are adjusted too short, the valves will not open enough or for long enough. If the pushrods are too long, the opposite happens and you can get too much



*Adjustable push rods being inserted prior to adjustment.*

valve overlap. This latter scenario increases the risk of unburned fuel going straight out of the exhaust and, apart from cooking your catalytic converters, increases your hydrocarbon emissions considerably. Make the rod excessively long and the spring will become coil-bound, resulting in bent rods! I will not bore you with the process, but suffice it to say it took Holly a good hour to get everything spot-on.

## CAM DRIVE GEAR

As with all American-derived V8s the distributor is driven directly off a bevelled gear attached to the camshaft. This is located by means of a keyway tapped home with a small hammer. Once in position, Holly torqued down a rather meaty bolt and washer to ensure everything remained in situ. Naturally, Stud Lock was applied to the bolt's threads for that additional reassurance. Holly was then faced with a choice for the next task in hand: sump, timing cover or inlet hardware? The order is not an issue, and the decision was made to seal the front of the engine.



*Front cover, powdercoated in chrome.*

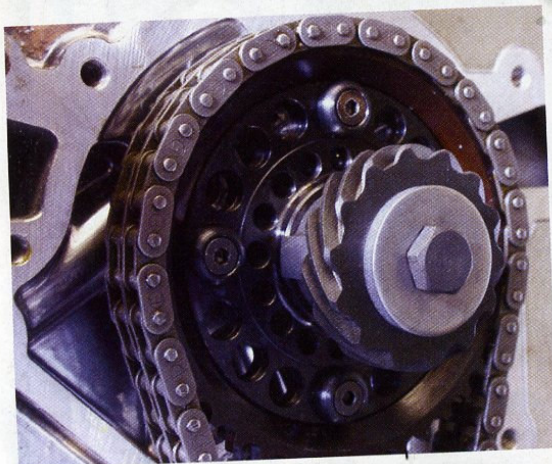
## FRONT COVER

If there is one aspect of a kit car Rover V8 installation which confuses builders it's the front cover. This assembly incorporates the water pump, oil pump, distributor (if present) and pulleys. The complication is because Rover changed the design over the years and they all vary in size. Later variants incorporate a rather bulky serpentine set-up which simply cannot fit into a tight Sevenesque chassis. Consequently the older 'V' pulley set-up was the order of the day for the Raptor F85. Prior to bolting the front cover and pulleys to the block, the large round oil seal was gently tapped home and lightly lubricated prior to the whole assembly being slid over the crank's nose. This attention to detail is essential in any engine build, since oil seals can overheat and become damaged in a matter of

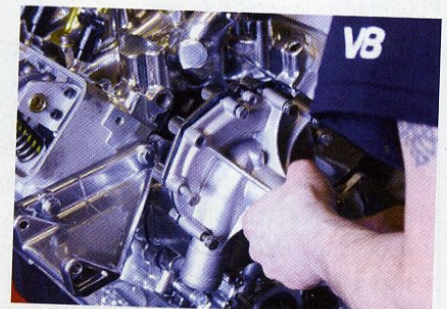
seconds if allowed to run dry. Ignore this advice and you will get an oil leak. Holly also took great care ensuring the correct bolts were used in the corresponding holes. This is for two very good reasons: firstly, all the holes receiving fasteners to attach the front cover are blind; and secondly, they are of differing depths. It has been known for inexperienced Rover V8 engine builders to puncture a liner by not following the correct procedure.

Holly primed the oil pump with grease prior to bolting the oil filter take-off plate into position, another modification required to allow the huge V8 to be shoehorned into the slight frame of the Rush.

A new water pump was fitted to complete the front end, along with the pulleys. This component is relatively



*Distributor drive gear on end of camshaft.*



*Brand new water pump being attached to the front cover.*



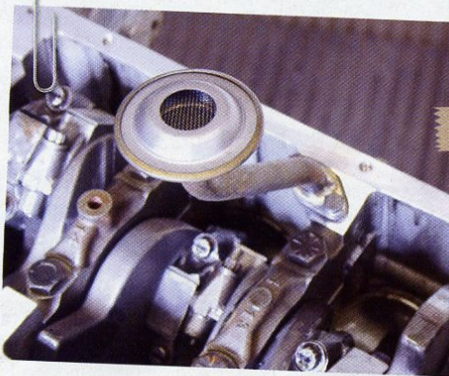
inexpensive and should always be replaced during an engine rebuild. Any water pump casing bolts passing through the water jacket were covered in grease prior to insertion to aid removal at a later date. Alternator positioning is another issue during kit car installations, but exact clearances had to wait until the Raptor was sitting in the Rush chassis.



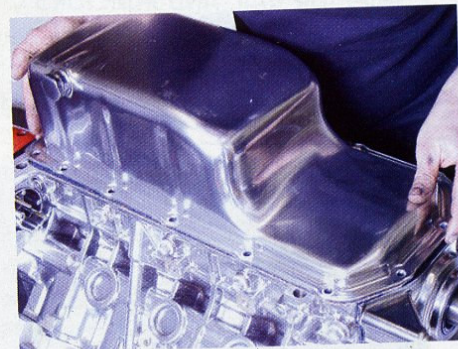
*Pulley set-up in place. Will the alternator fit in the Rush chassis?*

## SUMP

Chris had a brand new sump powdercoated in chrome to match the block, and pretty amazing it looked too. There was no need to opt for a modified alternative since the Rush ground clearance is absolutely fine with the standard offering. Prior to sealing the bottom of the engine, an oil pick-up pipe



*Oil pick-up pipe.*



*Sump, again powdercoated.*

was attached to the base of the block. A quick check with a ruler ensured it didn't rest on the bottom of the sump, a potential problem which restricts oil flow. Only at this point was the sump gasket neatly placed on the engine's base and the sump bolted into position.

## TRUMPET BASE AND INLET MANIFOLD

The decision to go fuel injection was a conscious one for numerous reasons. The need for accurate fuel metering is essential to meet tight SVA emission requirements but, more importantly, I would like easy starting and instant throttle response. Even though a well set-up carb can, in theory, meet all these criteria you can't beat the refinement of a fuel injection system.

The first stage was to upgrade the trumpet base. The size and format of the eight trumpets which sit inside the fuel injection plenum have not changed since the first 3.5 litre variant was launched over twenty years ago. This is amazing when you consider the larger 3.9, 4.2 and 4.6 litre units have to rely on this rather restricted inlet hardware. The solution is as follows:

- Remove the standard 38 mm diameter trumpets and discard.
- Port out the trumpet base from 38 mm to a massive 45 mm.
- Insert shortened and larger profiled 45 mm diameter trumpets into the new trumpet base.

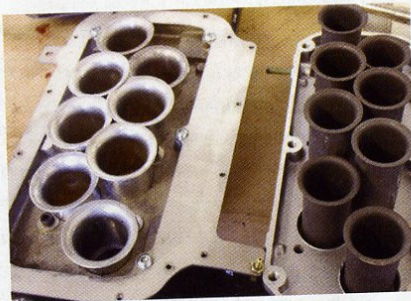
The net result of this time-consuming process is significant. The trumpets are not only larger in diameter, but also shorter and have a wider throat (or flare). The former increases air flow and the latter induces a



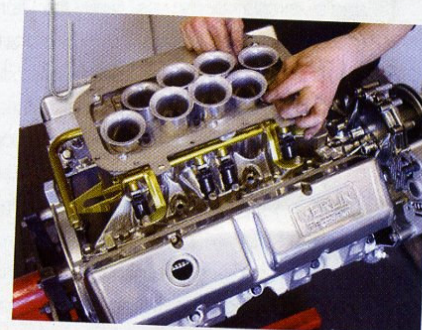
*Injection inlet manifold being assembled. This is actually a dummy run as the inlet ports still need to be opened out to maximise gas flow.*



*Looking good.*



*On the left is the ACT trumpet base and on the right is the standard set-up. The former is one secret to obtaining 300 bhp plus on the dyno.*



*Trumpet base bolted into place.*

ram air effect. This set-up increases volumetric efficiency by approximately 30%. Oh yes, it also looks the dog's wotsits - just a shame it's all covered up in the final installation!

Naturally the inlet manifold is also ported to 45 mm to match the trumpet base, again another rather time-consuming activity. In the case of the Raptor F85, once fully machined both pieces of hardware were subjected to that all-important chrome finish.

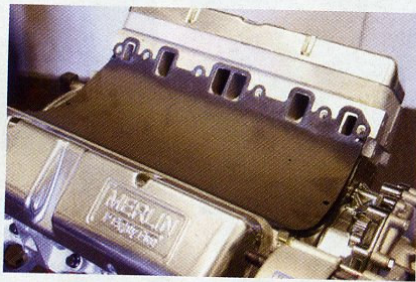


## INJECTOR RAIL AND INJECTORS

Prior to fitting the inlet manifold, Holly inserted the eight high-capacity injectors into the fuel rail and secured each with its own retaining clip. Once all were in situ (including the fuel temperature sender) the whole assembly was pushed home into the inlet manifold and secured by four stainless steel cap head screws.

## INLET MANIFOLD FITMENT

The coming together of the block and inlet manifold required Holly to accurately position a composite valley gasket, including a few strategic applications of silicone sealant to avoid potential leaks. Highly polished stainless bolts were used to clamp the whole assembly in place, painstakingly prepared by Holly to provide that show-quality finish. The torquing procedure was again another multi-stage process, one often overlooked by home builders. The issue is that the inlet manifold is in the shape of a 'V' and this needs to be progressively clamped down onto the heads and block. Holly also pointed out the need to use thick washers under the inlet manifold bolts.



*Valley gasket in situ.*

This ensures an even distribution of pressure, something not achievable if you use a thin washer which can deform. These are common mistakes he sees on a regular basis when confronted with a leaking or poorly running V8.

## PLENUM AND THROTTLE BODIES

From the other side of the build room I could see the Raptor was nearing completion, but Holly left the crowning glory until the end. The standard fuel-injected series of Rover V8 engines utilise a cast aluminium plenum and single throttle body. As with the trumpet assembly this design has a number of weaknesses and, in all honesty, has been primarily designed for longevity rather than outright performance - not an ideal option for a lightweight sports car (though the setup found its way into a selection of mid-nineties TVRs).

Several companies provide alternative solutions and one in particular has worked with RPi for many years: ACT Performance Products Ltd. Providing a huge range of tuning hardware (to the TVR fraternity in particular), ACT is well-placed to meet the needs of the kit car builder wanting the ultimate for their V8 powerplant. The talented man behind the business is Tim Lamont, who is yet another respected talent within the Rover V8 fraternity.



*On goes the ACT carbon fibre triple throttle body plenum. Absolutely exquisite.*

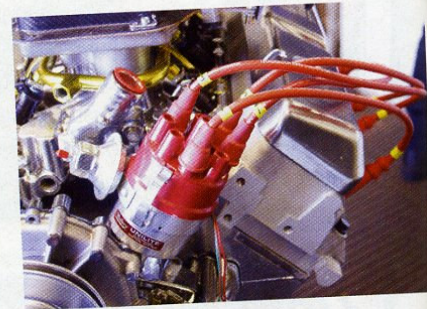
Specialising in carbon fibre plenum upgrades combined with alternative throttle bodies and ECU remapping services, the range of Rover V8 solutions on offer is absolutely mouthwatering. Probably of no surprise, Chris had the ultimate ACT package lined up for my Raptor F85: an exquisite carbon fibre plenum with not one, not two, but three throttle bodies. Costing £1,345 plus VAT (including the upgrade to the trumpet stack already mentioned) you can appreciate this route is only for the serious. Apart from looking absolutely amazing, the advantages of this totally bespoke solution are as follows:

- **Instant throttle response (apparently it's phenomenal).**

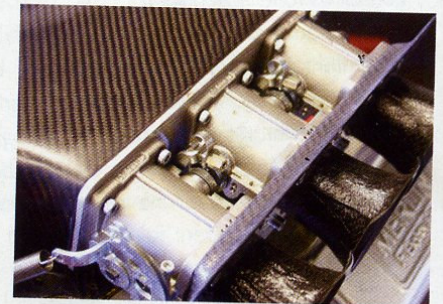
## DISTRIBUTOR

Having dealt with the fuelling, Holly turned his attention to the sparks and, as with all RPi's high specification units, only the Mallory Unilite would do. A name synonymous with high quality and performance, this dizzy shares the voltage equally between two sets of points, resulting in a spark which can last at least four times as long as a conventional points system - handy when my Raptor will have to deal with copious amounts of charge in very short periods of time. Another unique offering of this set-up is the adjustable advance curve which will allow the ignition to be matched perfectly to my Raptor's feeding habits. Mated to a set of high-performance 8 mm Magnecor leads and NGK plugs, all the well-known Rover V8 weaknesses in this department were addressed.

Holly demonstrated how easy it was for him to install a dizzy in a Rover block: a rather challenging and frustrating little activity for the mere mortal, as I'm sure you will agree if you have tried it yourself.



*Distributor and Magnecor leads.*



*Triple throttle bodies deliver hair-trigger throttle response.*

- **Increased torque and bhp throughout the entire rev range.**
- **Reduced heat soak from the engine.**
- **Improved induction noise.**

Combined with the Tornado chip installed in the ECU (supplied by RPi), the net result should be ... well, how can I put it? ... outstanding!

Bolting the ACT kit onto the Raptor wasn't too taxing for Holly, especially as the plan was to remove it prior to installation into my Rush to avoid damaging the sacred carbon fibre. The induction hardware erupts through the bonnet and is on show to all, making this option so well-suited to the CV460. Being constructed from carbon fibre, it should look amazing against the high-gloss black bodywork.



## THE END RESULT

Apart from the smaller items, such as rocker cover breathers and some plumbing, Holly had finished. Throughout the day numerous RPi employees - including Chris and the odd customer - had been popping their heads around the corner to see progress. Once finished, a small crowd gathered - and the

overwhelming consensus? I must be insane to install this monster in a lightweight kit car!

Before the Raptor could be delivered to my garage it had one engagement: pride of place on RPi's stand at the Retro Classic Motor Show in Essen, Germany. It was a little painful to witness my pristine V8 being whisked away so soon, but Chris assured me he wouldn't be persuaded to sell it for a

few beers and bratwurst! Next month it's back to the Dean garage and, if all goes to plan, the Raptor F85 will be sitting in my CW460. I simply can't wait ...



All finished - £14,000 to you, Sir.

### DESCRIPTION

Turn key Raptor F85 including Tremec gearbox, bell housing, clutch assembly and fly wheel. In fact everything you need including technical support.

### COST

£12,000

**TOTAL £12,000**

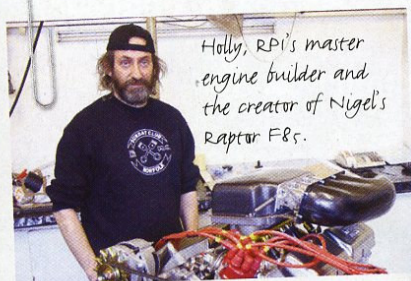
Totals to date

| BUILD                 | ACTIVITY SUMMARY  | TIME (HRS) | COST              |
|-----------------------|---|------------|-------------------|
| Part 1                | Order build packs 1 - 5   | 0          | £5,434.00         |
| Part 2                | Source and prep donor parts   | 8          | £1,410.15         |
|                       | Collect build packs from DAX  | 8          | £75               |
|                       | Chassis preparation   | 3          | £0                |
|                       | Panel chassis   | 24         | £0                |
| Part 3                | Filmit of final drive and suspension components                           | 48         | £0                |
|                       | Research into non-standard items  | 20         | £0                |
| Part 4                | Research and filmit of braking system                                     | 26.5       | £905.71           |
|                       | Handbrake and pedal box   | 2.5        | £141.00           |
|                       | Fuel system   | 10         | £580.56           |
| Part 5/6              | Extensive research into engine and gearbox specification including build. | 100        | £14,100           |
| <b>TOTALS TO DATE</b> |   | <b>250</b> | <b>£22,646.42</b> |

## A FINAL WORD ON RPI

RPi Engineering can meet every kit car builder's needs in the Rover V8 department, be it an alternator, piston set, short engine, block, carburettor kit, gearbox, bell housing kit or even a full turnkey Raptor F85. You too could get your hands on one of these very, very special engines. If nothing else, do visit their website ([www.v8engines.com](http://www.v8engines.com)) and take a good look, especially if you are considering a Rover V8 in your project. If tempted, give the guys a call on 01603 891209 and they will offer some sound, free professional advice regardless of your budget. Alternatively, access their eBay shop (via the website) and you will find a massive selection of V8 hardware, from blocks ... to pistons ... to ignition leads ...

Huge thanks go to Chris, Holly and the team for making me so welcome, for their invaluable help and for the numerous cups of coffee!



Holly, RPi's master engine builder and the creator of Nigel's Raptor F85.

## TEENAGERS TAKE

Hi there again, Evie here. Stress has finally mounted inside the garage walls this fortnight - I knew it was only a matter of time. There was the big saga of getting the engine inside the Rush. Talk about tense - it hasn't been this bad since the arrival of the kit back in the beginning.

Firstly, Dad watched the heart of his baby being built (and told us all about it in minute detail - thrilling, that was) and then it was taken by the company to a show in Germany. You'd think it was his human newborn being sent away the way he worried about it and why, can anyone tell me, all the way to Germany? I don't know, it beats me.

Shortly after its return (probably the next day if I know Dad), he had to pick the engine up and was 'White Van Man' once again. He roped in his poor 78 year old father - honestly, you'd think Dad would choose one of his 20 year old friends (ok, let's be realistic, 40 year old friends) to help him, but he always ends up dragging out poor old Pops to do the dirty work, quite literally. The other day Pops was in the garage and kept leaning

on the fuel rail. I heard Dad say, "Dad, it's not a good idea to lean on that." Five seconds later, "Could you please not lean on that, Dad" followed by "Dad, you'll brake that b\*\*\*\*y thing in a minute", etc., etc. ... Pops gets such a hard time I really don't know why he continues to offer to help. Bless him.

Oh sorry, where was I? Oh yes, once the engine arrived home and had been carefully unwrapped from the stalk's swaddling bands, it was cradle carried into the car frame. The anxious pair were kindly helped with this stressful procedure by Tim, the landlord of next door's pub (The King's Head - they serve some lovely food in there by the way, and all for under a tenner too!). who just happened to be a removals man in his previous job. How lucky was that! Let's just say I'm sure he was glad to be back behind the bar at the end of it all. I'm sure the whiskey was to calm his nerves.

So, the baby was given its heart and a momentous occasion it was too ... well, it probably was for Dad. Yey - ok, I'm over it! Don't forget to catch next month's issue - the return of the grandfather. See you then. Bubbi for now.



Nigel's daughter, Evie, with another of her Teenager's Take.