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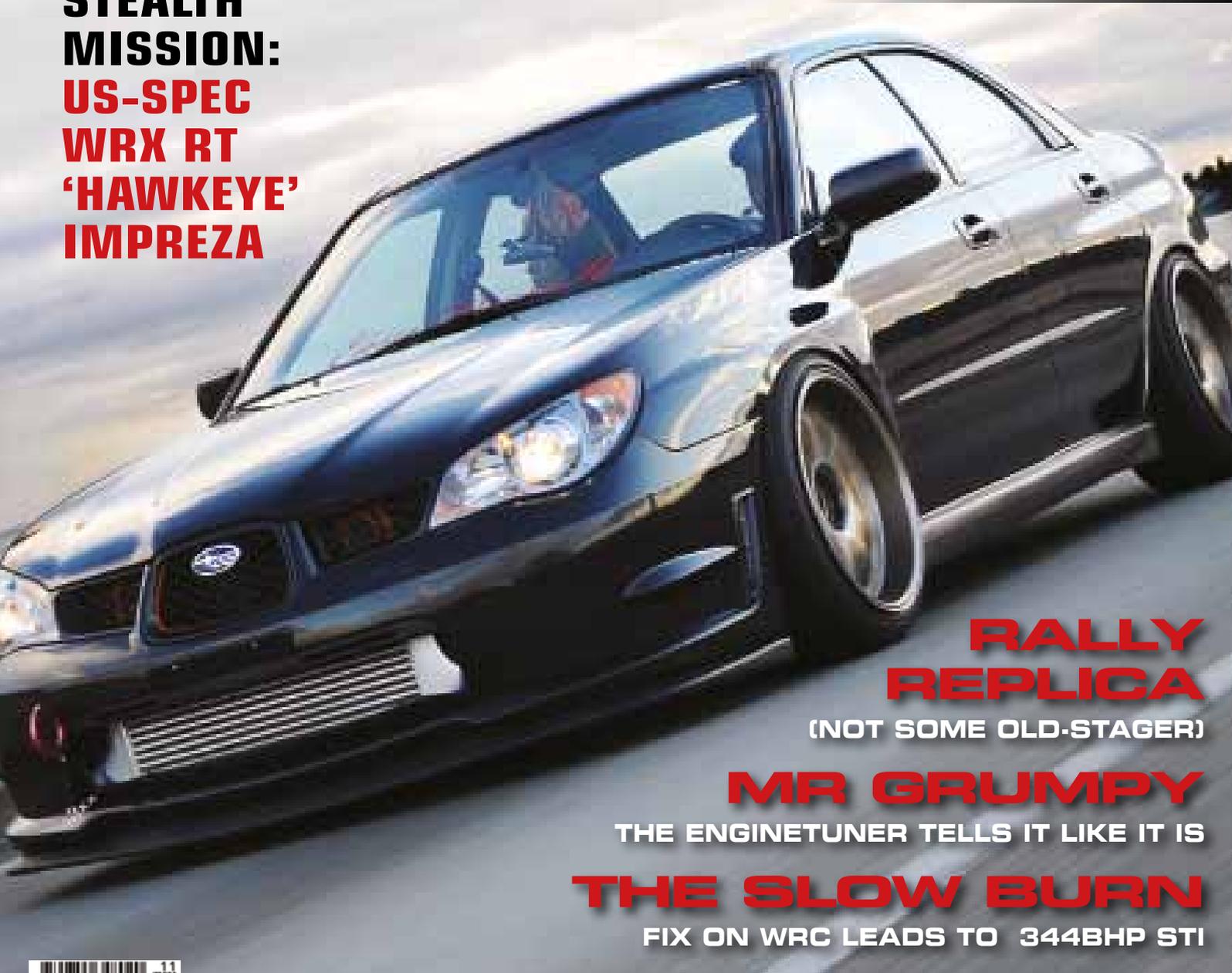
# IMPREZA

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# SEAT OF POWER

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Total Impreza reviews the top-dropped Impreza that's not!



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# THE 'INSIDER'



It was difficult to believe that I would now be working for the company that ran Colin McRae in the 555 Impreza, a driver whom I had been watching in Wales, on the Sweet Lamb special stage, the previous November. In fact, seeing and most definitely hearing the rally cars was about to become part of my daily life.

Having been employed to work on a contract with Subaru in Japan to assess, test and develop a number of confidential vehicles and dynamic control systems over a three year period, I was involved extensively in testing both in the UK and then presenting the results on a succession of visits to Japan. It was a shame that I do not like sushi.

I used Subaru's secret test facility up in the mountains behind Tokyo. It was like visiting the set of Tracy Island on Thunderbirds. There was no evidence of it existing until you spotted an unmanned security gate at the side of a hill road. I met some great Japanese engineers and managers on these visits. They always treated us like VIP's, which was a humbling experience.

## EARLY DAYS

The first Impreza I developed was what became known as the WR Sport 99. My chief and I took the Impreza Turbo, fitted with the existing performance upgrade, and looked at how we could turn it into a rally weapon for the road. The standard turbo was good fun to drive but was quite soft. It rolled significantly, there was a constant feeling of pitching and more understeer than we liked.

We went back to first principles on

the suspension, designing new springs, dampers and bump-stops. The car required specific spring rates both front and rear to give a balanced non-pitching ride. We increased the rates by over 40%. Prodrive was a service centre for Bilstein at the time, so we were able to carry out the damper rebuilding in-house. I had an expectation that the car should be able to 'jump' like a rally car. A lot of work went into the dampers and the result flew pretty well. It was an interesting element to develop and I learnt the locations of the best hump-back bridges in the vicinity of Banbury.

Along came the P1. This is the car that changed everything for me and set my career properly along the tuner path. It also got me promoted to principal engineer. I was given total responsibility for developing the ride and handling performance. It was high-pressure, definitely, but it was the most exciting project I had ever worked on. It was known internally as the 'EHPC' (European High Performance Car) with the target being the Mitsubishi EVO VI.

The brief for the suspension tune was to make a sophisticated fast vehicle, with a large amount of grip, excellent handling characteristics and a high level of driver involvement but also incorporating high standards of refinement. It was a tall order.

The Impreza and EVO were assessed on both road and track subjectively and targets were set. Each change to spring rates, damper specifications and static geometry settings was reviewed for over 120 characteristics for ride, handling, steering and NVH (noise, vibration and harshness). Every day, for many weeks, the car was driven on a route between Banbury

and MIRA, along the Fosse Way. Boy! It was fun!

There is a wet handling circuit at MIRA (a motor industry proving ground). The EHPC was fantastic to drift around it. The older cars were so much lighter and nimble and the steering was not corrupted by a front LSD, unlike the more recent examples. The car could be driven nearly as quickly in the wet, as it could be in the dry. It also worked really well on the high-grip 'Dunlop Circuit' and the very rough and contoured Ride and Handling Circuit, both used extensively by the rally team.

## STRETCHING THE ENVELOPE

As well as developing the suspension, I also carried out a range of other testing activities in the P1, including tyre clearance, for the 18-inch wheel option, high-speed cooling and all of the performance tests. Recording 0-60mph in 4.66 seconds was impressive at the time. The figures were taken two-up, with full fuel, on the horizontal straights at MIRA.

I also did the 'V Max' testing, which took place at the high speed bowl at Millbrook (another key facility). We quoted 155mph as the average maximum but recorded a best of 160.9mph. The aero-kit worked very well at providing high speed stability. Driving the car on the bowl without it, at over 150mph the front felt like it was flying over the ground and there was significantly reduced steering control. I am happy to admit that I felt more like a nervous passenger, at that point.

From then on, I developed Prodrive branded suspension kits and wheel and tyre packages for each new model of

In May 1997, Peter Cambridge was fortunate enough to be joining Prodrive as the senior chassis development engineer, just as the company opened a new engineering division to operate alongside its motorsport business as an engineering consultancy. Peter tells his story so far and we will look forward to regular insight in future issues.

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Impreza that was launched in the UK, apart from the first of the 'bug-eyes', due to commitments on a larger engineering consultancy project. All of those products were developed for the sales division and I was known among the engineers as having moved across to the 'dark side'. It was an interesting view, considering that it was the side of the company that enhanced the Prodrive image and it made a lot of money in the process. Working on the 'dark side' was the best!

The Prodrive spring kits were a popular accessory sold through Subaru dealerships. They gave significant improvements to the handling of Imprezas, changed the attitude of the car away from the nose-high stance to a more level and purposeful look, as well as providing a better ride quality. To many customers, they were good value for money.

The 2003MY WRX was a car that had fast steering response, but it was not matched by the body control. Loads of roll on the turn-in to a corner and then significant levels of understeer dulled the sporting experience. It also seemed to use nearly all of its suspension travel on any undulating road. The spring kit and revised geometry settings got everything back into balance. The roll control matched the steering response and our customer, Subaru UK, was very happy indeed.

The 2003MY STi was more of a challenge. The press reports had been critical of the ride. The cars were running a LSD in the front, which was not helping the initial turn-in, and they were getting heavier, mostly on their noses. After a great deal of testing, I achieved the optimum characteristics but had to get Subaru UK to buy into changing the front bump-stops, which were a non-serviceable item. We

always worked closely with the importer and its technical manager was the essential sign-off for any of the products. Having received his blessing, we supported it with detailed fitting instructions for the dealers.

### SELECTING RUBBERWARE

The spring kit carried on with the limited edition WR1, with some changes made to the rear spring design. This model introduced the driver controlled centre differential (DCCD) to UK cars, which gave greater control of the handling in various road conditions. It was very good in the snow, I recall. I did a lot of tyre testing on this project to select the ultimate 225/40 R18 tyre to match the classic Prodrive PFF7 wheels. The Pirelli PZero Nero gave the best overall performance and, with revised geometry settings, made the car very involving to drive. It received great press reviews with a lot of praise for the ride.

The 2005MY Impreza was heavier and a complete new approach to the STi spring kit was required. Significantly stiffer springs, than I had used before, were required but we got the understeer under control and made it a fun, confidence-inspiring vehicle. We developed a larger tyre package for the car going up to a 235/40 R18 for the first time. Tyres from all the major brands were tested and I selected the Michelin Pilot Sport 2 as the best overall tyre. Performance in the wet was superb, and a great deal better than the standard fit Bridgestone RE070. I had to tweak the front tyre pressures by 0.1bar to keep the initial steering responses required.

The WRX had changed to inverted mono-tube struts and I used the replacement STi front bump-stop together with the existing spring designs to fine-tune the ride and

handling. Revised geometry settings were created away from the factory specification to fine-tune both handling and steering. The press liked it, stating that the 'ride had been transformed'.

The RB320 limited edition was an emotional one for all of us at Prodrive and Subaru UK. Richard Burns had been a great driver and ambassador for rallying. I engineered a new wheel for the RB320. It was styled in-house at Prodrive and manufactured by Rim Stock in the UK. It was good to be working on a completely British product. The GT1 8.5 x 18" rim was designed to be as light as possible. Many detail changes were made to the finite element analysis and full rig-based durability and impact tests were carried out.

The S204, available exclusively in Japan, had been a significant influence on the project. With our contacts at Pirelli from the engineering consultancy we were able to have the special Pirelli Corsa System tyre homologated for European use that had been developed specifically for the car in Japan. As this car was a very significant limited edition it was decided that a bespoke suspension would be created for it. This included revised spring rates and ride height, Bilstein dampers and an adjustable rear anti-roll bar.

The damping rates were based on those of the S204, which was deemed to be the best handling STi to date. Personally, I designed the rear anti-roll bar to be adjustable, so the car could be made more exciting for those owners indulging in on-track activities. Petter Solberg drove the car and really loved its handling, especially with the bar in its stiffest setting. The whole car was a fitting memory to Richard.

The final limited edition Impreza to be created by Prodrive was the GB270. It



The GT1 wheel at home on the track



An early rendering of the GT2

The P1 driven to the country  
for action again.....



> was a combination of existing parts and a new wheel and tyre package. A 7.5 x 18" version of the GT1 was engineered and I performed a tyre selection exercise to come up with the best compromise. Pirelli had made some revisions to the PZero Nero and this was by far the best tyre overall.

#### NEWCOMER WEIGHS IN

The new hatchback version of the Impreza, which arrived in 2008, proved to be a challenge. I had just employed a development engineer to work with me on the suspension tuning side and I used these vehicles as a platform on which he could learn. We attempted to create a spring kit for the new WRX but the changes made to the damping by Subaru gave us no headroom to run anything stiffer and I had to hold up my hands and say we could not offer something better than standard.

Yet, we enjoyed successes with the STi. Our technicians fabricated a set of height adjustable coil-overs out of a standard set of dampers and we tested a range of spring rate combinations using Eibach main and tender race springs, until we were happy that a significant advantage over the standard car could be offered. The rear had a tendency to bounce back up in the air after a single large input. The Group N rally engineers had spent a long time trying to resolve the issue. We came up with a spring design and bump-stop that, while not curing it completely, reduced it to a more acceptable level.

The spring kit, with new geometry settings, made a great difference to the car, reducing the level of roll and understeer and also improving the steering response a little. I engineered a new 19-inch wheel, the GT2, which was again styled in-house and manufactured by Rim Stock. We

followed the up to date style of five thick spokes splitting into 2 as they met the rim. They were optimised to be as light as possible and we think that they worked well with the modern shape of the STi.

While I was at Prodrive I was responsible for the ride and handling of a number of limited editions for other manufacturers, including the Fiat Stilo Schumacher GP edition, Mazda RX-8 PZ, Alfa Romeo Brera S and the Prodrive Aston Martin V8 accessories lines. I am pleased to say that all of these went down well with the press and the owners I have met really appreciated the work that went into creating them.

I am now running a small engineering consultancy, PCA Dynamics, and continuing to tune road cars and produce up-rated parts, while carrying out a variety of other tasks from consulting on the dynamics of military vehicles, to setting-up geometry. I have also been doing some presentations and magazine articles on tuning and vehicle dynamics for various car clubs. I hope to make OE quality products and knowledge available to the enthusiast.

One area of benefit to the Impreza community is a project I am working on with the tyre retail chain Protyre. We are putting together a car club-based scheme for setting up the static geometry of cars, using the latest camera-based technology. The difference in how a car drives, when the geometry is set correctly is surprising.

Many of the owners of cars I have set up recently email to tell me that their car is transformed and they have much better steering responses and greater confidence



to drive quickly. For cars like the Impreza, the figures I developed for the various kits and limited editions will be used, so models from the classic WR Sport and P1 to the RB320 and 08 STi will be catered for. The scheme will be running in the New Year and I am organising group events currently through the Warwick Protyre site and I am there to discuss specific settings for particular uses or modifications. Please look at my website for details.

I am also supplying OE quality bump-stop kits to suit many modified vehicles including the Impreza range. These have proved critical in getting the cars to handle and ride well, especially when lowered. I have learned a lot over the past 12 years and I am currently looking at the feasibility of producing some revised suspension kits for the older Impreza models, some more extreme set-ups for track day use and also road versions that address some of the compromises we found years ago. Hopefully I shall continue to be surrounded by that classic flat-four burble.

#### CONTACT

Peter Cambridge  
Tel: +447827778743  
Email: peter@pcadynamics.com  
Web: www.pcadynamics.com