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Editorial

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Scrap metal down

▶ The price of scrap metal has recently dropped to a low of £20 per tonne, according to my local recycling centre. Compare that to six or seven years ago, when we were being offered up to £250 per tonne. Throwing away our worn-out bangers was advantageous back then. Now, though, a small hatchback would probably gain you £10, if you're lucky.

Obviously, there are pros and cons when scrap becomes this cheap across the UK. The negative effect of low scrap metal prices is that our steel industry is forced to lower the price of the new steel it produces, consequently making little or no profit. Not good for our export business, especially when we have to compete with cheap Chinese steel being sold on the open market.

China is also partly responsible for our low scrap prices in a more direct way. As China is the country to which most of our scrap metal is exported, the fact that it is undergoing an economic downturn means there is less demand. We're screwed both ways.

When the price of scrap was high, scrap merchants would actively seek out vehicles for scrapping, offering to collect your old motor for free. That's all changed as there's no point in the recyclers offering this service. Will this mark the return of dumped vehicles on our wasteland? We shall see...

A couple of positives I can see from cheap scrap prices is that secondhand vehicles at the bottom end of the market have become even cheaper. It's perfectly possible to pick up a roadworthy motor for around £200 these days. And if you have discarded spare parts lying outside your garage or on your driveway, at least it's unlikely that anyone will want to pinch them!

Of course, it's not just vehicles that are recycled for scrap profit. Those electrical white goods we have in our household were also once money makers. The trouble now is that taking a washing machine or cooker to the recyclers is hardly worth the trip, hence we may see a rise in fly-tipping.

I've always recommended storing any 12V batteries you are discarding, rather than dumping them at the local council tip. They are worth money, after all. Even with the price of scrap metal so low, you can still get around £2.50 per battery. If you get friends and neighbours to give you their dead batteries too, it could make you a tidy amount of money.

Flooding the market

Talking of scrap cars, I'd just like to point out that it's likely that a lot of those vehicles caught in the recent winter floods across the country will now be appearing on the secondhand market – dried out, of course. Many will be classified as Cat B insurance write-offs and won't be returning to the road. However, others will be identified as Cat C or D write-offs and it might not be obvious they were submerged in filthy water. Some flood-damaged stock might only be classified as 'unrecorded', so be sure to carefully inspect any vehicle where it seems like the price is too good to be true. Check the carpets and under the rear seat/boot area for signs of stale water residue. There could well be a contamination risk from vehicles that have suffered this fate.

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The low price of scrap metal is causing scrap merchants a bit of a problem – they are holding too much stock!

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MODERN-DAY Decoking

In making engines cleaner, they have become dirtier. This irony is not lost on **Rob Marshall**, as he looks at modern decoking techniques that do not demand an expensive engine strip.

One might have thought that decoking had been banished to the history books long ago. At one point, it was normal for engines to require a semi-regular tear-down to remove carbon that had accumulated on the pistons and valve-gear. The procedure was necessary because carbon and sludge, both of which are byproducts of combution, built-up on the engine's operating parts, restricting either their movement or interrupting efficient airflow. Not only can these issues reduce reliability, efficiency and engine life, but emissions and fuel consumption can also increase.

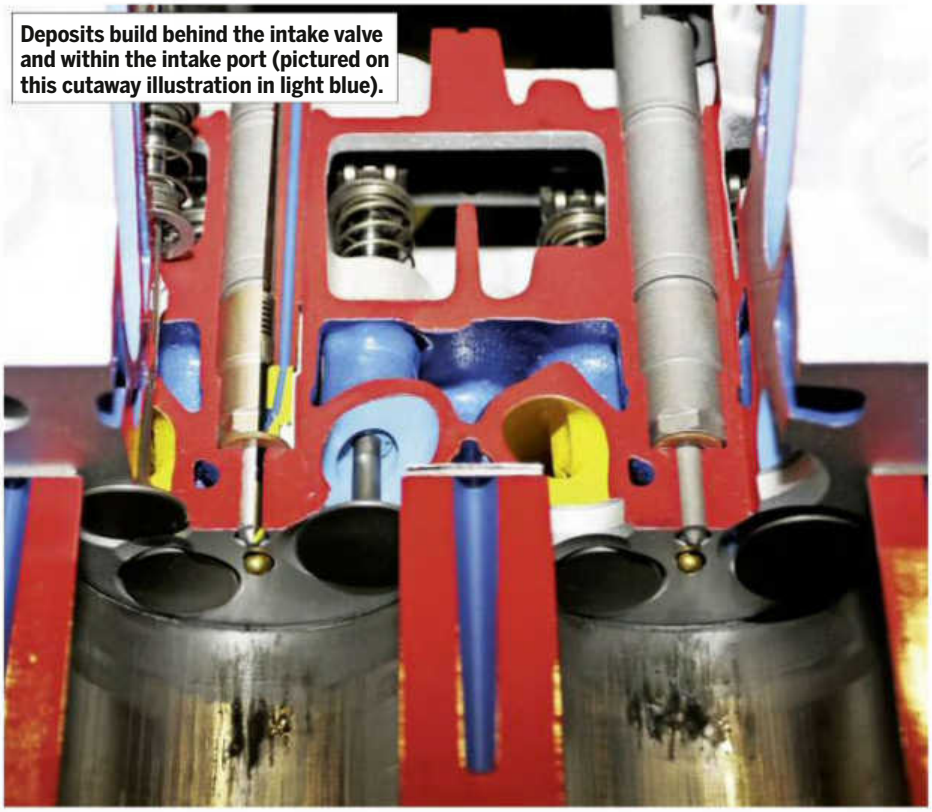
Is this progress?

Over the years, cleaner fuels, enhanced lubricants and better engine design have negated the need for regular decoking. At the same time, engine designers have increased engine power, while decreasing fuel use and overall exhaust emissions. Heightened complexity is the main cost of these seemingly incompatible achievements, along with a greater tendency for combustion deposits to build within the engine, from its air inlet to the sump. Sadly, the situation even afflicts engines that have been well-maintained, although neglected units suffer to a greater extent. Consequently, decoking has made a comeback, albeit with several modern twists.

Should you decide to dismantle an engine to deal with other faults, it is prudent to clean the internal components, especially as evaluating their condition will be easier, plus the risk of old contaminants shortening the life of a rebuilt unit will be reduced. Despite decarbonising being a straightforward process, when an engine's parts are laid out on a workbench, stripping the unit to deal with the issues alone is time-consuming and not cost-effective. Thankfully, a number of recent developments enable you to remove deposits from certain parts of the engine without having to dismantle the engine block and tear down the cylinderhead.

◀ **EGR valves and inlet manifolds can be cleaned manually, using solvents that can range from inexpensive brake cleaner to aerosols containing bespoke EGR cleaner.**

▶ **If cleaning out the intake with solvents, ensure that all traces of the cleansing vapour have been removed before refitting the parts to the car.**



Deposits build behind the intake valve and within the intake port (pictured on this cutaway illustration in light blue).

Dr Helmut Leonhardt of Shell Lubricants revealed that car-makers require that lubricant manufacturers develop products that minimise inlet valve deposits.

Starting at the top

One of the major ways in which engineers have enhanced efficiency in small capacity petrol and diesel engines has been to install direct injection. In the case of petrol engines, non-direct injection (port injection) relies on the fuel injector being situated behind the intake valve and the continuous contact with the solvent keeps the area clean. Once direct injection design relocated the injector within the cylinder, this 'washing' effect was removed.

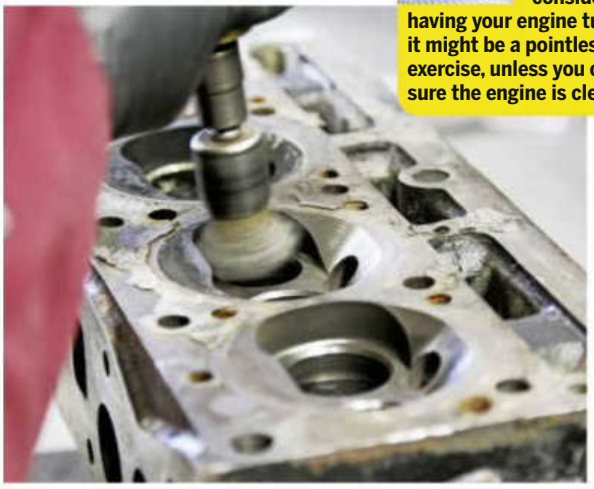
Although carbon results from burning petrol and diesel, engine oil can pose a greater problem. In theory, an engine should not consume its lubricant, but production tolerances, breather design and wear mean that all vehicle engines burn oil to a degree. As an engine is not permitted to vent toxic crankcase gases into the atmosphere, they are recirculated through the breather system and into the inlet tract. Inevitably, some engine oil vapour is carried along, too. Some enterprising enthusiasts try and negate the issue, by integrating an oil catch tank into the crankcase ventilation circuit, to separate the lubricant from the blow-by gases. Catch tanks (or 'cans') tend to have limited success, depending on the make and model of car. The tanks also require periodic emptying, which is another reason why they are not used on mainstream production vehicles. Valve stem seal wear exacerbates the problem, because oil seeps down the valve stems, then carbonises and builds on the rear of not only the inlet valve but also, potentially, the exhaust valve. Excessive oil consumption will also damage post-treatment devices, including diesel particulate filters (DPFs) and catalytic converters.

Viscosity improvers are a vital component of engine oil blends, yet they are responsible for starting the process of inlet valve deposits on many direct injection engines.

ROB'S TOP TIP

If you are considering having your engine tuned, it might be a pointless exercise, unless you can be sure the engine is clean.

◀ Poor engine design and excessively long oil change intervals can result in sludge accumulating within the lubrication system, including the sump.



▶ One can remove carbon from pistons and cylinderheads manually, but the dismantling process is expensive. TerraClean removes carbon chemically.

Exhaust gas recirculation (EGR) valves pose an additional complication. The system was introduced as an effective means of increasing engine efficiency (by reducing pumping losses), while driving down NOx emissions. Unfortunately, as hot, untreated exhaust gases flow from the EGR valve and into the inlet manifold, the existing sticky oil film attracts certain exhaust gas deposits, including carbon. The build-up restricts not only the ports' diameters but also inlet manifold swirl flap movement, on engines thus fitted. Fortunately, the deposits can be scrubbed out with a suitable cleaner, which necessitates removing the inlet manifold. Despite being messy and time consuming, the procedure is a fairly straightforward DIY task.

The intake tract, within the cylinderhead of a typical direct-injection engine can be even harder to clean. Not only does a narrow port present an access problem, but the higher temperatures involved also bake the oil deposits onto the back of the intake valve, which acts subsequently as a 'fly-catcher' of unburnt particles from the incoming exhaust gases. The result is a rubbery accumulation that is incredibly difficult to remove.

Dr Helmut Leonhardt, Shell Lubricants' team leader for the development of engine oils in Europe, revealed to *CM* that inlet valve deposits are not a new problem. He tackled the issue for his PHD in the mid-1980s: "Over 30 years ago, lead oxide built-up on the rear faces of inlet valves, which is a porous deposit that absorbed the incoming fuel; the biggest deposit that I ever removed from the back of single inlet valve in those days weighed a whopping 4.5 grammes."

Helmut admitted that, when indirect injection was used in conjunction with new additive blends of unleaded petrol, the issue of intake valve deposits disappeared. However, the advent of direct injection and the various demands to reduce oil viscosity for efficiency and emissions reasons have seen the problem resurface.

Carbon build-up within the cylinder can ignite the fuel/air mixture at the wrong moment, resulting in poor running and, possibly, damage to the engine.

Crushed walnut shells

Dr Leonhardt says: "Today, intake valve deposits are caused primarily by viscosity improvers within the oil blend, which become baked onto the hot inlet valve and are burnt subsequently by incoming exhaust gases from the EGR, causing the deposit to carbonise and trap further deposits. Here at Shell, we develop lubricants for car-makers and many of those engine oils have to pass an intake valve deposit test, to comply with manufacturer-set specifications."

As intake valve deposits are a consequence of many direct-injection petrol engine designs, knowledgeable owners can reduce the problem. As it is illegal to disable pollution control equipment, we do not recommend removing the EGR valve; even if you were to do this, it would not provide a solution, because oil can still enter the inlet via the breathers. Rerouting the system and venting the gases straight into the atmosphere is also an offence and may lead to unpleasant odours permeating the interior of the vehicle.

A potential option is to select a lubricant with fewer viscosity improvers, the cause of the initial build-up, which will be present in oil with a bigger differential between its cold and hot viscosity grades. For example, this means that a 0w30 oil is likely to contain more viscosity improvers than one with a 10w30 grade. This is not an excuse for you to stray outside of the recommended oil viscosity for your engine – always stay within the car-maker's parameters.

Unfortunately, post-combustion fuel additives, water injection and even solvent cleaning tend to be ineffective. Firing abrasive particles under pressure into the inlet may also cause damage, especially if grains of the fine grit stray into the combustion chamber. Fortunately, crushed walnut shells have provided a solution, as they are tough enough to remove the deposits, without scoring the metal surfaces.

While the procedure is not a DIY task, it is a significantly cheaper option than dismantling the engine. As the PSA/BMW 'Prince' series of 1.6-litre direct injection petrol engines seem to be particularly prone to inlet valve coking, this operation is common for MINIs built around the R56 platform – even some main dealers carry out the work.

Given their experience of dealing with the problem on both MINIs and BMWs, we approached SWSS MINI of Cardiff for its insight into what the operation entails and how effective it can be. This is the first time that the photographed 2007 Cooper S had been subjected to the operation in its 75,000 miles of existence.

WALNUT SHELL CLEANING

1 **The French direct-injection petrol engine, used in MINIs from 2006, as well as various Citroëns and Peugeots, is particularly prone to inlet valve deposits.**

2 **The blast medium is crushed walnut shells. They are considerably less abrasive than conventional beads, used for shot blasting, so they will remove carbon without damaging soft aluminium castings.**

3 To gain access, the air filter box has to be removed, along with its associated ducting. If choosing an aftermarket filter (such as this K&N unit), ensure that it is well maintained and do not over-oil...

4 ...because unfiltered contaminants will end up in the inlet, possibly adding to the deposit. Remove any breather pipes carefully. On the MINI, the throttle body also needs to be removed.

5 Unscrew the bolts and/or nuts that retain the inlet manifold to the cylinderhead. Remove the part from the working area, ensuring that any separate gaskets, if fitted, are discarded.

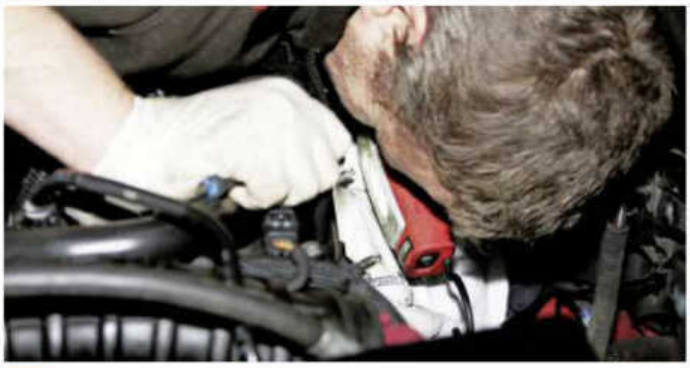
6 Remove the spark plugs (plus the coils, if necessary), which will make the engine easier to turn over by hand. Store them carefully, so that they cannot be damaged. After engaging a forward gear...

7 ...insert a screwdriver into cylinder No 1 hole. As the offside wheel is rotated, with the nearside chocked, the screwdriver's highest point indicates when top dead centre has been reached.

8 Although walnut shells are soft and non-abrasive, precautions are taken at SWSS MINI of Cardiff to reduce the chance of any ingress, by plugging any intake pipes with non-fluffy cloths.

9 The tool-end is bespoke to the engine type, because it must form a tight fit inside the cylinderhead's inlet tract. Fitted to the tool is both an injector and a suction device.

10 As the walnut shells are fired into the port, the technician will direct the flow, by manipulating the nozzle's angle. Afterwards, he, or she, will turn off the flow and vacuum out the remaining particles.

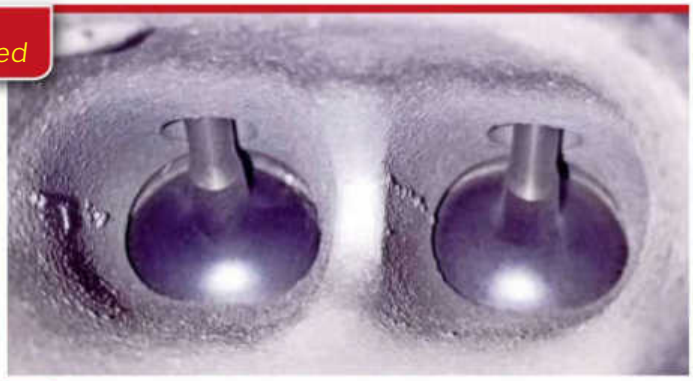


11 After the tool has been removed, the technician will inspect how clean the inlet track has become. Based on this, he or she will decide whether or not the process needs to be repeated.

12 For comparison, this was the initial state of the MINI's inlet system. The deposits were fixed firmly to both valves, restricting the incoming airflow within the port.

WALNUT SHELL CLEANING *continued*

13 After the first session of blasting, which took approximately 10 minutes, the technician decided that the process had to be repeated, because not all of the deposits had been shifted.

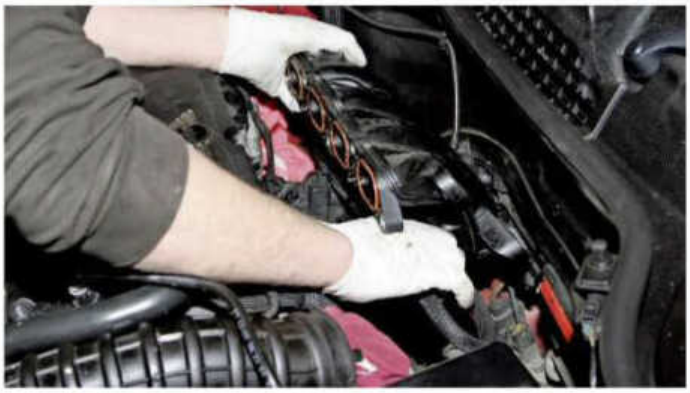


14 After a further five minutes, the deposits had been removed entirely, with the intake restored to as-new condition. It is important to verify that no walnut shell traces are left behind.

15 Pictured are particles that were dislodged by the walnut shells. With their rubbery consistency, they are difficult to remove and affect the engine's performance.

16 The process is repeated on cylinder No 4, followed by No 3 and No 2. The entire procedure takes approximately four hours, working on a four-cylinder engine.

17 Prior to refitting, the inlet manifold gasket must be renewed. On the MINI, these consist of replaceable rubber rings that locate into the moulding's recesses.



18 The protective rags are removed and the spark plugs and coils refitted. The inlet manifold can be reunited with the cylinderhead, along with the throttle body (if necessary) and ducting.

19 Before the engine is restarted, it is checked for error codes. If any are found, they are reset and checked afterwards for any reappearance. In this case, no codes were found.

20 As the engine ECU is self-learning, its values must be reset, to permit the engine to work at its factory-set values, now that its inlet ports have been restored to as-new condition.

21 The engine is run in the workshop for several minutes, while the technician checks for any new fault codes and analyses the live readouts. The car is road-tested afterwards.

Continued on page 12

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Chemical combustion chamber cleaning

Evaluating the many fuel and oil additives on the market is an almost impossible task. To investigate a more concentrated, direct and quicker cleaning procedure for fuel injectors and the combustion chamber (including the piston crown), both of which tend to be inaccessible without major engine dismantling, we turned to TerraClean, a Canadian-developed product that is promoted to the UK's motor trade by Randstad of Cramlington, Northumberland.

The procedure involves disconnecting the engine from its fuel supply and reconnecting it to a dedicated machine that contains a mix of the appropriate fuel and the company's cleansing solutions. For commercial reasons, one can understand why Randstand does not reveal the exact composition of TerraClean's cleaning mixtures, preferring to use the vague explanation that the car is run on "negatively charged, highly-refined fuel... which will collide with the positively-charged particles, normally found in the combustion process." At the time of writing, the description on the importer's website of how the procedure works is even more elusive.

ROB'S TOP TIP

Keep the engine's breather system in order, including cleaning out any breather gauzes.

When *CM* looked first at TerraClean's claims, shortly after its UK debut in March 2013, contributor Steve Hole provided evidence of an approximate 20% reduction in smoke opacity emissions on his tuned 2003 BMW X5 3.0 diesel. In the case of my own car – a well-maintained 2007 Citroën C5 2.0 16v HDi in stock specification and with 80,000 miles – I consider a smoke emission test as not being a very accurate means of assessing the treatment's effectiveness, because the car is fitted with a DPF, which would trap any freed carbon. Also, it is easy to fall victim to a placebo effect, when assessing any real-world performance difference. Nevertheless, I found an obvious difference post-treatment, in that my car's clutch started to slip on full-throttle applications immediately on my return journey, which I can only theorise was caused by the slight increase of torque being liberated. While this is a good thing, be wary that the TerraClean treatment could highlight mechanical deficiencies after its cleaning process has worked its 'magic', despite not being the root cause.

My own experience, like that of many others, is non-scientific, so we requested that Randstad provide independent evidence to confirm TerraClean's claims. As the company is planning to obtain such results later this year, it could not supply us with any independent, substantive evidence to back up the claims further. Despite this magazine's positive past and current findings, we advise that you weigh up the anecdotal evidence and come to your own conclusions.

To demonstrate the procedure, we approached Scotlands Ash Garage in Didcot, Oxfordshire, to treat my Citroën HDi and a 2003 Volkswagen Passat 1.9 PD diesel, which had over 220,000 miles recorded. TerraClean recommends that the treatment is carried out every 15,000 miles as a preventive measure. The cost of having the work done at each or every second service represents a big increase in maintenance costs, which many people would (understandably) find hard to swallow. It could be argued that the procedure would be more worthwhile as a preventive measure on a vehicle that covers a low annual mileage, primarily in urban conditions.

TERRACLEAN PROCEDURE

1 With the engine switched off, the plastic covers are removed to give full access to the fuel system. As it requires a power supply, the TerraClean machine is connected to the car's battery.

2 The car's fuel injection system must be isolated from the fuel tank. The low-pressure pipes are disconnected and plugged, where necessary, to prevent any external contaminants from entering the fuel system.

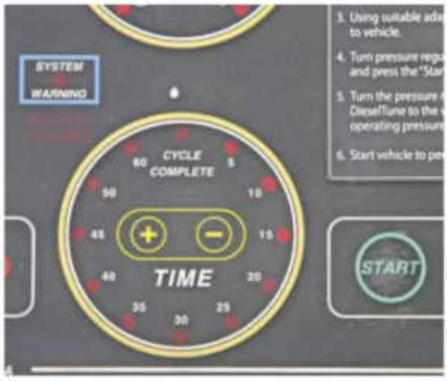
3 This VW PD engine employs a low-pressure lift pump, immersed within the diesel tank. To separate the car's fuel tank from the injection system, the intake and return pipes from the tank are connected together.

4 As our Citroën does not employ an in-tank lift pump, only a single diesel pump on the engine, there is no need to create a return circuit; only connections to the machine's inlet and return are necessary.

5 With the pipes connected to the TerraClean machine, the operator ensures that the internal operating pressure matches that of the vehicle fuel line, negating the risk of the vehicle generating a fault code.

6 Ensuring that the engine is warmed fully, its speed is held at a constant 2000rpm for 15 minutes, to allow carbon, varnishes and tar deposits to be loosened from the injectors, pump and combustion chambers.

7 During this process, some tailpipe smoke may be emitted on cars without DPFs. The engine coolant temperature is also monitored continually, to ensure that overheating does not result.



8 The exact cycle time can vary, depending on the vehicle make, model and engine size. When the engine has completed its 15-minutes run, it returns to idle for a further two minutes...

9 ...to allow the turbocharger to slow and its heat to dissipate. The engine is then switched off for a further 15 minutes. This 'soak' period utilises the last unburnt injection pulse to loosen carbon from the piston crowns.

10 The operator restarts the engine and runs it at 2000rpm for a further 15 minutes, before allowing the unit to idle again, prior to switching it off. The TerraClean machine is then disconnected from the vehicle. The car is road-tested. On DPF-equipped vehicles, the released carbon can become lodged within the filter, making it necessary for the vehicle to be treated to a long run at a sustained speed and load, to allow the filter to regenerate.

11 TerraClean has developed other processes, including exhaust gas recirculation (EGR) valve cleaning. Here, the tool is attached to the EGR cooler, which drives cleansing fluid towards the valve.

12 An EGR valve prior to being treated. This one is not especially dirty, although some units can coke up significantly, restricting the valve's operation and resulting in an illuminated engine warning light.

13 Post-treatment, the EGR valve appears completely cleansed of carbon, without any dismantling being necessary. While cleaning can extend the part's life, it will not prevent solenoid failure, for example.

14 TerraClean has also developed its own DPF cleaning, which drives fluid into the filter, by attaching the pictured insert into one of the pressure differential sensor pipes.

The 'wet' side

To look after the lubrication system, all you need to do is change the oil and filter regularly, a function of which is to hold many of the by-products of combustion in suspension, preventing them from being deposited within the engine and causing damage. As modern oils have a greater tendency to 'stick' to the internal parts – which is desirable to reduce the rate of component wear on cold start-ups – as the oil pressure builds, the suspended contaminants are less likely to fall into the sump. The problem is exacerbated, thanks to long service intervals making the oil more likely to become over-saturated with deposits, leading to the formation of sludge that can build-up not only on the exposed metal surfaces but also within the lubrication system's innards. Furthermore, the greater effort that is needed to pump the oil around the engine is one way by which efficiency decreases and running costs rise as a car ages.

Although many people use oil flush additives to resolve the problem, some owners believe they might free-up deposits to wreak havoc in other parts of the engine, especially in a poorly maintained unit. Furthermore, a proportion of the flush will, inevitably, remain inside the castings after the sump plug is replaced. While not wishing to become embroiled too deeply in this debate, EDT (Engine Decontamination Treatment) Automotive of Ashford, Kent, argues that its US-developed decontamination/detox process (it prefers not to use the term 'flush') provides an answer to the last point, mainly because its cleansing solution is sucked out of the engine. Arguably, the success of this depends on the sump drain hole location, which is not always at the lowest point on the pan. Even in this case, EDT Automotive reports that any remaining cleansing fluid, which is both non-acidic and non-toxic, will be negligible and in a far smaller quantity than that of the old oil and flush.

Last year, EDT Automotive won a Green Apple Environment Award for its technology, which pulses the engine's lubrication system with a pre-heated, soya-based cleansing fluid. Since its UK introduction two-and-a-half years ago, the company has treated approximately 20,000 vehicles and, while a 2012 Mercedes-Benz SLK 250 2.2 diesel is our guinea-pig, the oldest vehicle EDT has treated is a 1974 MGB, while the highest-mileage example was a London Taxi TX1 with 470,000 miles.

As with Terraclean, many positive reviews exist, but where is the proof?

CM has intercepted a batch of independent MoT emissions data, which backs up the company's claim of substantial pollutant reductions, based on pre- and post-treatment results. However, we also have to consider that new oil will also make a positive contribution to those results. Even so, the figures are impressive. A 10-year-old Jaguar S-TYPE diesel saw its average smoke opacity reduced from 0.66m(-1) to 0.07m(-1), while a 10-year-old, 81,000-mile Ford Puma 1700cc petrol saw its carbon monoxide levels reduce from 0.08% (still within MoT pass limits) to 0.02%. A more detailed emissions test found the hydrocarbon emissions of a 1995 BMW 318, with 132,000 miles, drop from 307ppm (parts per million) to 25ppm, although its CO_2 emissions rose slightly by 1.25%. EDT Automotive also showed us independent dynamometer readings, revealing a 2.4% increase in horsepower, after a 1997 Alfa Romeo 2.0 Twin Spark was treated. A 2003 Chrysler Crossfire 3.2 also realised a 3.1% increase. Fuel economy differences are only based on anecdotal feedback from customers, however.

EDT Automotive also claims that customers have reported other unofficial benefits, including reduced (or cured) cold-start top-end and timing chain rattle. While main dealer rates for the operation tend to be higher, independent garage quotations start from £99 inc VAT. Like the Terraclean treatment, however, this can raise the cost of a typical service significantly and EDT Automotive recommends retreatment intervals at 20,000-25,000 miles.
We must also highlight that an EDT treatment treats the lubrication system only and not the pre-, post- or 'dry' sides of the engine. Additionally, because our demonstration Mercedes SLK 250 is fitted with a DPF, conducting our own smoke opacity test would have been pointless, because the pre-test figures would have been too low to give an accurate comparison.

EDT TREATMENT PROCEDURE

1 As well as independents, certain main dealership groups have adopted EDT machines. We are grateful to Inchcape Mercedes of Stratford-Upon-Avon, which demonstrated the procedure on one of its sales cars. The EDT procedure pumps warm, pressurised fluid via the oil filter housing. More recent vehicles rely on cartridge-type filters, of which there are many types, but EDT Automotive has made adapters suitable for most engines.

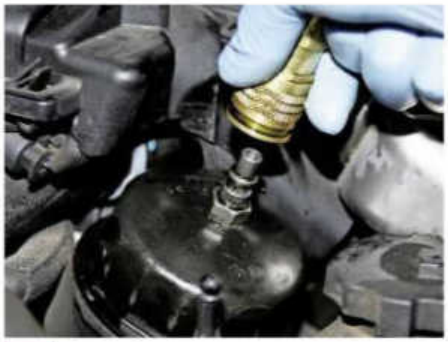
2 Older cars that are fitted with cartridge-type filters are not left out; they require a different adapter and threaded collar.

3 The engine must be warmed, prior to the oil filter being removed, the sump bolt unscrewed (note the plastic pan on this Mercedes) and the old lubricant captured in a suitable receptacle for recycling.

4 Once the oil flow has ceased, a special threaded adapter is screwed into the sump, connected in turn to an extension pipe, through which the cleansing solution returns to the EDT machine for filtering.

5 The machine is equipped with four filters. A non-replaceable gauze within the machine (pictured), two canister filters of five microns thickness (one used for petrol treatments, another for diesels), that are renewed every 40 treatments.

6 Finally, another five micron filter (a typical oil filter is around 25 microns) is renewed by the technician after each treatment. The machine also contains two canisters of soya-based cleaner, one for petrol, the other for diesel engines.



7 The soya fluids last for 40 treatments, before they have to be renewed. The filters have to be of such fineness to ensure that one engine's contaminants cannot affect others. An oil filter adapter is fitted and connected to the machine.

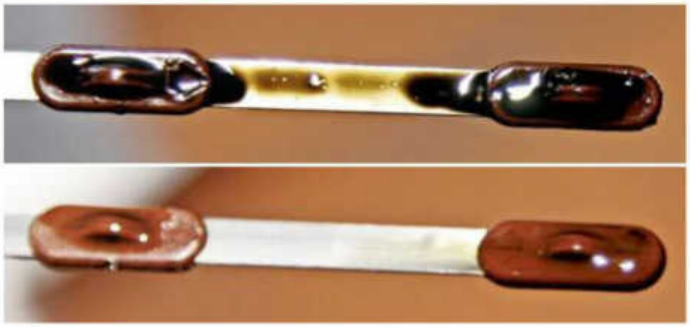
8 As separate soya fluid tanks are used for petrol and diesel, the operator selects the appropriate cycle. To start, the machine pulses the solution, heated to 42°C, through the engine at 40psi for 90 seconds.

9 As the soya-based solution is sucked out via the sump plug, it passes immediately through the single use filter (pictured), then the gauze, prior to returning to the main tank. After all of the cleansing fluid is sucked...

10 ...from the engine, the soak stage sees 4.5 litres of fluid passing through the appropriate canister filter into the sump, which soaks for a minute, before being sucked out in the third stage.

11 The three stages are repeated twice and the machine's hoses are cleaned. After the replaceable five-micron filter is removed and allowed to drain, trapped particles are evident. In the photo you can see the difference between a used and new filter.

12 The machine's adapters are removed from the car, the sump plug is re-torqued, a new oil filter is installed and fresh lubricant added. The engine is run for a minute, before being switched off and the oil level re-checked.



13 Note the difference in dipstick cleanliness, both pre- and post-EDT treatment, after the engine had run for 60 seconds. This might not be the case if not all parts of the lubrication system are reached, such as oil coolers; this is because the cleansing solution is not sufficiently hot to open their thermostats.

COSTS

WALNUT SHELL DECOKE

Cost provided by **SWSS Saab, BMW & MINI**, Unit 2 Lewis Court, 50 Portmanmoor Road, Cardiff CF24 5HQ. **www.swssmini.co.uk** 029 2047 3040. MINI petrol and diesel – **£259.00 inc VAT**
BMW 6-cylinder diesel and petrol – **£299.00 inc VAT**

TERRACLEAN

TerraClean treatment costs vary. To find your local agent, visit **www.terraclean.co.uk/find-a-local-agent** or call 01670 706203. RRP: Cars up to 2.0-litres **£108.00**; Cars above 2.0-litres **£126.00**.

EDT TREATMENT

EDT treatment costs vary, depending on local labour rates. Prices usually start at **£99.00 inc VAT**, plus oil and filter change cost. For more information, see **www.edtautomotive.com**

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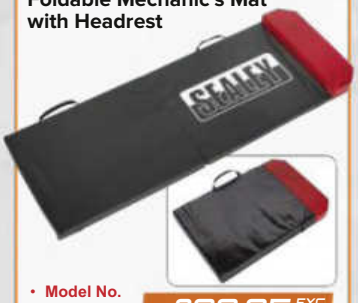

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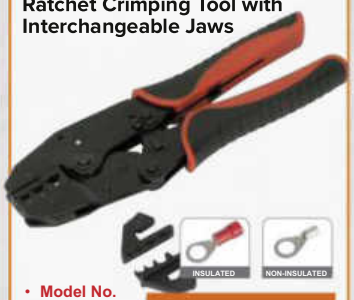

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CM Insider

Dave Taylor brings the latest news and product news

Practical Classics Resto Show kicks off

▶ **The Practical Classics Restoration & Classic Car Show** will be taking place at Birmingham's NEC on 5/6 March, with over 700 classics cars from rusting wrecks to concours winners on display.

This year's event promises displays from more than 120 car clubs, plus a wealth of practical advice and demonstrations. As well as classes for novices and masterclasses for those looking to enhance their skills, there will be seminars offering expert advice and special guests doing demonstrations on the live stage. There will also be trade stands for marque specific retailers, along with the UK's biggest indoor spring autojumble.

Motoring celebrities lined up to appear include *Wheeler Dealers'* Mike Brewer and Edd China, as well as Fuzz Townshend from *Car SOS*. The Sporting Bears will be offering Dream Rides in a British Sports classic or Italian supercar in exchange for a donation to charity.

The organisers have promised to have the UK's biggest display of barn finds and they're aiming to beat last year's mix of 25 vehicles found in various states of (dis)repair. You can also see the latest restored cars in the Lancaster Insurance Pride of Ownership display.

CAAR
www.caarparts.co.uk

If you are looking for a classic or project, Silverstone Auctions will be selling some of the best the market has to offer, while the UK's top dealers offer classics to suit all depths of pockets.

Advance tickets are available for £14 per day or £23 for the full weekend.

For full ticketing info and booking details, visit **www.necrestorationshow.com**

Chicago Pneumatic CP7711 ¼in Butterfly Impact Wrench

1 TO GIVE AWAY

▶ Joining Chicago Pneumatic's series of ultra-compact air tools, the powerful CP7711 butterfly impact wrench is the lightest tool of its type on the market. It gives you unrivalled access and manoeuvrability in tight spaces when removing or tightening fasteners during transmission and engine repairs or when working on body panels, oil pans, ignitions and vehicle seats.

Ultra-compact in size at 5.5in (140mm) long and 1.5in (40mm) wide, the ¼in wrench fits neatly in the user's hand. It weighs just 1.16lbs (0.53kg) and delivers a maximum torque in reverse of 80ft lb (110Nm), giving an unsurpassed power-to-weight ratio. The forward and reverse butterfly lever is positioned on the top for easy operation, while the built-in 180° air inlet swivel and three-speed power regulator are at the back of the tool.

Constructed with an aluminium housing and a high-durability single hammer mechanism, the lightweight design offers longer periods of use without causing strain to the operator.

For further information about Chicago Pneumatic's CP7711 butterfly impact wrench or other air tools in the range, go to **www.cp.co.uk**

● A ⅜in version of the Chicago Pneumatic butterfly impact wrench, identified as CP7721, will be available later in the year.

WIN We have one **Chicago Pneumatic CP7711 ¼in butterfly impact wrench** to give away to *CM* readers. For a chance to win it please complete the coupon on page 21.

WIN a Sealey toolchest

▶ Sealey is giving *CM* readers the chance to win one of its new retro-styled toolchests worth more than £1000.

The toolchest comprises a four-drawer topchest, two-drawer midbox and four-drawer rollcab, all featuring ball bearing drawer slides. With its blue finish and white racing stripes, it would look impressive in any garage or workshop.

Closing date for the competition is March 31, 2016.

To enter, visit **www.sealeycompetitions.co.uk**

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Elwis C-Series Professional COB LED Lamps

4 TO GIVE AWAY

There are four models of these innovative Danish-designed COB LED hand lamps. The Chip On Board LEDs fit dozens of strands of Galium Arsenide and/or other LED substrate materials onto a printed circuit board with a heat-sink behind, to allow them to provide a powerful and bright light output with the use of a wide-angle beam.

The lamps are extensively drop tested and their rubberised ABS bodies can withstand being run over by a vehicle of up to 1.8 tonnes. They each come supplied with a 230V UK charger.

Elwis C1 (**£24.99**) provides 350 lumens, with a four-hour charge providing five hours of continuous usage. The unit has a belt clip and rear magnet.

Elwis C2 (**£39.99**) provides 350 lumens, with a four-hour charge providing five hours of continuous usage. The unit has a hanging hook and base magnet, plus a connector for a 12V charger.

Elwis C3 (**£24.99**) provides 180 lumens, with a four-hour charge providing three-and-a-half hours of continuous usage. With belt clip and rear and base magnets, plus a USB charger.

Elwis C4 (**£49.99**) provides 350 lumens, with a four-hour charge providing five hours of continuous usage. Has flex function, a hanging hook, base magnet and a docking station.

The Elwis lamps are available from GSF Car Parts and other leading retailers. Please see **www.gsfcarparts.com**

WIN

We have one of each model of the four Elwis C-Series Professional COB LED lamps to give away to *CM* readers. For a chance to win one please complete the coupon on page 21. Please note: winners will receive one of the Elwis lamps chosen at random.

SIP 1.5KVA Heat Induction Tool

The new SIP 1.5KVA heat induction tool is perfect for removing stubborn rusted nuts and bolts, plus other metallic parts. It's more efficient, cost effective and safer to run compared to oxyacetylene bottles and torches, delivering more than 800DC of localised heat at the press of a trigger. Compact and highly portable, it comes supplied with four flexible heating elements, which can be easily bent or moulded to reach nuts and bolts in tight and hard-to-reach spaces. The tool is powered from a 230volt/13amp supply and includes sensors to prevent overheating. User instructions are supplied along with a hard carry-case for protection and easy storage. No training is required before use.

The SIP 1.5KVA heat induction tool is available at a discounted rate of **£499.98**+VAT until April 30 as part of the SIP Get a Grip on Winter promotion, but shop around for the best deals and special offers. For more information, visit **www.sip-group.com**

Heat Holders

Heat Holders claim to be the warmest thermal-wear products in the world, with a TOG rating of 2.34. New to the range is a Workforce socks for men and women, with a reinforced heel and toe for heavy-duty usage outdoors or in a workshop environment. They provide unbeatable comfort and outstanding durability to see you through the colder months.

Heat Holders Workforce socks are available in sizes 6-11 and 12-14 for men and 4-8 for women at **£6.99** per pair from **www.heatholders.co.uk**

NEWS IN BRIEF

Euro Car Parts has opened a new branch in Enfield after closing its existing ex-Unipart site, which was operating as a satellite branch to Edmonton. The new 10,000sq ft unit is five times the size of the old branch and includes ECP's new fast-track Click & Collect counter service.

Autodata has joined forces with fellow automotive data publishers Robert Bosch GMBH, HaynesPro, Hella Gutman Solutions, Sator Holding LKQ and TecRMI to create an organisation to ensure fair access to automotive data and information across Europe. The new European Independent Automotive Data Publishers Association (ADPA) also wants to provide a competitive framework of conditions for independent data publishers.

Workwear specialist **Dickies**' new 200-page catalogue will be available from early March. It will include its latest lines in heavy-duty jackets, trousers, overalls, gloves and footwear for the garage or workshop. Order a copy online at **www.dickiesworkwear.com**

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NEWS IN BRIEF

▶ Trends in engine design have provided challenges to engineers to eliminate torsional vibrations in the drivetrain. **Schaeffler** has developed an economical answer in the form of a clutch disc with torsion damper and centrifugal pendulum absorber. Potential applications include engines with torque ranges up to 250Nm and high tractive force even at low speeds.

▶ **Sealey**'s new Vehicle Service Promotion runs from February 1 until May 31. The 40-page brochure is packed with hundreds of new and established products specifically for automotive servicing, with discounts of up to 69%. Get a copy from your Sealey stockist or online at **www.sealey.co.uk**

▶ Chassis and suspension specialist **SuperPro** has introduced an uprated engine mount kit for the Volkswagen Polo 9N chassis to improve refinement and eliminate vibration and torque steer, particularly on smaller three-cylinder diesel models. The bush is priced at £39+VAT. See **www.superpro.eu.com**

▶ **Quinton Hazell** has been appointed the official approved supplier to Kwik Fit for their steering and suspension products. QH offers one the most comprehensive OE quality aftermarket product ranges in Europe, which will be available at all 800 Kwik Fit branches.

NEW from LASER TOOLS

Digital Torque Ratchet

▶ Smaller in length than a full-sized torque wrench, these new Laser digital torque ratchets are designed to secure fasteners that need to be tightened to lower torque figures, where over-tightening is a real risk, to an accuracy of plus or minus 3-4%.

The ¼in-drive model (part no 6207; **£65.48**+VAT) has a length of 200mm and covers the range 6-30Nm (4.4-22.1ft lb), the ⅜in-drive model (part no 6206; **£66.78**+VAT) is 230mm and covers 16-80Nm (11.8-59ft lb), and the ½in-drive model (part no 6205; **£68.14**+VAT) is 275mm and covers 20-100Nm (14.8-73ft lb).

With a clear digital display and automatic shut-off function, they all feature a very smooth 72-tooth ratchet mechanism and are supplied in a sturdy moulded case for storage. Batteries are included.

Brake Rewind Tool

▶ This innovative brake rewind tool (part no 6329) dispenses with the need for multiple tools or adaptors. It has an adjustable two-pin adaptor that will fit any pistons with a pin distance between 20-35mm, covering numerous popular vehicle applications.

The tool features a powerful internal spring that applies firm pressure to the piston as you turn the T-handle, to ensure the inner piston mechanism is wound back. The set also includes a standard two-pin adaptor, which enables it to be used with any piston adaptor – for example, single-pin versions – as well as an adjustable three-pin adaptor for electronic park brake calipers.

The Laser brake rewind tool has a recommended price of **£83.82**+VAT.

For further information about any of these products, as well as for details of the latest special offers and discounts, visit **www.lastertools.co.uk**

Gtechniq Crystal Serum Light

1 TO GIVE AWAY

▶ Car care expert Gtechniq has developed the Crystal Serum Light ceramic paint protection coating to help you extend the lifetime of your car's showroom shine. This is a consumer version of Gtechniq's professional-only Crystal Serum formula, which has the added advantage of being able to be machine-polished from your vehicle.

Serum Light forms an ultra-durable, high-gloss, slick-to-touch, chemically bonding, inorganic layer of 9h optically clear ceramic to paintwork. Once applied, it maintains gloss levels for significantly longer than traditional paint protection products, forming a resistant layer to chemicals ranging from pH2-pH12.

It also makes stubborn contaminants such as tree sap, tar and hard water spots much easier to remove. And unlike mainstream wax and organic polymer coatings, it can resist much more extreme temperatures, from -40°C to 250°C.

Crystal Serum Light costs **£55** (30ml) or **£85** (50ml), from **www.gtechniq.com**

WIN We have one bottle of Gtechniq Crystal Serum Light to give away to *CM* readers. For a chance to win it please complete the coupon on page 21

Click & Collect vehicle spares, workshop tools and leisure equipment at over 400 independent member stores. www.caarparts.co.uk CAAR

Bridgestone DriveGuard tyres

▶ Bridgestone has announced the April 2016 launch of the DriveGuard range of run-flat tyres, for owners to upgrade their cars cost-effectively. The new tyre can be driven safely with zero air pressure for 50 miles, at a top speed of 50mph, without exhibiting the traditional run-flat disadvantages of a vastly harsher ride and louder acoustics.

Made from an all-season rubber compound, wear rates are expected to be equivalent to conventional premium tubeless covers and puncture repair costs will be the same as non-run-flats. The company has also prioritised running costs and estimates that the DriveGuard option will be priced at around a 10% premium, bringing them within the reach of even the most budget-conscious of motorists.

Initially, DriveGuard will be available in selected sizes only, and your car must be fitted with Tyre Pressure Monitoring Sensors (TMPS). Aftermarket TPMS kits can be used, but they must comply with ISO requirements. You also must advise your insurance company of the upgrade, although hikes in premiums are unlikely. Further information on availability from **www.bridgestone.co.uk**

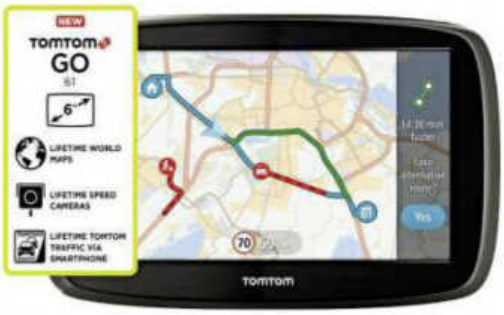
Comma MVMTF Plus 75w Gear Oil

▶ Oil expert Comma has expanded its extensive range of 28 gear and transmission oils with the new Comma MVMTF Plus 75w, a low-viscosity, fully-synthetic gear oil recommended for certain BMW, Ford, Land Rover and VW vehicles requiring a 75w API GL-4 lubricant. Supplied in 1-litre, 5-litre and 25-litre pack sizes, it covers 17.6% of all manual transmission applications in the UK car parc.

In addition, Comma has announced replacement upgrades for the discontinued Comma MVMTF 75w90, MVMTF 75w80 and Comma EP75w80 oils. The new Comma MVMTF Plus 75w90 and Comma MVMTF Plus 75w80 are available in 1-litre, 5-litre and 25-litre pack sizes, while Comma EP75w80 Plus is also available in 205-litre drums.

These extend Comma's overall applications coverage for manual gearboxes to 84% of the UK passenger car and LCV parc. Full product details are available at **www.commaoil.com**

TomTom Go sat-navs from Halfords



▶ Two new TomTom sat-navs are available exclusively from branches of Halfords or online. The TomTom Go 51 features a five-inch touchscreen, while the TomTom Go 61 has a six-inch touchscreen. Both of them come with Lifetime Speed Camera alerts and World Maps, so there are no costly subscription fees.

As both of the units are compatible with MyDrive, you can review traffic updates, plan routes and set destinations on your smartphone, tablet or computer and send the information direct to your sat-nav before you step into your car.

The TomTom Go 51 retails for **£149.99**, while the TomTom Go 61 costs **£169.99**.

For further details and ordering information, visit **www.halfords.com**

NEWS IN BRIEF

▶ **BorgWarner** is expanding its engine timing business in Korea, by supplying its advanced cam torque actuated variable cam timing technology for Hyundai and Kia vehicles powered by 3.0-3.8-litre V6 petrol engines.

▶ The Retail Motor Industry Federation's training centre, the **RMI Academy of Automotive Skills**, will be running a pilot scheme for the new MoT tester training from April 2016. MoT testers will soon be being trained to a National Occupational Standard, which will be a recognised qualification with the aim of setting a professional standard for the industry.

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A 38

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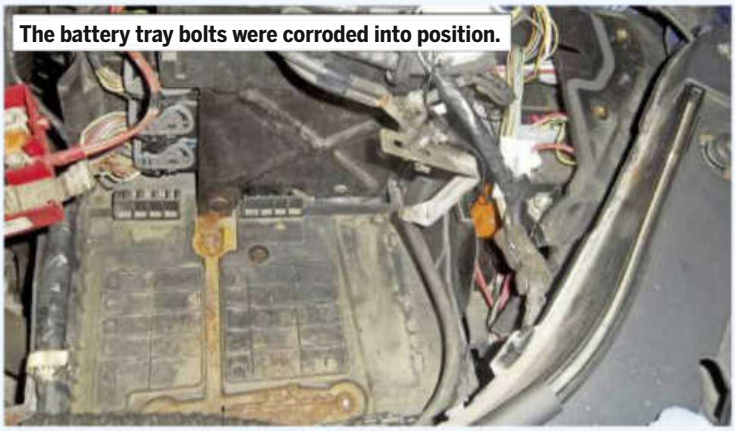
RENAULT SCENIC

Corroded loom causes concern



The battery tray bolts were corroded into position.

When this 2006 Renault Scenic suddenly cut out at the traffic lights, the owner removed and reinserted the key card, attempting to start the car by pushing down the clutch and pressing the start button. When this didn't work, he tried to disengage the handbrake to push the motor out of the way. This was when he discovered that the electric handbrake was not operating. With the traffic building up behind him, he opened the boot and tugged the emergency handbrake release. He was then able to move the motor out of the way.

The recovery services delivered the Renault to us and we began our investigations. The problem turned out to be corroded wiring in the fusebox in the nearside inner wing. Before we could begin the tedious testing procedure to discover the exact location of the fault, we first had to remove the battery, battery tray and ECU support bracket. With the battery tray bolts corroded into place, this task took longer than it should have done.

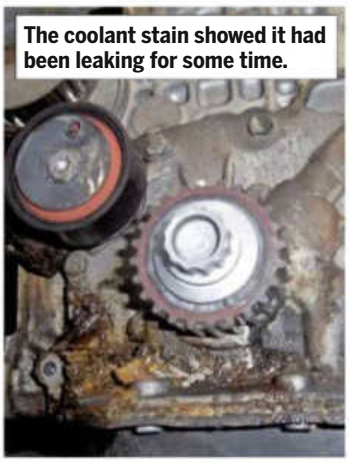
Once we had accessed the problem area, the corroded connection was repaired and the vehicle reassembled.

VOLKSWAGEN GOLF

Long-term coolant loss

This 2009 Volkswagen Golf had needed the coolant level topping up regularly for a few months. The situation had now deteriorated and the level was dropping daily. Aware that the leak could be due to the water pump, the owner was rightfully concerned that the vehicle might fail totally. So the Golf was bought to us for a new cambelt kit and water pump.

Once the cambelt cover was removed, we could see that the leak had been present for quite a while given the staining on the lower part of the engine block. It was also apparent that the cambelt had suffered as a result and possibly would not have lasted too much longer.



The coolant stain showed it had been leaking for some time.

It always nice to complete this kind of job, knowing that the work carried out has saved the engine from failure and will ensure the smooth running of the vehicle for some time to come.

BMW M5

Minor rust, major job

In for its MoT, this 2001 BMW M5 was the owner's pride and joy. The body was regularly washed and polished, and was in pretty good condition given its age. The test went well, except for one small area of rust that had begun to take hold in the offside inner sill.

What was a fairly minor section of rust was going to be a major job to rectify because of the fuel tank, which needed to be removed to safely access the corrosion.

Not making the job any easier was the fact that the owner kept the fuel tank topped up. With a full tank to drain down, we were aware that the fumes would need to be extracted from the area before we could begin to weld. Once the tank was extracted, another small amount of rust could be seen on the nearside inner sill, so this was dealt with at the same time.

Dealing with the rust meant removing the fuel tank.

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With the protective boot pulled back, we could see the chrome of the piston had been damaged by corrosion.

MAZDA RX-8

Corrosion causes sticky brake caliper

▶ Feeling a distinct lack of performance from his 2003 Mazda RX-8, the owner was also aware of a distinct hot brake smell from the front of the vehicle. This was confirmed when the driver felt the front nearside wheel and found it was extremely hot. It soon became evident that the Mazda would not roll in neutral when the handbrake was off, as a result of friction from the front offside brake.

After letting it cool down, the owner brought it to us to be checked. We confirmed that the offside front brake caliper was binding and removed the caliper to inspect it, with a view to freeing it off.

Once the caliper was off, we found that there was severe corrosion on the piston. The chromed piston could not be saved, so the only option was a new brake caliper. Once this was fitted, the owner could drive his RX-8 around without the brake binding.

FORD Ka

Is the engine overheating?

▶ The owner of this 2002 Ford Ka had brought the vehicle in for its MoT, but also remarked that the engine was overheating. Further questioning revealed that the red warning light had not come on, and as the vehicle had no temperature gauge, the reason she thought the engine was overheating was because the vehicle was always hot.

Using our scan tool plugged into the 16-pin diagnostics socket, we checked the engine coolant temperature and found that it was sitting at around 90°C, as it should.

The trouble with this Ka was not that it was overheating, but that the heater tap was stuck in the hot position, meaning the inside of the vehicle was feeling continually hot. The failure of the heater tap is very common on Kas and Fiestas, but luckily replacement is fairly simple.

The heater tap is easily accessible once the plastic shield is removed from the rear of the engine bay.

AUDI A3

Disappearing dipstick

▶ Given its reputation for using a small amount of oil, the owner of this 2007 Audi A3 with the 2.0 FSI engine did regularly check his engine oil and realised the dipstick no longer clicked into place as well as it used to. Further investigation revealed that the top section of the dipstick, which should seal it into the tube, was slowly disappearing.

We agreed that a new dipstick was needed. It is not uncommon for the plastic section of the dipstick tube to also fail, so this was ordered up as well. The dipstick and tube came to less than £15 and fitting the dipstick guide was a quick and simple process, only requiring the removal of one securing screw holding the tube to the inlet manifold.

Once out, the new one was popped into place before refitting the dipstick, which now clicked into place to form the important seal to the crankcase breather system.

The top guide of the Audi A3's dipstick had broken away.

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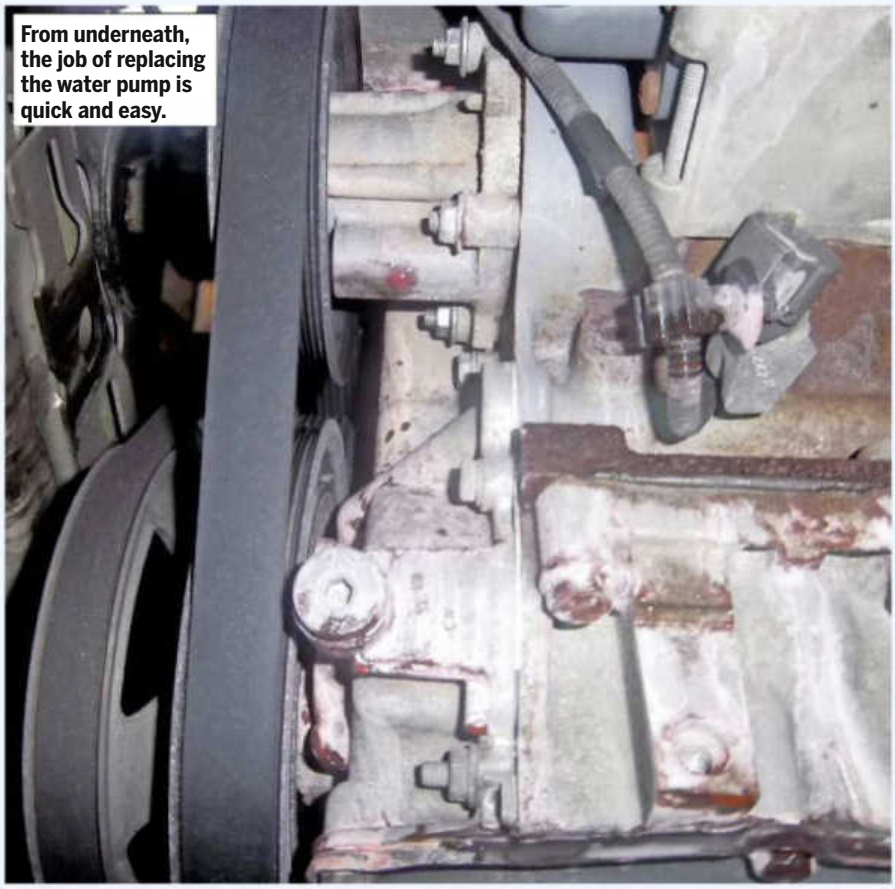
FIAT FIORINO

Easy change water pump


From underneath, the job of replacing the water pump is quick and easy.

▶ There is a popular lager advert that says if this brewery made other products then they would probably be the best in the world. Well if that brewery ever had a hand in engine design it must have been for the 2010 Fiat Fiorino. That's not to say the vehicle is designed to perfection, but the water pump must be the easiest we have ever changed.

The van had come in with a coolant leak and our plan was to raise the van on the ramp, drain the coolant, then move the vehicle to complete the job. However, because it was so accessible from underneath, we popped off the drivebelt, too. Undoing the four 10mm nuts securing it and removing the pump was done in a few minutes.

The new pump, complete with rubber seal, was fitted just as quickly and all that remained was to move the van into another part of the workshop to fill and bleed the cooling system.

VAUXHALL ASTRA

Thermostat access

▶ The Vauxhall Astra 1.6 single overhead cam engine is a tough and uncomplicated unit, and this 1999 Astra was still going strong and running smoothly. It had just one problem, which was a tendency to run too hot when sitting in traffic. The cooling fan was operating as it should, but, on feeling the radiator, it became evident the coolant wasn't flowing as quickly as it should.

Our first action was to check and, if necessary, replace the thermostat. Unfortunately, on this engine, the designers who had done a pretty good job with everything else, had decided to hide the thermostat behind the cambelt. This means that replacing the thermostat involves stripping the cambelt and the back cover to reach the thermostat housing.


Accessing the thermostat involves first having to remove the cambelt and top camshaft pulley.

Once we had accessed and removed the thermostat, our diagnosis was confirmed when we discovered that the unit was not opening at the allotted temperature. With a new thermostat fitted and everything back together again, the engine now produced a good flow through the cooling system and stayed at the correct temperature.

RENAULT KANGOO

Fitting a CV boot

▶ Failing its MoT on a perished outer CV boot, there were two options to repair this 2004 Kangoo. Actually, you could say there were three options, if you were to include a split-type gaiter being glued in place, but never having much luck with this, we discounted this option.

This left either extracting the driveshaft from the gearbox and removing the inner joint by unclipping the circlip and sliding it off, or else pushing a stretchy boot over the joint using a nylon cone.

As taking the driveshaft out of the gearbox would involve losing gear oil, we opted for the stretchy boot. The quality of these items is very good, and fitting them using the cone and pushing tool is an easy process if you apply a bit of grease to ensure the boot slides along the cone. Once in position after greasing up the joint, the boot can be clipped in place, before refitting the driveshaft into the hub.


The outer joint on the Kangoo cannot be disassembled.

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The rust had corroded the pipe beyond repair.

PEUGEOT 206

Convertible with a corroded cat

▶ The catalytic converter on this 2003 Peugeot 206CC was in perfect working order. The little hard-top convertible had covered only 30,000 miles in its lifetime and the cat would probably go on working for a while yet.

The only problem was that the metal downpipe which housed the chemical convertor had begun to corrode. This wasn't the first time the owner had complained of a noisy exhaust and a couple of years previously we had managed to weld up the pipe to extend its life a little longer. This time, welding up was not an option. The metal had rusted through and, as everyone knows, you can't weld rust.

As with every rusty exhaust, the main concern is that the nuts securing the unit will not come undone. This was not a problem with this vehicle, making the replacement a smooth process. Even the O2 sensor unscrewed without a struggle, so the new cat was soon in position and the little Peugeot now sounded a lot quieter.

MERCEDES SLK200

Manifold mayhem

The manifold had cracked around the flange support, causing a nasty exhaust blow.

▶ Coming in for what sounded like a simple exhaust downpipe gasket failure, this 2000 Mercedes SLK 2.0-litre needed to cool down before we could have a good look at the problem. Our mechanics have been burned too many times to simply start feeling around a hot exhaust manifold.

Once the motor had cooled, we started it up again to check the source of the blow. The conclusion was that it was the manifold itself that was to blame.

Unlike many exhaust manifolds, the unit on the Merc is not cast-iron but a pressed steel assembly. Thankfully all its securing nuts came undone without any drama, and once the unit was off the vehicle we could see that the flange retainer had completely broken away. We did consider the option of repairing the manifold by welding the fracture, but the owner opted for a new assembly. At that stage, he was unaware of the £445 + VAT price tag, although once the job was completed and his Merc was purring along silently, he was quite happy.

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ROVER 620

ABS failure

▶ With the MoT on this 1997 Rover 620 due in a few weeks, the owner was concerned the glowing ABS light might be a problem. Unlike more modern vehicles, which can simply be plugged into a diagnostic scanner, the easiest way to find a failed sensor on this 620 is to unplug each sensor and use a meter to check the signal.

The two front plugs are easily accessible from under the bonnet and the two rear plugs from the boot. When checking all four sensors, the one that gives a different reading to the other three is the faulty unit. In this case, it turned out to be the nearside rear sensor.

Once the replacement sensor arrived at a cost of £150, running the cable to the plug took about the same time as actually bolting the sensor into place.

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	CTC500B	5 Dr cabinet	675x335x770	£109.98	£143.98	£131.98
	CTC800B	8 Dr chest/cab set	610x330x1070	£94.99	£125.99	£113.99
2	CTC700B	7 Dr cabinet	610x330x875	£119.98	£143.98	£143.98
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	CTC109	9 Dr chest	662x305x421	£69.98	£89.99	£83.98
5	CTC105	5 Dr cabinet	685x465x790	£159.98	£203.98	£191.98
	CTC107	7 Dr cabinet	685x465x950	£189.98	£239.98	£227.98

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CBB315	36"	5 Dr Cabinet	927x416x985	£279.98	£359.98	£335.98
CBB228B	41"	8 Dr cabinet	1126x468x1000	£369.00	£474.80	£442.80
1 CBB224B	41"	14 Dr chest	1045x415x486	£259.98	£323.98	£311.98
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CBB231B	56"	9 Dr chest	1460x615x490	£399.00	£502.80	£478.80
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3 CBB309DF	9 Dr chest	975x370x420	£159.98	£215.98	£191.98
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FROM £29.98 EXC.VAT £35.98 INC.VAT

150KG PER SHELF (evenly distributed) Strong 9mm fibreboard shelves

350KG PER SHELF (evenly distributed) Strong 12mm fibreboard shelves

Contents not included (all items)

MODEL SHELF DIMS WxDxH(mm)	EXC.VAT	INC.VAT
150kg 800x300x1500	£29.98	£35.98
350kg 900x400x1800	£49.98	£59.98

SAVE 10% WHEN YOU BUY ANY MIX OF 5 FROM THIS RANGE SAVE AT LEAST £17.99 INC.VAT

CHOICE OF 5 COLOURS

RED, BLUE, BLACK, SILVER & GALVANISED STEEL

NEW RANGE COMING SOON!

ALL SIZES/SPECIFICATIONS ARE APPROXIMATE

SEE NEXT PAGE FOR MORE!

Machine Mart

NOW 65 SUPERSTORES NATIONWIDE

WHERE QUALITY COSTS LESS

Clarke MIG WELDERS

Quality machines from Britain's leading supplier

See online for included GAS, TIPS, SHROUDS & WIRE IN STOCK

135TE

FROM ONLY £179.98 EX.VAT £215.98 INC.VAT

MODEL	MIN-MAX AMPS	EXC.VAT	INC.VAT
PRO90	24-90	£179.98	£215.98
110E	30-100	£214.99	£257.99
135TE Turbo	30-130	£239.98	£287.98
151TE Turbo	30-150	£269.98	£323.98
165TEM Turbo	30-155	£339.00	£406.80
175TECM Turbo	30-170	£399.00	£478.80
205TE Turbo	30-185	£429.00	£514.80

airmaster TURBO AIR COMPRESSORS

8/250 Superb range ideal for DIY, hobby & semi-professional use

BIG 2HP 7.5CFM

FROM ONLY £79.98 EX.VAT £95.98 INC.VAT

HUGE CHOICE OF SPRAY GUNS & AIRTOOLS

MODEL	MOTOR	CFM	TANK	EXC.VAT	INC.VAT	WAS INC.VAT	NOW INC.VAT
8/250	2HP	7.5	24ltr	£79.98	–	£95.98	
7/250	2 HP	7	24ltr	£89.98	–	£107.98	
11/250	2.5HP	9.5	24ltr	£109.98	£143.98	£131.98	
8/510	2HP	7.5	50ltr	£119.98	£155.98	£143.98	
11/510	2.5HP	9.5	50ltr	£139.98	£179.98	£167.98	

Clarke NO GAS/GAS MIG WELDERS

- Professional type torch with on/off control
- Thermal overload protection
- Turbo fan cooled
- Easy conversion to gas with optional accessories

FROM ONLY £109.98 EX.VAT £131.98 INC.VAT

MIG145

*no gas only

MODEL	MIN/MAX AMPS	EXC.VAT	INC.VAT
MIG 102NG*	35/90	£109.98	£131.98
MIG 145	35/135	£149.98	£179.98
MIG 180	40/160	£179.98	£215.98
MIG 196	40/180	£199.98	£239.98

Clarke NO GAS/GAS MIG WELDERS

- Uses flux cored steel wire, which creates own gas shroud as it burns

FROM ONLY £169.98 EX.VAT £203.98 INC.VAT

151EN

MODEL	AMPS	EXC.VAT	INC.VAT
90EN	24-90	£169.98	£203.98
105EN	30-100	£184.99	£221.99
151EN	30-150	£209.98	£251.98
130EN	30-130	£224.99	£269.99
160EN	30-150	£259.98	£311.98

Clarke AT161 ARC/TIG INVERTERS

FROM ONLY £129.98 EX.VAT £155.98 INC.VAT

MODEL	AMPS	ELECTRODE DIA.	EXC.VAT	INC.VAT
AT101	10-80	1.6-2.5mm	£129.98	£155.98
AT132	10-130	1.6-3.2mm	£159.98	£191.98
AT161	10-160	1.6-4.0mm	£199.00	£238.80

Clarke HIGH FREQUENCY BATTERY CHARGERS

- Energy efficient inverter, protects battery from high current damage
- Microprocessor provides appropriate charging rate
- Variable current output for quick, medium or trickle charge

HFBC12/24

FROM ONLY £39.98 EX.VAT £47.98 INC.VAT

MODEL	MAX CHARGE	MAX BATTERY	EXC.VAT	INC.VAT
HFBC12	6 Amps	100Ah	£39.98	£47.98
HFBC12/24	20 Amps	200Ah	£69.98	£83.98

Clarke INDUSTRIAL AIR COMPRESSORS

FROM ONLY £369.98 EX.VAT £443.98 INC.VAT

Offers the durability & reliability demanded by professionals.

- Cast iron pumps on SE16 and SE19
- Twin cylinder pumps
- Motor overload protection
- Petrol models in stock

H/DUTY

MODEL	CFM	MOTOR (HP)	RCVR (LTR)	EXC.VAT	INC.VAT
SE1/1C*	9	2	100	£369.98	£443.98
SE16C100*	14	3	100	£399.00	£478.80
SE16C150+	14	3	150	£429.00	£514.80
SE16C200+	14	3	200	£499.00	£598.80
SE18‡	18	4	200	£549.00	£658.80
SE26^	23	5.5	200	£679.00	£814.80
SE29+◊†	28	2x3	270	£969.00	£1162.80
SE36^●	30	7.5	270	£979.00	£1174.80
SE37+◊†	36	2x4	270	£1099.00	£1318.80
SE46#^	40	10	270	£1449.00	£1738.80

*230V Supply +Run From 30 Amp Supply ‡Run From 40 Amp Supply ^400V 3 Phase •Supplied With Direct On-Line Starter ◊Supplied With Sequential Direct On-Line Starter †V-Twin #Supplied With Pre-Wired Star Delta Starter

Clarke ARC WELDERS

FROM ONLY £49.98 EX.VAT £59.98 INC.VAT

For home user, automotive and industrial applications.

MODEL	AMPS	EXC.VAT	INC.VAT
EA110	40-100	£49.98	£59.98
EA165	65-160	£64.99	£77.99
115N	30-110	£64.99	£77.99
EA200	60-200	£87.99	£105.59
160N	40-150	£67.99	£81.59
190N	50-185	£94.99	£113.99
190TEN#	35-180	£139.98	£167.98
235TEN#	40-210	£149.98	£179.98

SEE THE FULL RANGE ONLINE & IN-STORE

#Turbo fan cooled

Clarke ARC ACTIVATED HEADSHIELDS

GWH4 £39.98 EX.VAT £47.98 INC.VAT

CWH7 £44.99 EX.VAT £53.99 INC.VAT

GWH5 PRICE CUT NOW FROM £46.99 EX.VAT £56.39 INC.VAT WAS £59.98 INC.VAT

- Activates instantly when Arc is struck
- Protects to EN379
- Suitable for arc, MIG, TIG & gas welding

Clarke AUTOMOTIVE WHEEL DOLLY SET

AWD1

BIG 3" CASTORS

£44.99 EX.VAT £53.99 INC.VAT PER PAIR

- Four non-marking castors for easy movement in confined spaces
- Heavy duty steel construction - load rating 500kg per dolly

Clarke INTELLIGENT AUTOMATIC CHARGER / MAINTAINERS NEW

FROM ONLY £29.98 EX.VAT £35.98 INC.VAT

Keep batteries in top condition over a long period

CB09-12

MODEL	STAGES	BATTERY	EXC.VAT	INC.VAT
CB03-12	3	6Ah-40Ah 12V lead acid	£29.98	£35.98
CB09-6/12	9	Up to 80Ah 6V / 12V lead acid	£39.98	£47.98
CB09-12	9	Up to 160Ah 12V lead acid & calcium	£59.98	£71.98

Clarke BC520N BATTERY CHARGERS/ENGINE STARTERS

- Ammeter
- Multi-position charge regulator
- Overload protection on charging cycle

FROM ONLY £61.99 EX.VAT £74.39 INC.VAT

MODEL	MAX AMPS CHARGE/BOOST	EXC.VAT	INC.VAT
BC130C	15/120	£61.99	£74.39
BC190	38/180	£89.98	£107.98
BC210C	25/200	£94.99	£113.99
BC410E	35/400	£119.98	£143.98
WBC180 NEW	35/180	£129.98	£155.98
BC205N NEW	30/200	£169.98	£203.98
WBC240	45/240	£159.98	£191.98
WBC400	60/350	£199.00	£238.80

Clarke 12V BATTERY CHARGERS

For lead acid batteries

NEW

LA6

*Automatic charger - maintains optimal charging condition

MODEL	MAX CHARGE AMPS	EXC.VAT	INC.VAT
LA4	4	£14.99	£17.99
LA6	6	£16.99	£20.39
AC80*	8	£27.98	£33.58

FROM ONLY £14.99 EX.VAT £17.99 INC.VAT

Clarke 3HP V TWIN AIR COMPRESSORS

PRICE CUT NOW FROM £209.00 EX.VAT £250.80 INC.VAT WAS £263.98 INC.VAT

- Suitable for powering all common air tools & spray equipment

TIGER 16/510

MODEL	AIR RECEIVER	AIR DISPLACEMENT	EXC. VAT	INC. VAT
Tiger 16/510+	50 litre	14.5 cfm	£209.00	£250.80
Tiger 16/1010*	100 litre	14.5 cfm	£259.98	£311.98

+ was £263.98 inc.VAT * was £323.98 inc.VAT

Clarke CAR RAMPS

- Lift cars safely and quickly
- Tough angled steel construction

FROM ONLY £26.99 EX.VAT £32.39 INC.VAT PER PAIR

MODEL	CAPACITY	EXC.VAT	INC.VAT
CR2	2000kg	£26.99	£32.39
CRW25	2500kg	£36.99	£44.39

UK MADE

Clarke AXLE STANDS

- Ratchet action for quick height adjustment
- Sold in pairs

FROM ONLY £10.98 EX.VAT £13.18 INC.VAT

MODEL	MAX TONS	MIN/MAX HEIGHT	EXC.VAT	INC.VAT
CAX2TF	2	235-360mm	£10.98	£13.18
CAX-3TBC	3	300-430mm	£19.98	£23.98
CAX-6TBC	6	400-615mm	£29.98	£35.98
CAX10TP‡#	10	450-750mm	£79.98	£95.98

‡ was £107.98 inc.VAT #per single stand

Clarke PRO 7" SANDER/POLISHER

£69.98 EX.VAT £83.98 INC.VAT

CP185

- Includes hook & loop backing pad and hook & loop wool polishing bonnet.
- 1200W motor

Clarke HYDRAULIC BOTTLE JACKS

PRICE CUT NOW FROM £7.99 EX.VAT £9.59 INC.VAT WAS £11.98 INC.VAT

*Telescopic Range

MODEL	CAP.	JACK HEIGHT (mm)	EXC. VAT	WAS INC. VAT	NOW INC. VAT
CBJ2B	2	148-276	£7.99	£11.98	£9.59
CBJ3B	3	180-350	£11.99		£14.39
CBJ5B	5	185-355	£14.99		£17.99
CTBJ5*	5	220-495	£49.98		£59.98
CBJ8B	8	190-365	£17.99	£23.98	£21.59
CBJ10B	10	195-375	£21.99	£27.59	£26.39
CTBJ10*	10	210-525	£69.98		£83.98
CBJ12B	12	200-380	£24.99	£31.19	£29.99
CTBJ12*	12	235-580	£89.98	£119.98	£107.98
CBJ15B	15	205-390	£29.98		£35.98
CBJ20B	20	217-407	£34.99	£44.39	£41.99

Clarke GRINDERS & STANDS

- Stands come complete with bolt mountings and feet anchor holes

6" & 8" AVAILABLE WITH LIGHT

STANDS FROM ONLY £47.98 INC.VAT

FROM ONLY £29.98 EX.VAT £35.98 INC.VAT

POLISHING KITS 4" TO 8" FROM ONLY £23.98 INC VAT

With sanding belt *8" whetstone & 6" drystone

‡ was £67.19 inc.VAT

MODEL	DUTY	WHEEL DIA.	EXC.VAT	INC.VAT
CBG6RP	DIY	150mm	£29.98	£35.98
CBG6RZ	PRO	150mm	£39.98	£47.98
CBG6RSC	HD	150mm	£49.98	£59.98
CBG6SB#	PRO	150mm	£49.98	£59.98
CBG6RWC	HD	150mm	£54.99	£65.99
CBG8W* (wet)‡	HD	150/200mm	£49.98	£59.98

Clarke TAP & DIE SETS

- High quality tungsten steel
- Supplied in metal storage case (except 16pce)

FROM ONLY £14.99 EX.VAT £17.99 INC.VAT

TYPE	EXC.VAT	INC.VAT
CHT203 16pce Metric	£14.99	£17.99
CHT302 24pce UNC/UNF/NPT	£19.98	£23.98
CHT303 28pce Metric	£23.99	£28.79
CHT304 33pce Metric/UNF/BSP	£31.99	£38.39
CHT774 37pce Metric NEW	£34.99	£41.99
CHT527 32pce Metric	£41.99	£50.39
CHT776 76pce Metric NEW	£59.98	£71.98

Clarke HYDRAULIC PRESSES

PROFESSIONAL QUALITY

Built for tough daily use in automotive/industrial workshops

- All models include gauge

MODEL	EXC.VAT	INC.VAT
4 ton bench‡	£129.98	£155.98
10 ton bench* ▲	£187.00	£224.40
12 ton floor* †	£239.00	£286.80
20 ton floor*	£399.00	£478.80
50 ton floor‡#	£1499.00	£1798.80

▲ was £227.98 inc.VAT
† was £287.98 inc.VAT
# was £1917.60 inc.VAT
* Available with/without 7 pce pin, bracket & pressing plate ‡Without kit

FROM ONLY £129.98 EX.VAT £155.98 INC.VAT

Clarke HEAVY DUTY LONG REACH JACKS CTJ10GLS

NEW RANGE

PRICE CUT NOW FROM	MODEL	TONNES	EXC.VAT	INC.VAT
£164.99 EX.VAT £197.99 INC.VAT *WAS £203.98 INC.VAT	CTJ2GLC*	2	£164.99	£197.99
	CTJ3GLS	3	£229.00	£274.80
	CTJ5GLS	5	£329.00	£394.80
	CTJ10GLS	10	£489.00	£586.80

Clarke 2 TONNE TROLLEY JACKS

FROM ONLY £19.98 EX.VAT £23.98 INC.VAT

CTJ2001G

MODEL	TYPE	EXC.VAT	INC.VAT
CTJ2B	DIY	£19.98	£23.98
CTJ2MB	DIY + Case	£24.99	£29.99
CTJ2250LP *	Low Profile	£39.98	£47.98
CTJ2QLG	Pro Instant	£69.98	£83.98
CTJ2001G	Pro Garage	£74.99	£89.99

* CTJ2250LP has a 2.25 tonne capacity, has a low entry of only 80mm and includes 2 sockets

Clarke 3 TONNE JACKS

FROM ONLY £44.99 EX.VAT £53.99 INC.VAT

QUICK LIFT

JACKS ALSO IN STOCK UP TO 5 TONNE

CTJ3000G

MODEL	TYPE	SADDLE HEIGHT MIN-MAX MM	EXC. VAT	INC. VAT
CTJ3000QL	Quick Lift	195-520	£44.99	£53.99
CTJ3QLG	Pro Instant Lift	145-500	£83.99	£100.79
CTJ3000G	Pro Garage	120-520	£84.99	£101.99

Kielder KWT-002 18V BRUSHLESS IMPACT WRENCH

- Heavy-Duty, lightweight design perfect for garage, on site or home use
- 1/2" Square Drive
- 3.0Ah Li-ion battery

NEW

450Nm Max Torque

£149.98 EX.VAT £179.98 INC.VAT

INC 2 BATTERIES

Clarke 5 PIECE AIR TOOL KIT

KIT1100

- Gravity Fed Spray Gun
- Air Wash Gun
- Tyre Inflator
- Air Blow Gun
- 5 Metre Air Recoil Hose

£19.98 EX.VAT £23.98 INC.VAT

Clarke SPRAY GUNS

HUGE CHOICE IN-STORE/ ONLINE

FROM ONLY £19.98 EX.VAT £23.98 INC.VAT

MODEL	DESC	EXC.VAT	INC.VAT
PR012C/ 14C/18C	1.2mm, 1.4mm, 1.8mm	£19.98	£23.98
PGF14	Pro, Gravity	£24.99	£29.99
HVLP‡	AP15, 2.2mm	£24.99	£29.99
SP14/18C	1.4mm/ 1.8mm	£27.99	£33.59

PR012C

‡ was £33.59 inc.VAT

ALUMINIUM RACING JACKS

- Quick lift
- Non-marking nylon wheels
- Rubber contact pad - helps protect vehicle undersides

CTJ250AB

FROM ONLY £84.99 EX.VAT £101.99 INC.VAT

Clarke RACING

*steel chassis

LOW ENTRY ONLY 85MM

MODEL	LIFTING CAP.	EXC.VAT	INC.VAT
CTJ1250AB	1.25T	£84.99	£101.99
CTJ1800A NEW	1.8T	£149.98	£179.98
CTJ2000A	2T	£149.98	£179.98
CTJ2500QLG*	2.5T	£139.98	£167.98

Clarke 24V CORDLESS IMPACT WRENCH

CIR220 ONLY £89.98 EX.VAT £107.98 INC.VAT

CIR220

- Inc. 17, 19, 21 & 23mm chrome vanadium sockets
- 2x 24V Ni-Cd Batteries & 1 hour fast charger

HEAVY DUTY

OTHER MODELS	MAX TORQUE	EXC.VAT	INC.VAT
Corded CEW1000	450Nm	£56.99	£68.39
Cordless CIR450C NEW	450Nm	£119.98	£143.98

Clarke CRANES

FROM ONLY £149.98 EX.VAT £179.98 INC.VAT

MODEL	DESC.	EXC.VAT	INC.VAT
CFC500F	1/2 ton fold	£149.98	£179.98
CFC100	1 ton fold	£154.99	£185.99
CFC1000LR	1 ton long reach	£199.98	£239.98

- Folding and fixed frames available
- Robust, rugged construction
- Overload safety valve

Fully tested to proof load

CFC100

Clarke TOOL CHEST AND TOOLS PACKAGE DEAL

CHT624

SAVE OVER £61 OFF OUR NORMAL PRICE

PRICE CUT ALL THIS ONLY £249.98 EX.VAT £299.98 INC.VAT WAS £311.98 INC.VAT

329 HAND TOOLS

- This great value set includes CTC900B 9 drawer chest & CTC500B 5 drawer cabinet
- Includes the most popular sockets, spanners, pliers, drivers, wrenches etc

Clarke 6 SPEED METAL LATHE WITH 12 SPEED MILL DRILL - CL500M

VIDEO ON-LINE

FULL RANGE OF ACCESSORIES IN STOCK

£849.00 EX.VAT £1018.80 INC.VAT

- 430mm between centres
- Compound slide with 4 way tool post
- Power fed screw cutting facility
- Forward/reverse lathe operation
- Clutch for independent mill/drill operation

ALSO AVAILABLE:

CL430 - As above but without the Mill/Drill head £699.00 exc.VAT £838.80 inc.VAT

24877LH

Clarke JUMP STARTS

Provides essential home, garage and roadside assistance
- Integral work light
- 910 includes air compressor
- Long life battery

FROM ONLY £52.99 EX.VAT £63.59 INC.VAT

MODEL	START BOOST	PEAK AMPS	EXC.VAT	INC.VAT
900	400A	900A	£52.99	£63.59
910	400A	900A	£59.98	£71.98
4000	700A	1500A	£114.99	£137.99
12/24	1000A@12v 500A@24v	2000A@12v 1000A@24v	£129.98	£155.98

EXTRA LONG 1m LEADS

HEAVY DUTY 17KG

GREAT NEW WEBSITE

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Clarke HEAVY DUTY INSTANT GARAGES/WORKSHOPS

- Ideal for use as a garage/workshop
- Extra tough triple layer weatherproof fabric
- Heavy duty powder coated steel tubing
- Ratchet tight tensioning

ZIP CLOSE DOOR

FROM ONLY £229.00 EX.VAT £274.80 INC.VAT

IDEAL ALL-WEATHER PROTECTION

10' RANGE NARROWER WIDTH GREAT WHERE SPACE IS TIGHT

LENGTH UP TO 24'

MODEL	SIZE (LxWxH)	EXC.VAT	INC.VAT
CIG1015	4.6 x 3 x 2.4M	£229.00	£274.80
CIG1216	4.9 x 3.7 x 2.6M	£259.00	£310.80
CIG1020	6.1 x 3 x 2.4M	£279.00	£334.80
CIG1220	6.1 x 3.7 x 2.5M	£299.00	£358.80
CIG1224	7.3 x 3.7 x 2.5M	£379.00	£454.80

Clarke TURBO FAN GAS HEATERS

Offering low cost, efficient heating

PROPANE GAS FIRED

FROM ONLY £64.99 EX.VAT £77.99 INC.VAT

*stainless steel #Dual Volt 110V/230V

MODEL	MAX OUTPUT KW	EXC. VAT	WAS INC.VAT	NOW INC.VAT
Little Devil	10	£64.99	—	£77.99
Little Devil SSII*	10.3	£79.98	—	£95.98
Devil 650	15	£74.99	—	£89.99
Devil 660 SS*	15	£99.98	£131.98	£119.98
Devil 900 NEW	24.9	£129.98	—	£155.98
Devil 860SS*#	31	£149.98	—	£179.98
Devil 1600 NEW	36.6	£159.98	—	£191.98
Devil 2100 NEW	49.8	£249.98	—	£299.98
Devil 4000	70–131	£379.00	£479.98	£454.80
Devil 3150#	46 – 100	£469.98	—	£563.98

Clarke ELECTRIC HEATERS

NEW RANGE

Huge range of quality electric models – From DIY, trade to Industrial

FROM ONLY £49.98 EX.VAT £59.98 INC.VAT

DEVIL7003

MODEL	VOLTAGE	HEAT OUTPUT KW	EXC. VAT	INC. VAT
DEVIL 6003	230V	1.5-3	£49.98	£59.98
DEVIL 7003	230V	3	£54.99	£65.99
DEVIL 6005	400V	2.5-5	£74.99	£89.99
DEVIL 7005	400V	5	£79.98	£95.98
DEVIL 6009	400V	4.5-9	£119.00	£142.80
DEVIL 7009	400V	9	£137.99	£165.59
DEVIL 6015	400V	5-10-15	£179.00	£214.80

Clarke HOME/ WORKSHOP AIR TOOLS

FROM ONLY £14.99 EX.VAT £17.99 INC.VAT

CAT117

HUGE CHOICE IN-STORE/ONLINE

CAT113

MODEL	DESCRIPTION	EXC.VAT	INC.VAT
CAT110	½" Impact Wrench	£24.99	£29.99
CAT111‡	Air Orbital Sander	£19.98	£23.98
CAT113	3" Cut Off Tool	£16.99	£20.39
CAT114	Air Hammer with Chisel Set	£14.99	£17.99
CAT115#	½" Reversible Ratchet	£19.98	£23.98
CAT117	13 piece ½" Impact Wrench Kit	£32.99	£39.59
CAT120	43 Piece Air Tool Kit	£89.98	£107.98
CAT121	Dual Action Sander	£22.99	£27.59
CAT123½"	Reversible Air Drill	£29.98	£35.98

‡ was £27.59 inc.VAT # was £29.99 inc.VAT

Clarke ENGINE DIAGNOSTICS

PRICE CUT NOW FROM £34.99 EX.VAT £41.99 INC.VAT WAS £47.98 inc.VAT

MODEL	EXC.VAT	INC.VAT
EOBD Fault Code Reader	£34.99	£41.99
Engine EOBD/OBD2 Fault code reader	£54.99	£65.99
Engine Diagnostic & EOBD/OBD 2 Fault Code Reader	£99.98	£119.98

Clarke CAR CREEPERS

- Oil resistant vinyl covered padded backs & headrests
- Swivel castors for easy manoeuvrability

FROM ONLY £21.99 EX.VAT £26.39 INC.VAT

MODEL	DESCRIPTION	EXC.VAT	INC.VAT
CMC36	Car creeper	£21.99	£26.39
CMC45	With adjustable headrest	£28.99	£34.79
CMC40	With tool storage	£36.99	£44.39
CMC50	Folding car creeper	£44.99	£53.99

Clarke ENGINE STANDS

NEW RANGE

- Rotates through 360°
- Fully tested to proof load
- *Folds for storage

FROM ONLY £49.98 EX.VAT £59.98 INC.VAT

CES680F

MODEL	CAPACITY	EXC.VAT	INC.VAT
CES340	340kg	£49.98	£59.98
CES450	450kg	£69.98	£83.98
CES560	560kg	£84.99	£101.99
CES680F*	680kg	£119.98	£143.98

Clarke DIESEL/PARAFFIN HEATERS

Ideal for fast efficient heating
- Extra-long run fuel tanks – up to 53 litres
- Variable heat output with thermostat control

FROM ONLY £179.98 EX.VAT £215.98 INC.VAT

XR80

MODEL	MAX OUTPUT	EXC.VAT	INC.VAT
XR60	14.7kW	£179.98	£215.98
XR80	20.5kW	£229.98	£275.98
XR110	29.3kW	£279.98	£335.98
XR160	46.9kW	£329.98	£395.98
XR210	61.5kW	£369.98	£443.98

Clarke HEAVY DUTY PETROL POWER WASHERS

PLS195

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Multimeter Masterclass

Part Two: Following on from last issue's introduction to multimeters, **Dave Rogers** looks in more detail at the measurement procedures that are used in typical automotive applications.

Mastering the practical aspects of using your multimeter to take the most commonly required measurements – volts, amps and ohms – will ensure that you get accurate, reliable results every time. We'll outline some of the measurements and applications that are possible with your device.

Alongside this information, we'll look at some considerations you need to think about when buying yourself a device, as well as a glossary of multimeter-related terminology.

Safety first

- Never use a multimeter on mains equipment or other electrical systems or components where high voltages occur unless you are experienced or qualified to do so.
- As a general rule, if you are inexperienced you should only measure systems below 50 volts AC or DC. If you are in any doubt, don't!
- Only use the correct meter leads to execute measurements.
- If the fuse blows in the meter then replace it with one of the same rating.
- Check and double-check the leads and dial setting before measuring.

Voltage measurement (Volts)

Voltage is a measure of the system 'pressure' which pushes the current around a circuit and is measured in volts. Before attempting to read the voltage, connect your meter across the vehicle battery – this shows that the meter is working and that the battery is not flat. Note that in voltage range setting, the resistance of the meter is 'high', so that it doesn't affect the circuit being tested by being a significant additional current path.

To measure voltage, simply plug the leads into the appropriate jack sockets in the multimeter. Use the dial to select the correct measurement range: for a 12-volt vehicle system, it's between 10-20 volts, or, if the meter is capable of auto-ranging, just select 'DC volts'.

Now connect the leads: for negative earth cars, connect the black lead to a good earth and the red lead to the test point; for positive earth vehicles, the leads are connected the other way round. You can establish the earth polarity by simply looking at which battery terminal is connected to the chassis ground. In nearly all cases it will be the negative terminal, which means negative earth. The exception will be vehicles fitted with dynamo charging systems, manufactured before 1970; these could be positive earth. The display will show the voltage potential at the test point. The test point should show a voltage reading similar to battery volts.

Practical Measuring Tips

- Most multimeters measure both AC (Alternating Current) and DC (Direct Current). For vehicle applications, you will be measuring DC almost exclusively.
- When measuring, make sure the meter is set to the correct mode – AC volts, DC volts, etc – before you connect to the test point.
- Make sure you correctly connect the test leads for the mode you want to measure. There are normally different jack sockets for current and voltage. If you don't connect them correctly, you will either get no reading or you could damage the meter.
- Some meters are auto-ranging, which means they are able to automatically detect the correct range according to the input. However, with some meters you have to select the range manually. Take care when doing this; if you are not sure which range you need, start at the highest and work your way down the scale.
- Most digital multimeters will read a maximum current of 10 amps and are fitted with an internal fuse. If they are overloaded, the fuse will blow before the cables or the meter can be damaged.

Buyers Guide

▶ You can get a lot of multimeter for your money, but you need to make sure that all of the basics are covered in the device that you finally choose. It's also possible to end up with features on your device that you don't need, so make sure you are clear in your mind about your own requirements and what you personally need from your multimeter.

Generally, the more you pay, the more you get, but there are also some exceptions that offer great value. A typical multimeter needs the following basic features, which are essential for the advanced DIY mechanic or practicing technician, who will mainly use the meter for electrical fault-finding and testing their vehicles:

- ▶ DC volt measurement up to 50 volts, with high input resistance (also known as input impedance) – we would suggest this at a value of 10Mohm/volt.
- ▶ DC current measurement up to 10 amps, preferably fuse protected.
- ▶ A large clear display with a minimum of 3½ display digits.
- ▶ Resistance measurement mode. ▶ Diode check mode.
- ▶ Audible continuity test mode.
- ▶ Decent length leads are essential for use around the vehicle – look for leads of approximately 1 metre

As a basis for purchasing, look at the following key criteria:

Quality/durability A multimeter is a precision measurement device and should always be treated as such. However, the garage or workshop is a harsh environment and the meter must be able to stand up to this. The meter has to be well made, durable and able to survive the odd knock and bump (or worse!).

Usability You need a meter that is easy to use and understand. A large, clear display and a logical operating panel for selecting the correct range and mode are essential – auto-ranging is also a useful feature. Clearly marked connector jacks, decent length leads and a good instruction manual should also be expected.

Features/functions Apart from the basic requirements, some meters have useful extra features and these should be considered – in particular, any features that make measuring easier or are specifically useful for automotive applications (for example, backlit displays and lead connection indicators).

Price/performance Paying a higher price is acceptable, as long as you get some added value for the additional cost. Look for additional features or better quality construction for the more expensive units. Make sure that nothing is missing on budget-priced units.

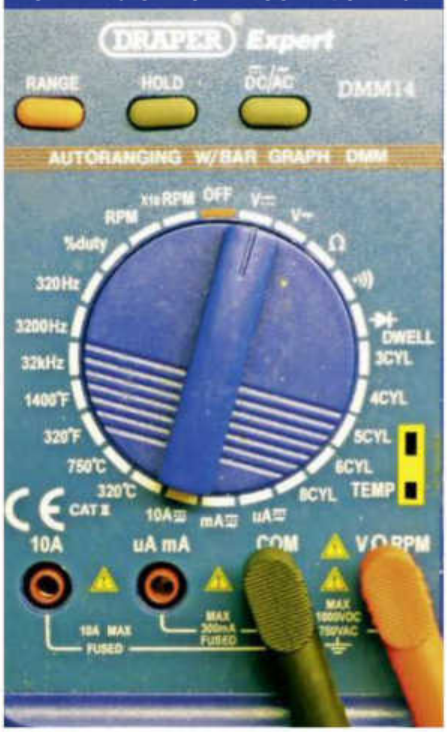
Current measurement (Amps)

Electrical current consists of electrons travelling down a cable, like water flowing down a pipe, and current measurement can be likened to the flow rate and is measured in amps. Nearly all digital multimeters can measure current up to about 10 amps. This is enough to check current in many vehicle circuits with smaller devices – for example, lighting circuits.

To measure the current, the meter must be connected 'in-circuit'. Set the meter range to 'Amps' – the highest range first if the device is not auto-ranging. Plug the leads into the correct jacks on the device (note that often there is a separate jack for measuring current at 10 amps). Energise the circuit and note the reading on the display. For lower current readings, most meters are capable of reading milliamps (one thousandths of an amp) with the appropriate range selected.

Note that in the 'Current Range' setting the resistance of the meter is 'low', so that it doesn't affect the current flow in the circuit being tested. Never connect the meter across the battery or any other voltage source when in the 'Current Range' setting.

1 SETTING UP TO MEASURE VOLTAGE



First, you need to decide what you want to measure and set the meter accordingly. Here, we have selected 'DC volts' mode and connected the leads to the appropriate sockets. The meter is auto-ranging, so no range needs to be selected.

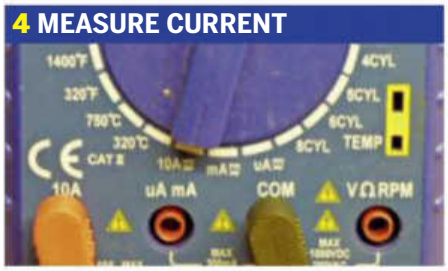
2 CONNECT UP IN PARALLEL

We need to connect to the circuit. In this case, we're looking at the voltage supply at the headlamp connector. Using the meter probes, we've connected directly to the positive and earth terminals at the disconnected socket. It would also be possible to connect from the back, whereby the connector would remain in place.

3 MEASURE THE VOLTAGE

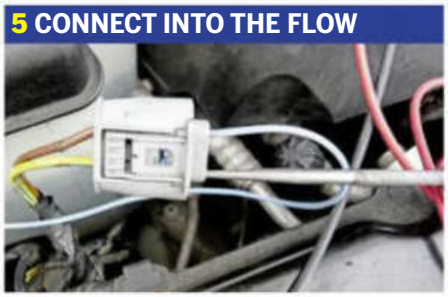
Now we are ready to measure. Switch on the circuit (if required) and note the meter reading. Give the meter a second or two to stabilise, then read the display, noting the position of the decimal point. In this case, we're seeing 12.10 volts at the connector with no circuit load.

4 MEASURE CURRENT



First, set up the meter, current measurements use the 'low resistance' sockets of the device. In addition, you need to set the current mode correctly. Here, we're measuring a substantial current of a headlamp bulb, so the 10-amp range is the correct one. This will be the most commonly-used range for vehicle work.

5 CONNECT INTO THE FLOW



A current measurement with a multimeter will be intrusive, meaning breaking into the circuit to connect the meter so that the current will flow through the meter itself. Here we've used a small jumper leader to connect the meter to the headlamp socket terminals temporarily.

Resistance measurement (Ohms)

Any current-carrying conductor will have some resistance to the current flow, much like a kink in a hosepipe restricts the water flowing through it. For electrical systems, this property is measured in ohms.

To measure resistance, the first step is to completely isolate and/or disconnect the circuit or component you wish to test. If you do not do this, you may damage the meter or get a false reading – or both!

Plug the leads into the meter jacks for resistance measurement and select 'Ohms' on the selector dial, selecting the correct range if necessary. Connect the multimeter leads together and observe the meter reading – it should settle on zero. Next, connect the lead ends to the device or circuit under test and observe the display; the meter applies a voltage to the component and measures the current flowing through it. From this, the meter can establish the resistance of the test subject.

Glossary of multimeter-related terminology

- **AC** Alternating current. Direction of current flow in a circuit is continually reversing, as is the case for mains current supply.
- **DC** A unidirectional current flow – for example, from a battery.
- **Voltage** Electrical 'pressure' in the circuit that pushes the current around, measured in volts.
- **Current** Electrical 'flow' around the circuit, measured in amps.
- **Resistance** Any current-carrying conductor has some opposition to the flow of current (which is a flow of electrons) – this is the resistance, measured in ohms. It results in loss of energy in a circuit, which is dissipated as heat.
- **DMM** Digital multimeter.
- **AVO** Amps/Volts/Ohm-meter.
- **Auto-ranging** Indicates the meter can select the range automatically and the user just has to set the measurement mode.
- **Diode** A device that has two terminals and has a high resistance to current in one direction and a low resistance to current in the other direction.
- **RMS** Root/Mean/Square. The value of AC current that will produce the same heating effect in a load resistor as the corresponding value of DC current. The RMS value of an AC waveform is 0.707 of the peak amplitude of the sine wave.

6 READ OFF THE DISPLAY

Now you can energise the circuit and take a reading. Be careful to ensure that any temporary wiring does not short circuit. In this case, with the circuit operating (ie, with the lights switched on), we can see a reading of just under 4 amps, which is the expected value for a bulb of this wattage.

7 MEASURE RESISTANCE

As before, set up the meter first, making sure the leads are in the correct sockets and that the mode and range setting are correct. Resistance measurements use the 'high resistance' inputs. The resistance setting is denoted by the ohm symbol, which looks like a horseshoe, as shown in the image.

8 CONNECT OUT OF CIRCUIT

For a resistance measurement, we need to connect out of the working circuit (ie, to connect in isolation to the unit under test). In this case, we've disconnected the headlamp bulb and we are directly connecting the meter across the bulb terminals using leads with crocodile clips.

9 TAKE THE READING

◀ The picture shows the reading from the main beam bulb. This is less than half-an-ohm, which is quite low, but remember that the filament will be cold, thus resistance will be low; the resistance will increase with the heat of operation. Bear this in mind as a reading from the meter could be misleading if you don't fully understand what you're doing.

Summary

A digital multimeter is a useful piece of kit, particularly units with specific extras that apply to automotive use. However, you don't need to spend a fortune – all multimeters will read volts, ohms and amps, and those are the basic functions you need for electrical system fault-finding. The most important things to look for are a good quality, durable unit with a protective case or holder that will stand up to the garage environment.

FEATURE AUTHOR

Dave Rogers is a trained master technician and auto electrician, as well as a technical author. Find out more at **www.autoelex.co.uk** or follow Dave on Twitter @Autoelex

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PART FOUR: Our S60 has a wobble under braking at higher speeds, plus we have a suspected power steering leak and issues with the swirl flaps. **Andrew Everett** sorts these problems.

As our S60 was Swedish and modern, we were expecting it to be a complex job to work on the rear brakes, involving wind-back calipers and the usual problem of brake discs retaining rounded-out set screws, not to mention the pain of cleaning up and adjusting the rear handbrake shoes. Well, we had none of that.

The rear calipers are conventional and the discs have a proper 10mm retaining bolt. Best of all, the handbrake mechanism inside the rear disc does not need adjustment – it's all spring located and adjusted on the handbrake lever, and when the shoes are worn out, you just fit new ones. However, we would advise cleaning the handbrake mechanism and applying a bit of spray grease.

Leaking or not?

With regards to the suspected power steering leak... we couldn't find one. The rack and connectors are bone dry – sometimes you can squeeze the rack gaiters and they are full of PAS fluid, but not in this case.

We were puzzled as to why there was no fluid in the reservoir and have a feeling someone syphoned it out before we bought the car. We added half-a-litre of the correct oil – the Halfords Advanced equivalent of Volvo/Ford WSS M2C204A – on the day we bought the Volvo and, over 2000 miles later, it hasn't used a drop.

These Volvos can have a problem where the seams split on the PAS reservoir. The answer is a new reservoir – Volvo did a recall on these. Also, the lower hose connection to the reservoir can leak, but ours had already been modified by replacing the standard clip with a Jubilee clip. Maybe it was replaced and the mechanic forgot to refill the reservoir?

JOBS LIST

✓ REPAIR REAR BODY AND BUMPER DAMAGE	PART 2 JAN 16
✓ ENGINE SERVICE	PART 3 FEB 16
✓ CAMBELT, TENSIONERS AND WATER PUMP	PART 3 FEB 16
✓ FIND AND REPAIR PAS FLUID LEAK	PART 4 MAR 16
✓ CHECK AND OVERHAUL BRAKES	PART 4 MAR 16
✓ RENEW SWIRL FLAP ACTUATOR	PART 4 MAR 16
✖ CHECK/CHANGE GEARBOX OIL	
✖ CHECK AND OVERHAUL STEERING AND SUSPENSION	
✖ REPAIR DRIVERS ELECTRIC WINDOW	
✖ REPAIR DRIVERS SEAT AND INTERIOR PLASTICS	

Plus anything else that goes wrong in the coming months

INVESTIGATING THE PAS RESERVOIR

1 The plastic PAS fluid reservoir often leaks from the seam that joins the upper and lower parts, and both the supply and return pipes can also leak. On our S60, the original factory clips had been replaced with better Jubilee types.

2 There are two types of PAS reservoir on the S60 and S80, the left one (like ours) has both return and supply pipes at the base, while the other type (mainly petrol models) has the return near the top. Both types slide into a bracket, with no screws to undo.

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Swirl flap actuator

We have also uncovered why the Volvo isn't going as well as it might and why it has been struggling to get past 37mpg when we know these five-cylinder oil burners can do 45mpg on a steady run.

Like many diesels, the S60 has a swirl flap set-up in the inlet manifold. The Volvo inlet manifold is built into the plastic cam cover, but there is only one swirl flap at the intake entrance and it doesn't go wrong. However, the electronic actuator does, and the plastic actuator rod can break or fall off.

The result is the 'ENGINE SERVICE REQUIRED' message and a noticeable flat spot over 3000rpm. We fitted a new actuator and the performance/economy were both transformed.

Fitting the actuator rod the way the old one came off resulted in the arm dropping off again because the ball pin at the engine end of the swirl flap arm is worn. Fixing this involves removing the cam cover and inlet manifold to fit a new swirl flap arm. But we had a good tip: just fit the new arm the 'wrong' way round and it clips on fine.

FITTING A SWIRL FLAP ACTUATOR

1 Here is the new actuator from Volvo. It must be a fairly common issue because we found it had been removed from the few S60 and S80 diesels we found in breakers yards. The part number is 30756099, but check with Volvo to make sure.

2 This photo shows the back of the new actuator and the actuating arm. It's commonly thought that the arm can be moved by hand, but it can't – don't think that it's seized! The actuator self tests every five start-ups so you can check if it works or not.

3 The actuator is very easy to remove. Just undo two 10mm bolts, unclip the plastic actuator rod and off it comes. The bolts are a little tricky to access, so we used a ¼-inch drive and a small ratchet with an extension, but you can do it with a ⅜-drive.

4 This electrical connector can be a bit tight to get off after a few years. Even so, we managed it in just a second or two with a flat-blade screwdriver. Do not try and test the motor with a 12-volt supply as you will damage it.

5 These are the two types of link rod. The upper rod is the original type and the lower one is the later one requiring a new swirl flap mechanism. Ours has the upper one, and we bought this new from Volvo for less than six quid.

6 Fitting the rod the correct way around resulted in it dropping off at the engine end; this is because the plastic ball had worn. Fitting it the 'wrong' way round resulted in a nice snap fit and a good fix! Dab a bit of grease on the ball ends once fitted.

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SORTING THE FRONT BRAKES

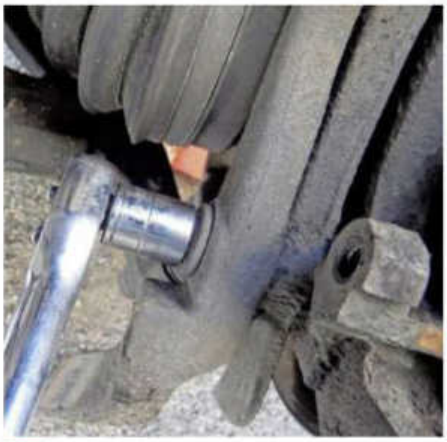
1 These are standard front discs with Ate calipers, but before you order new discs, measure the circumference of the old ones as the S60 can be fitted with either 285, 305 or 320mm discs. Our Sport model had 285mm stoppers.

2 The discs on our S60 had a minimal wear lip, while the pads still had plenty of material. We stripped and cleaned everything in the hope it would stop the vibration under braking, but it appeared one or both of the discs were warped.

3 Unlike many car manufacturers, Volvo doesn't use a set screw to secure the disc to the hub. Instead there's a 10mm bolt that's easy to remove. This means the factory wheels need to have recesses – bear that in mind if you fit aftermarket wheels.

4 The next job is to remove the calipers so that we can take off the old discs. Start by using a flat-blade screwdriver to extract the brake pad anti-rattle spring. During dismantling we found no trace of copper grease – the cause of the vibration?

5 Next, take out the black plastic caps and remove the two brake caliper slider pins using a 5mm Allen key as shown. Give the pins a good clean with fine emery and, upon refitting, coat them in copper grease so the caliper moves smoothly.



6 Use a 16mm socket and bar to undo the two bolts securing the brake caliper carrier to the front hub. These two bolts should be torqued to 100Nm on reassembly – smear a little copper grease on the thread, but it's not essential.

7 The Volvo S60 and S80 use this doubled-up brake caliper retaining bracket, but the lower part is actually a steering lock stop. It has a rubber stopper and prevents the front wheels from jamming against the inner wing on full lock.

8 With the disc removed, we found no evidence of copper grease between the disc and the hub to prevent corrosion forming and the disc going out of true. We found some minor rust that needed cleaning with emery paper, but not enough to cause issues.

9 The reason our brakes were vibrating under use became clear when we got the old discs off. For some reason they have these fine cracks in the outer surface and are quite badly warped – we'd be interested to know what make they are.

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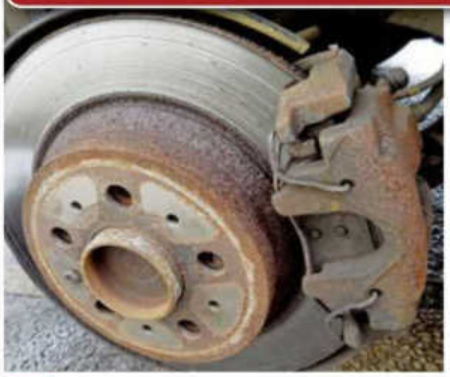
10 Fit the new brake disc to the cleaned and copper greased hub and do up the 10mm retaining bolt (10Nm) before fitting the cleaned up caliper bracket. For the best results degrease the disc and paint the inner 'bell' area with Hammerite so it doesn't get rusty.

11 Looking much better than before. The new brake pad end 'ears' were lightly coated in brake grease and are now good for thousands more miles. More importantly, the car now brakes quietly and smoothly – the wobble has totally vanished.

SORTING THE REAR BRAKES

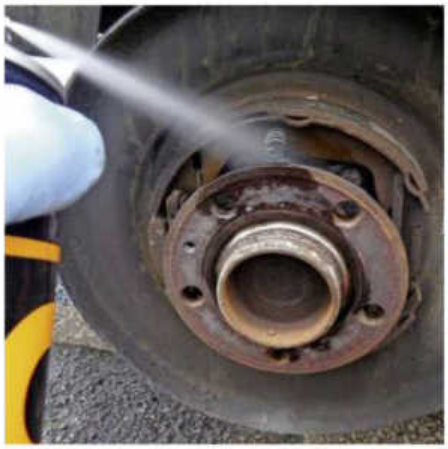


1 The rear discs mirror those on the front with the 10mm retaining bolt. The handbrake shoes are inside the centre brake disc 'bell'. Notice how the ends of the anti-rattle spring locate behind the 'ears' on the caliper itself. Ours had been fitted incorrectly.

2 As with the front brakes, use a 5mm Allen key to remove both caliper slider pins. These fit into the rubber sleeves – if they are tight, the caliper can stick. On reassembly they are torqued to 28Nm, both front and rear – do NOT overtighen!

3 Autosessive supplied the new DriveTec discs. They come in either 'dry' form with a light grey coating that must NOT be removed (it's there to bed in the pads) or, in this case, coated in protective grease, which needs to be cleaned off with an aerosol brake cleaner.

4 With the caliper unbolted and tied up out of the way to avoid straining the flexible hose, undo and remove the two 15mm rear caliper bracket bolts. Like the fronts, you can use some copper grease or mild thread lock, then torque to 60Nm.



5 To get the disc off, chock the front wheels before releasing the handbrake. With the rear disc off, it's time to look at the handbrake shoes. Ours were still in perfect condition, but they are cheap to buy and easy to replace, if required.

6 Before refitting, the caliper brackets need to be cleaned. A wire brush will get things started, and, if required, use a coarse flat file to clean the areas where the pads fit back to bright metal, before smearing lightly with copper grease.

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SORTING THE REAR BRAKES *continued*

8 These are the new DriveTec pads from Autosessive. They are in a similar price range to Pagid and Ate, and they work well. Before fitting, smear the backs and 'ears' lightly with copper grease or clear brake grease to avoid brake squeal.

9 This is the leading edge of the handbrake shoes – there is still lots of material on these and they're nowhere near ready for changing. To replace them, there is just a simple long spring to unhook at this end and two spring backplate clips.

10 Remember we said the handbrake shoes were easy to replace? That's because there is no adjuster in here. Take off the old ones, fit the new ones and before fitting the drum, fully slacken the single 10mm nut on the handbrake lever.

11 Before the caliper goes back on, the caliper piston will need to be retracted fully. You can use either a big pair of gas pliers, as shown, or a G-clamp. When you do this, remove the brake master cylinder cap, watching out for excess fluid spilling over.

PROJECT COSTS

£1497.00

PARTS & RUNNING COSTS

Annual road tax	£205.00
Repairs to offside rear wing	£960.00
Bonnet respray	£190.00
Water pump	£55.00
Gates cambelt	£45.72
INA tensioner kit	£99.59
Oil & filter change (inc materials)	£94.00
Labour to replace belt & water pump	£72.00
Antifreeze	£12.00
Auxiliary belt	£39.54
Front brake discs (pair)	£66.67
Front brake pads	£32.13
Rear brake discs (pair)	£47.39
Rear brake pads	£24.50
Swirl flap actuator (Volvo)	£166.44
Swirl flap actuator rod (Volvo)	£5.52
TOTAL COSTS	**£3612.50**

NEXT ISSUE

We fit an Eibach lowering spring kit, inspect the steering and suspension, and check if a rogue MAF fault code has returned.

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Parkside Autos (Worksop)
01909 506555

12 The new disc is on, the bracket refitted and the pads are in place. Smear a bit of copper grease (or brake assembly grease on alloy calipers – copper and aluminium don't mix) on the pads as shown, but avoid getting any on the brake disc face itself.

13 Finally, adjust the handbrake again. There is no adjustment on the actual shoes as it's all done here on the lever. Flip up the leather gaiter and get a long 10mm socket on the nut, adjusting it clockwise – about four or five clicks is ideal.

Ametech fixes most Mazda RX8 hot start issues

How Restore Works

WHAT IS RESTORE AND WHY SHOULD I USE IT?

Every vehicle's engine wears out as a result of fricton during normal operation. This friction causes wear of the cylinder walls which leads to compression loss. Lost compression results in your engine having less power - - ***it runs poorly and has sluggish acceleration.*** It also can cause ***increased oil burning, exhaust smoking, and poor fuel economy.***

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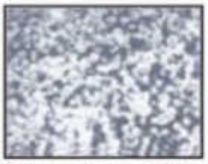
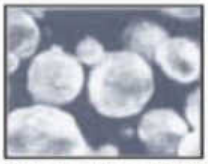
RESTORE is the **only product** that contains the proprietary **CSL** formula. This technologically advanced formulation has the unique mechanical and chemical properties that fill in and seal micro-leaks in the cylinder wall. The result is **increased engine compression and more engine power.**



CSL Particles 400X



CSL Particles 4000X

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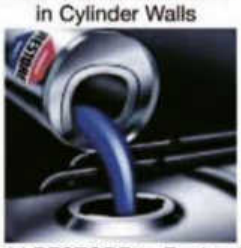
Wear Causes Scratches in Cylinder Walls



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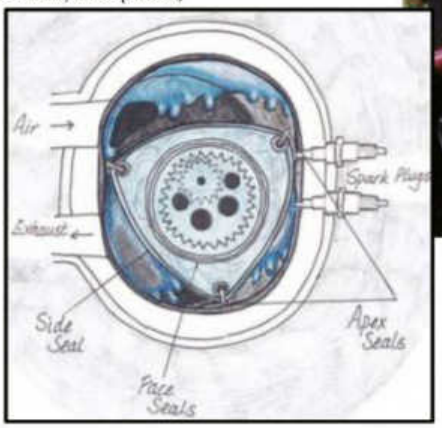

Feedback received from real eBay customers who used one 400ml can of Ametech Engine Restorer to help cure RX8 hot start issues:

I was very skeptical but it works. Rx8 starts just as easily hot as cold now! (mdrmaintenance)
Excellent product my rx8 is much improved, helpful seller (drakeysgottoo)
Worked on my RX8 helped starting (bac1460)
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Almost a miracle for my RX8 (hales7341)
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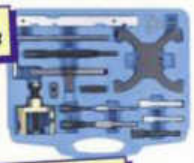

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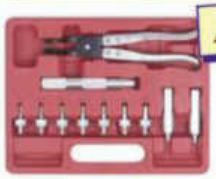

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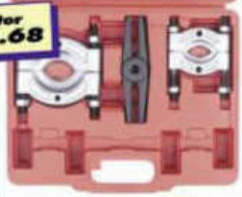

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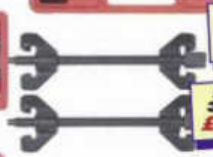

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Digital tyre depth gauge		£4.80	£5.76

TESTING EQUIPMENT

Cylinder Leak Detector £21.83 £26.80

NEW!

Cylinder leak detector	£21.83	£26.80
Fuel injection test port	£19.38	£23.26
Diesel engine compression test	£27.20	£32.64
9 piece petrol engine compression test	£14.92	£17.90
Flow meter common rail set	£21.20	£25.44
Radiator pressure test kit	£47.20	£56.64

LED LIGHTS

Rechargeable workshop light - 30 LED	£16.25	£19.50
Rechargeable under bonnet light - 120 LED	£39.50	£47.40

CIBIE LIGHTS & COVERS

Cibie 'Oscar Style' Lamp £39.00 £46.80

Genuine Cibe Oscar		£89.50	£107.40
Genuine Cibie Super Oscar		£99.50	£119.40
Pattern 'Oscar' lamp, E-marked		£39.00	£46.80
Pattern 'Super Oscar' lamp, E-marked		£44.50	£53.40
Spare Oscar light cover	pair	£15.90	£19.08
Spare Super Oscar light cover	pair	£19.90	£23.88

BATTERY CONNECTION PARTS

NEW!

Quick disconnect, cable connector & anti-corrosion washers	set	£4.90	£5.88
Terminals, 13.5mm post	pair	£2.90	£3.48
Terminals, 16.5mm post	pair	£2.90	£3.48
Washers and terminal boots	set	£2.50	£3.00
Hydrometer tester		£1.90	£2.28

WELDERS - ARC, MIG & TIG

NEW!

MIG 200 amp £194.48 £233.38

Arc welder, 200 amp	£93.29	£111.95
Mig welder, 120 amp	£87.88	£105.46
Mig welder, 200 amp	£194.48	£233.38
ARC & TIG welder, 180 amp	£157.20	£188.64

PROFESSIONAL Starter/Chargers

Starter/Chargers from... £47.32 £56.78

NEW!

Starter/Charger, max. 45 amp	£47.32	£56.78
Starter/Charger, max. 100 amp	£98.70	£118.44
8 stage charger - reconditions deeply discharged lead acid batteries	£29.80	£35.76
1kw inverter - incl. USB port	£99.90	£119.88

NEW!

All for just £149.70 £179.64

BlackLine

POWER TOOLS

450Nm Cordless Impact Wrench Set

Includes powerful 450Nm wrench (reverse), 120Nm (forwards), impact socket set, (1) 72T ratchet handle, (1) extendable ratchet handle, (2) x 4a Samsung batteries and quick charger

OTHER BLACKLINE POWER TOOLS & ACCESSORIES

450Nm Impact wrench, mains 240v	£47.82	£57.38
16 piece Impact socket set, 1/2" drive	£15.64	£18.77
Standard ratchet handle, 72 tooth, 1/2" drive	£7.98	£9.58
Extendable, 180° head ratchet handle, 72 tooth, 1/2" drive	£15.79	£18.95
4Ah Samsung spare lithium battery	£32.98	£39.58
Torque wrench, 40-210Nm (30-155lb ft)	£33.90	£40.68
5 piece twist socket set, 1/2" drive	£19.92	£23.90
Universal ball joint impact socket, 1/2" drive	£8.25	£9.90
250Nm lightweight impact wrench, 3/8" drive	£74.80	£89.76
13 piece impact long-reach socket set, 3/8" drive	£11.58	£13.89
1.5Ah Samsung spare lithium battery	£13.25	£15.90
Cordless power drill, 18v, 52Nm torque	£41.50	£49.80
19 piece cobalt drill set, din 338, 1-10mm	£16.58	£19.90
Cordless screwdriver, 7.2v, lightweight, 6 torque settings	£19.42	£23.30
Angle grinder, 1100w x 125mm diameter, 1100rpm	£23.00	£27.60
Polisher, 800-3000rpm, 180mm pad	£39.83	£47.80
Heat gun, 2000w, 50-650°, 500 ltr/min air flow	£24.92	£29.90
170w mini grinder (tool only)	£23.90	£28.68
170w mini grinder plus 130 piece rotary tool set	£33.90	£40.68

BlackLine

Portable Generators

0.9kw Portable generator	£82.42	£98.90
1.2kw Portable generator	£124.58	£149.50
2.5kw Workshop generator	£166.58	£199.90
3.0kw Workshop generator	£229.08	£274.90
ELP 2.0kw Inverter/Generator (suitcase style)	£331.67	£398.00

Tools - BIG RED JACKS

2.0 Ton Nascar Quick Jack £141.25 £169.50

JACKING EQUIPMENT

3.0 ton Trolley jack	£36.50	£43.80
2.0 ton, loin profile 'Pro' garage jack	£136.65	£163.98
3.0 ton, loin profile 'Pro' garage jack	£186.40	£223.68
3.0 ton double lock 'Pro' axle stands - pair	£19.50	£23.40
2.25 ton lightweight jack	£49.25	£59.10
2.0 ton 'Nascar' quick jack	£141.25	£169.50
3.0 ton 'Pro' axle stands, pair	£24.58	£29.50
Wheel skate, hydraulic lift - each	£49.58	£59.50
Wheel dolly, pair	£39.50	£47.40
750lb engine stand	£41.25	£49.50
1500lb flodable engine stand	£58.05	£69.66
Engine cradles - pair	£49.50	£59.40
3in1 tool box set	£35.90	£43.08
Trolley style tool box	£79.90	£95.88
Wheel ramp set	£57.92	£69.50
Tyre saver parking mat - pair	£12.42	£14.90
Anti-skid grid, rollable	£22.65	£27.18
Electric hoist, 200kgs	£58.76	£70.51
Electric hoist, 500kgs	£87.51	£105.01
Car creeper, lightweight, 36"	£11.90	£14.28
1 ton engine crane, foldable	£119.50	£143.40
Workshop 'Button' seat, pneumatic	£23.50	£28.20

Tyre Carriers

NEW!

(4) Wheel tyre carrier	£24.92	£29.90
(4) Wheel tyre carrier, handle & lock	£39.80	£47.76

Tyre Carrier, handle & lock £39.80 £47.76

AIR COMPRESSORS

Prices from £29.50 £35.40

Double cylinder air pump, max 150psi (60ltrs/min)	£29.50	£35.40
Hi-flow air pump (150ltrs/min)	£59.50	£71.40

Sealey Air Compressors

NEW!

Prices from £92.98 £111.58

Direct drive compressors

1HP, 6ltr tank, 4 CFM	£92.98	£111.58
2HP, 50ltr tank, 6.8CFM	£124.98	£149.98
3HP, 50ltr tank, 12.6CFM (V-Twin)	£194.97	£233.96
3HP, 100ltr tank, 12.6CFM (V-Twin)	£246.97	£296.36

Belt drive compressors

3HP, 50ltr tank, 13.4CFM	£415.97	£499.16
3HP, 200ltr tank, 13.4CFM	£597.97	£717.56

Other sizes available on our website

www.rallydesign.co.uk

Air Compressor Tooling

15 piece 1/2" impact wrench kit	£25.18	£30.22
15 piece 1/2" ratchet wrench kit	£24.04	£28.85
50 piece 1/2" air tool kit includes ratchet, impact, air hammer & accessories	£59.40	£71.28
9 piece 190mm air hammer kit	£17.18	£20.62
6 piece air drill kit	£19.35	£23.22
3 piece HVLP spray gun kit	£29.63	£35.56
Clubman tyre gun, 0-220psi (15bar)	£6.92	£8.30
Pro tyre lance, dual head, 0-220psi (15bar)	£8.92	£10.70

TIE DOWNS & TOW STRAPS

Prices from £4.83 £5.80

NEW!

ALL BS CERTIFIED IN HIGH-VIS ORANGE COLOUR

35mm wide x 8mtr ratchet tie downs	pair	£9.84	£11.81
50mm wide x 12mtr ratchet tie downs	pair	£18.48	£22.18
50mm wide x 5mtr tow strap		£7.67	£9.20
50mm wide x 0.25mtr (10") tow strap (complies with MSA regs)		£4.83	£5.80

NEW!

X-Folding Wheel Brace

SEE CLEVER NEW FOLD (Patented)
17, 19, 21 & 23mm sockets
£11.93 £14.32

STEERING WHEELS

Prices from £39.50 £47.40

Natural Carbon from £159.50 £191.40

Black spokes, suede rim	£39.50	£47.40
Black spokes, black leather rim	£43.50	£52.20
Carbon look spokes, suede rim	£52.50	£63.00

PLEASE NOTE: All prices in Red are EXCLUSIVE OF VAT

Project MINI One R50 1.6

Tailgate & new gear linkage

Part Seven: In the final instalment, **Rob Hawkins** follows Mad 4 MINI as they replace the tailgate, renew the gear linkage and change the tyres.

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JOBS LIST

✓ FIX NON-RUNNING ENGINE	PART 2-4 OCT-DEC 15
✓ INVESTIGATE ENGINE OIL LEAK	PART 2 OCT 15
✓ SERVICE ENGINE	PART 4 DEC 15
✓ RENEW RADIATOR	PART 4 DEC 15
✓ SERVICE/RENEW BRAKE DISCS & PADS	PART 5 JAN 16
✓ FIX BOTCHED BRAKE PAD WEAR SENSOR WIRING	PART 5 JAN 16
✓ RENEW BRAKE PIPES & FLEXI-HOSES	PART 5 JAN 16
✓ INVESTIGATE PAS FLUID LEAK	PART 6 FEB 16
✓ FIT A REPLACEMENT WINDSCREEN	PART 6 FEB 16
✓ FIT NEW FRONT LOWER ARM BUSHES	PART 6 FEB 16
✓ TREAT RUST ON TAILGATE	PART 7 MAR 16
✓ FIT A NEW ROOF AERIAL	PART 7 MAR 16

Some people may be astonished by how much we've spent on our MINI One project, but we've transformed an auction-bought non-runner into a low-mileage car that only needs routine maintenance for the next five years to provide thousands of miles of trouble-free motoring. Had we bought a similar-aged example in good working order, we would have had to pay around £2500 and there would have been no guarantee that all of the parts would have been as good as new, so the final bill could have easily escalated towards the £4000 we've spent.

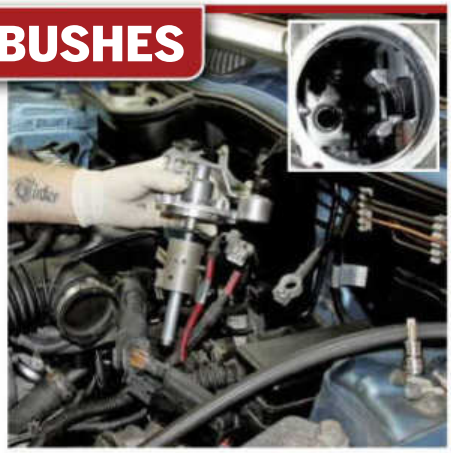
We have to admit that some of the jobs we've tackled turned out to be more expensive than we'd anticipated. The tailgate was one such case. We didn't manage to find a colour-matched tailgate and rejected several that were rusty or dented. Most secondhand tailgates are more than 10 years old, so we can't expect the world, especially when they only cost £100 + VAT. The tailgate we settled on was the best of a bad bunch; this was reflected in the respray, which restored it to good-as-new condition and with a perfect colour match. There is, however, a price to pay for such skilled and time-consuming work: the bodyshop spent four hours making sure all the dents and imperfections were removed, so we can't blame them for a final bill of £250 + VAT.

We've now completed 1800 miles in the MINI, thoroughly testing it to ensure the brakes are bedded in and that the replacement engine is behaving itself. So far, so good. This month, we're finishing off the series with the fitting of the replacement tailgate and a new set of tyres, an MoT test, some rustproofing and the easiest job of all, attaching a new roof aerial.

POWER STEERING PIPES & SUSPENSION BUSHES

1 The gear linkage in our MINI is noticeably notchy, so we decided to renew the assembly on top of the gearbox as this is often the cause of the problem. To access it, we had to remove the air filter housing, battery and battery tray.

2 After carefully prising off the ends of the two gear cables from the linkage, we removed the three Torx T40 bolts that secure the assembly to the top of the gearbox. We then extracted the assembly, noting how it is fitted.



3 Looking inside the gearbox, we could see how the gear linkage selects gears. We fitted the new one in position, sprayed light grease over the balljoint-style connectors for the gear cables, then refitted them. Job done.

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REPLACING THE TAILGATE

1 What started with a blown rear numberplate bulb led to the discovery of corrosion on the tailgate around the bulb securing area and the question of whether we needed to repair it or find a replacement. We opted to source a used one for £120, but it needed a respray.

2 We sent the MINI and the replacement tailgate to a local bodyshop, Invisible Touch, which colour-matched the tailgate to the original paintwork. They also removed any dents and made sure the finish would blend with the rest of the bodywork.

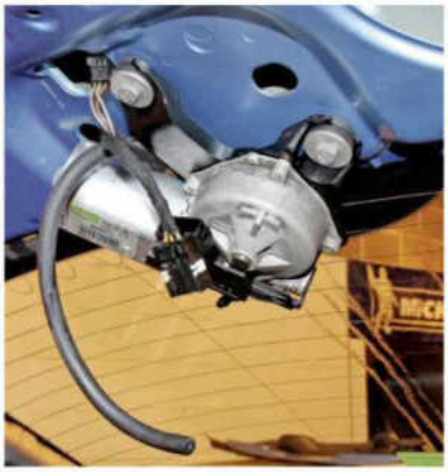
3 When we were ready to swap over the tailgates, we started by removing the unit that holds the numberplate lights and the electronic boot release switch. This is secured by four Torx T20 screws.

4 Our replacement tailgate didn't have any external trim, but it did have the glass and rear wiper. Using a trim tool, we carefully removed the old upper and lower trim from the original tailgate.

5 Our old tailgate has an optional spoiler. We needed to detach it in order to remove the high level brake light. We undid the two 10mm nuts from inside, then painstakingly prised it off (it's bonded onto the exterior).

6 The high level brake light is secured from inside with Torx T20 bolts, which can be accessed when the tailgate is open. Next, we detached the earth strap that is routed between the tailgate and the body, by undoing a 10mm nut.

7 The large inner trim panel on the inside of the tailgate has to be removed to be able to access the associated wiring, before disconnecting it. The panel is secured to the inside of the tailgate with six crosshead screws and some plastic clips.



8 The wiring for the rear wiper motor and the pipework for the rear windscreen wash need to be disconnected at the motor, then pulled through the tailgate. After releasing the washer pipework, it started to leak, so we bunged it with a bolt.

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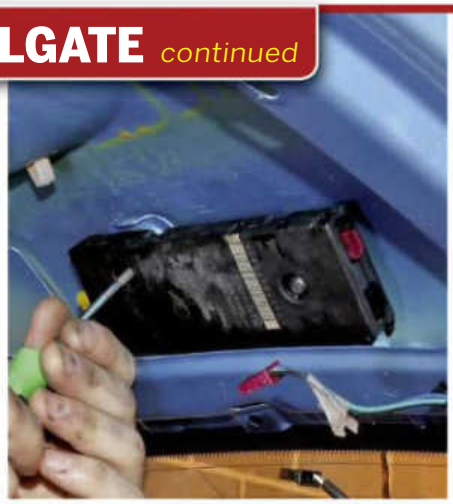
REPLACING THE TAILGATE *continued*

9 There were a number of small items that had to be transferred across to the replacement tailgate, such as these fixings for the parcel shelf cords, each one secured with a crosshead screw. We also had to unscrew a couple of rubber stops.



10 An aerial amplifier for the radio is fitted inside the tailgate. We had to move this amplifier over to the replacement tailgate, so we detached its wiring and undid two Torx T20 screws holding it in place.

11 There are three plastic pieces of trim fitted down the inside of the tailgate and along the bottom of the rear screen. Each one was clipped in position and needed prising off with a trim tool. These must be removed to be able to extract the wiring.

12 The most delicate parts of the wiring are the connectors for the heated rear screen plugs. We carefully detached them, making sure that the wiring we plan to reuse was in good condition.

13 The tailgate's striker locks it in position on the bodywork. It was in good condition and we didn't have one on the replacement tailgate, so we swapped it over by undoing two Torx T40 screws.

14 After unclipping the wiring from the rear screen pillars, we carefully fed it out of the top of the tailgate and into the roof of the MINI. This was a tricky task and took a few minutes to complete.

15 Here's all the wiring that's routed inside the tailgate. It's almost six feet long and needs to be preserved to ensure we don't have any electrical problems with the rear wiper, washers, radio and heated rear screen.

16 We were almost ready to remove the tailgate. After wedging some cardboard between the roof and the top of the tailgate, we detached the two gas rams, then undid the two Torx T40 bolts for the hinges.

17 Removing the old tailgate and fitting the new one is a two- or three-person job. Once the replacement tailgate was in position, we refitted the Torx T40 bolts and gas rams, then checked its alignment (the holes in the hinges are elongated).

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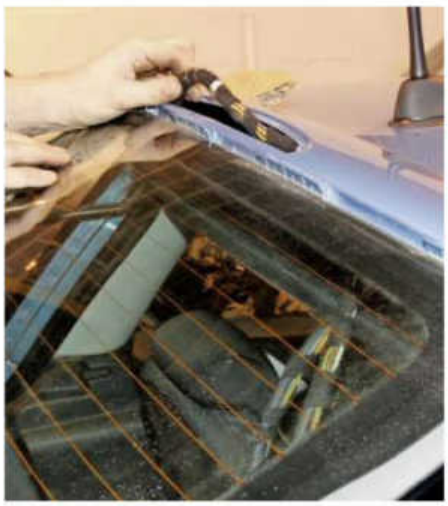
18 We fed a thick length of wire through the top section of the tailgate, attaching it to the respective end of the wiring loom and pulling the two back through. This helped on the offside, where space is tight.



19 The wiring loom that's routed through the nearside of the tailgate was a little easier to feed through because it could be accessed via the hole on the outside for the high level brake light.

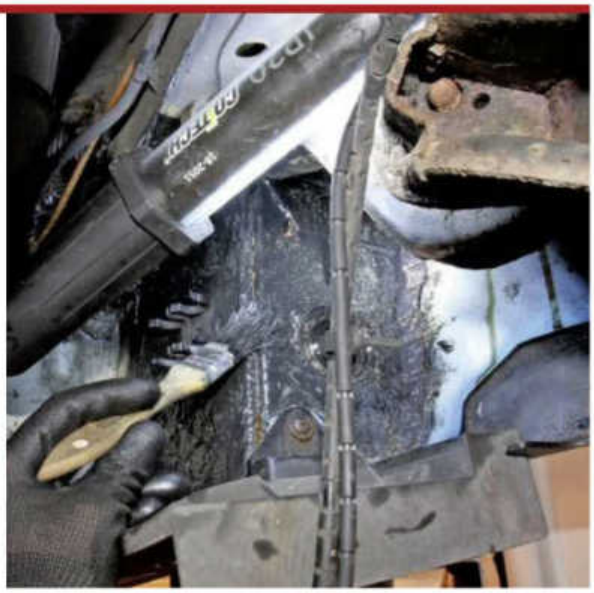
20 With the wiring in position, we tested the wiper. Sadly, the end of the washer jet had snapped off, so it wouldn't spray water over the rear glass. This is part of the motor, so we decided to reuse the one on our original tailgate.

21 More trouble arose when we tried to detach the wiper arm from the spindle on the replacement tailgate. It had seized, so we had to hacksaw through it so we could remove the motor.

22 We had similar trouble releasing the wiper arm from our old motor, snapping off the end of the arm, but we managed to make one good rear wiper and arm out of two. After fitting our old wiper motor, we tested it and the screenwash sprayed out.

RUSTPROOFING

1 While under the MINI, we noticed surface corrosion inside the sills. We've not heard of many problems with rust on these cars, but didn't want to take any chances, so we treated the corroded areas with POR-15 Cleaner Degreaser and Metal Prep from Frost Auto Restoration Techniques, then applied a coat of POR-15 Rust Preventative paint.



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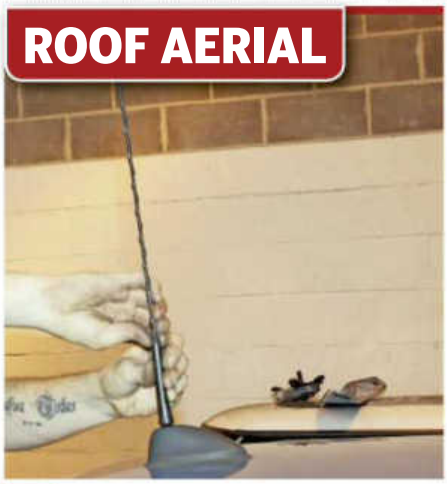
MINI MoT

1 We took our MINI One for its annual MoT on the day the old certificate expired. Every possible part that can fail had been renewed, so the car sailed through with no advisories.

ROOF AERIAL



1 This has to be one of the easiest repairs on our MINI. When we bought the car, the roof aerial was missing. A new one is simple to fit, as it's only held on by a screw thread.

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your local motor factors
www.blue-print.com

USEFUL CONTACTS

Blue Print www.blue-print.com
Mad4MINI 0113 276 1636
www.mad4mini.co.uk
Invisible Touch (bodyshop)
0113 252 5736
Frost Auto Restoration Techniques
01706 658619 www.frost.co.uk
Davanti www.davanti-tyres.com

FRESH TYRES

1 We had a mixed set of tyres on our MINI. Despite the treads being in good condition, the age of some of the tyres was reaching the recommended limit of six years. We decided to start 2016 with a new set of Davanti DX390 175/65 R15 tyres all-round.

PROJECT COSTS

PURCHASE OF CAR

£972.00

PARTS COSTS

Replacement 44K engine	£510.00
Air filter ADG02285	£6.98
Oil filter ADG02124	£2.96
Clutch kit ADG030148	£95.59
Clutch release bearing ADB113303	£10.68
Thermostat ADG09225	£26.32
Thermostat housing	£48.00
Radiator ADG09840C	£178.38
Auxiliary drivebelt tensioner ADB119601	£52.50
Auxiliary drivebelt AD06R870	£10.33
Used water pump from Mad4MINI	£25.00
Spark plugs	£24.80
Thread repair for spark plug hole	£144.00
MINI crankshaft pulley	£185.03
MINI steel water pipe	£148.80
Gaskets and seals	£5.50
HT leads ADG01630	£40.54
Engine and gearbox oil	£36.40
Sump plug	£5.50
Front brake discs (pair) ADG04374	£38.64
Rear brake discs (pair) ADG04375	£40.30
Front brake pads ADG04243	£26.40
Rear brake pads ADG04244	£19.65
Front flexihoses (pair) ADG05359	£38.44
Rear flexihoses (pair) ADG05356	£38.44
Handbrake cables ADB114601 & ADB114602	£55.28
Brake pad wear indicator ADB117202	£13.97
Copper pipe	£12.00
Exhaust system, gasket and new clamp	£86.40
Front lower arm bush (pair) ADG080146	£46.24
Droplinks (pair) ADG08525	£27.84
Anti-roll bar mount bushes ADB118005	£6.80
Windscreen renewal (fitted)	£140.00
A-pillar trim panels	£84.00
MINI gear linkage	£180.00
Replacement used tailgate	£120.00
Respray of tailgate	£300.00
Roof aerial	£6.00
MoT	£30.00
Davanti 175/65xR15 DX390 tyres	£187.80
TOTAL COSTS	**£4027.51**

Note: BLUE PRINT PRICES ARE RECOMMENDED RETAIL, BUT MAY BE CHEAPER THROUGH SOME STOCKISTS

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RING

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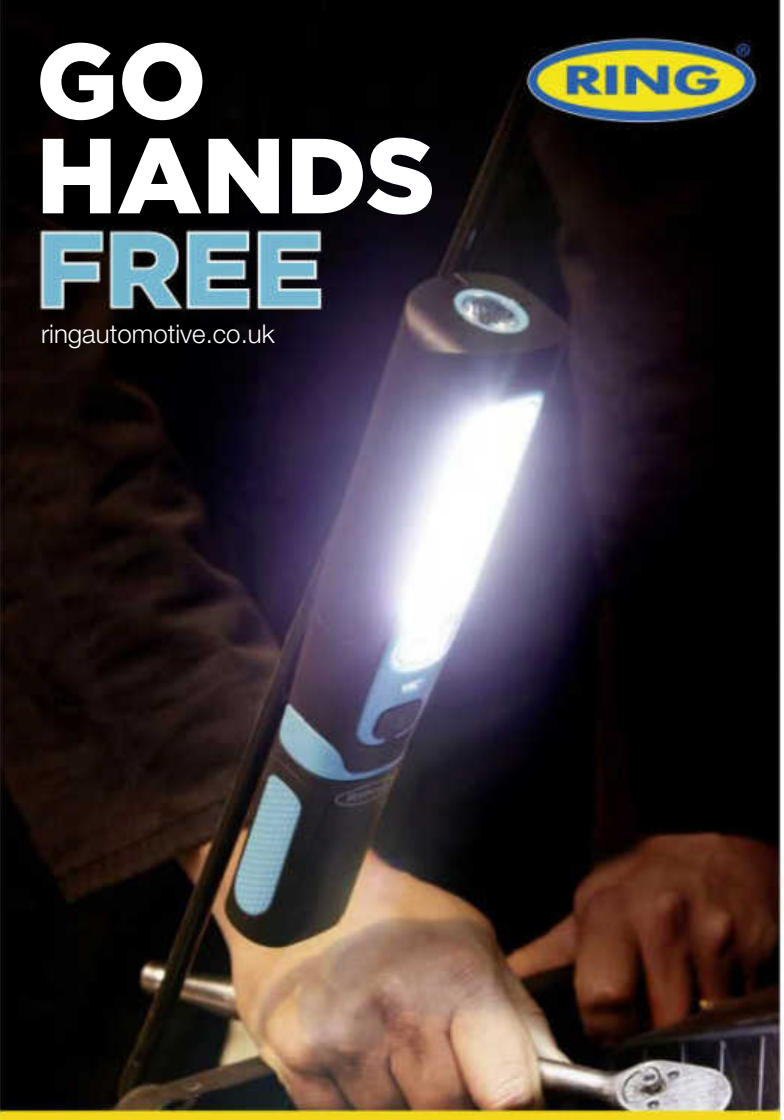

MAGflex RANGE

The MAGflex range of LED inspection lamps has been designed for hands free usage.

You can twist, hang, flex and fix the lamps to make sure you can position the light precisely where you need it.

LED

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Li-ion BATTERY

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RIL3600HP
MAGflex Twist

350 LUMENS

RIL4000
MAGflex

UV TORCH

440 LUMENS

RIL3100HP
MAGflex UV

Tools for the Workshop

6389/6390/6391

Extension Bars

- 6389 - 1/4"D
  6390 - 3/8"D
  6391 - 1/2"D
- Fast spin action.
- Quick release function/rotating sleeve.
- Length 185mm.
- Designed for use with any cordless drill complete with quick chuck.

6414

Power Bar/Impact Wrench 1/2"D

- Pneumatic powered impact wrench.
- Designed for use with the Laser Air Hammer - Part No. 6031.
- Designed for removing stubborn bolts in hard to reach areas.
- Length 560mm.

6429

Impact Socket Set

- Suitable for use with air tools and cordless impact wrenches.
- 19 Standard Sockets.
- 19 Deep Sockets.
- 1 x 125mm Extension Bar and 1 x Universal Joint x 1/2"D.
- Manufactured from Chrome Molybdenum.

6486

Low Profile Impact Socket Set - 1/2"D

- Metric.
- For tight areas in single Hex format (6pt).
- Manufactured from Chrome Molybdenum.
- Ideal for use with Mini Air Impact Wrench.
- Supplied on a socket rail.

6512

Super Slim Work Light - COB Bulb - 15 Watt

- Extremely bright and super slim makes this COB light an essential tool for any workshop, garage or tradesman.
- 170mm long, the lamp has an adjustable lumen switch that alters the brightness.
- Rechargeable with lithium battery with 360° magnetic base and hanging hook.
- Complete with charger and cable.

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We call in on those businesses making a difference to the motoring world, for an insight into their operations.

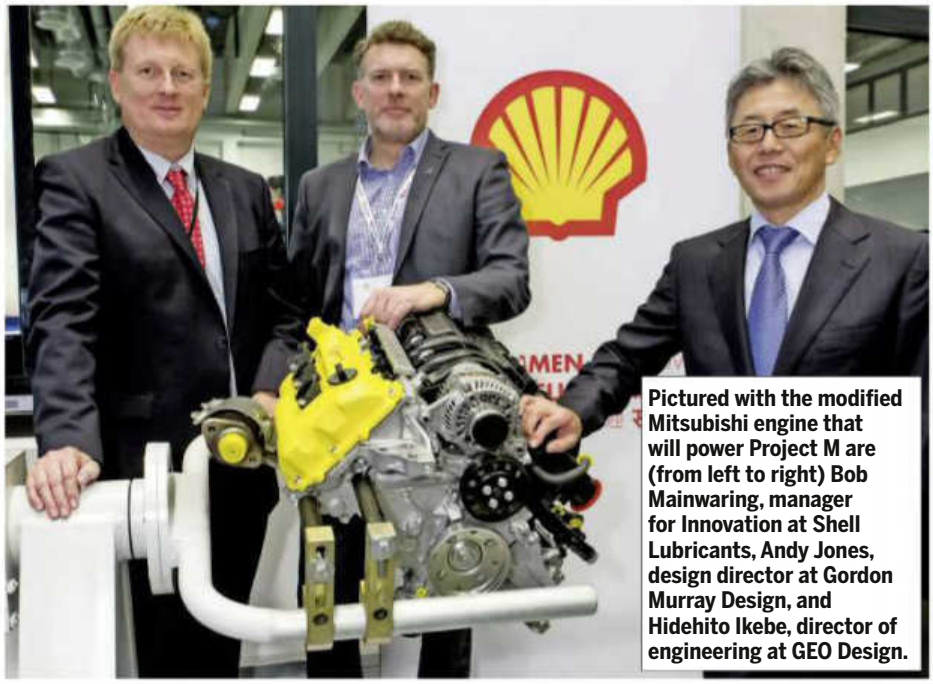
Shell Hamburg Technology Centre

Rob Marshall is given a sneak peek at Shell's Project M prior to its official launch, to discover how far current technology can enhance efficiency in passenger cars.

Was the UK government aiming for the impossible when it signed up to the Zero Emissions Alliance in Paris late last year, pledging that all new British cars would emit zero emissions by 2050? After all, OPEC's World Oil Outlook document, published in December, flew in the face of political posturing by stating that 78% of world energy needs would still be being met by fossil fuels in 2040. Who is living in a fantasy land: politicians or the oil-producing nations?

Shell Lubricants' vision of the medium-term future also appears to contradict the political viewpoint. By 2050, it predicts that not only will the internal combustion engine still be used, but also that the world's population will have ballooned to nine billion people, three-quarters of whom will migrate to cities, doubling global energy demands. All this is why, instead of employing new technologies such as electric or plug-in hybrid capabilities, Shell is funding an ultra-efficient petrol-powered prototype dubbed Project M – the 'M' stands for mobility.

The engine's output was reduced, but efficiency was increased by clever internal changes, coupled with ultra-low viscosity oil.



Pictured with the modified Mitsubishi engine that will power Project M are (from left to right) Bob Mainwaring, manager for Innovation at Shell Lubricants, Andy Jones, design director at Gordon Murray Design, and Hidehito Ikebe, director of engineering at GEO Design.

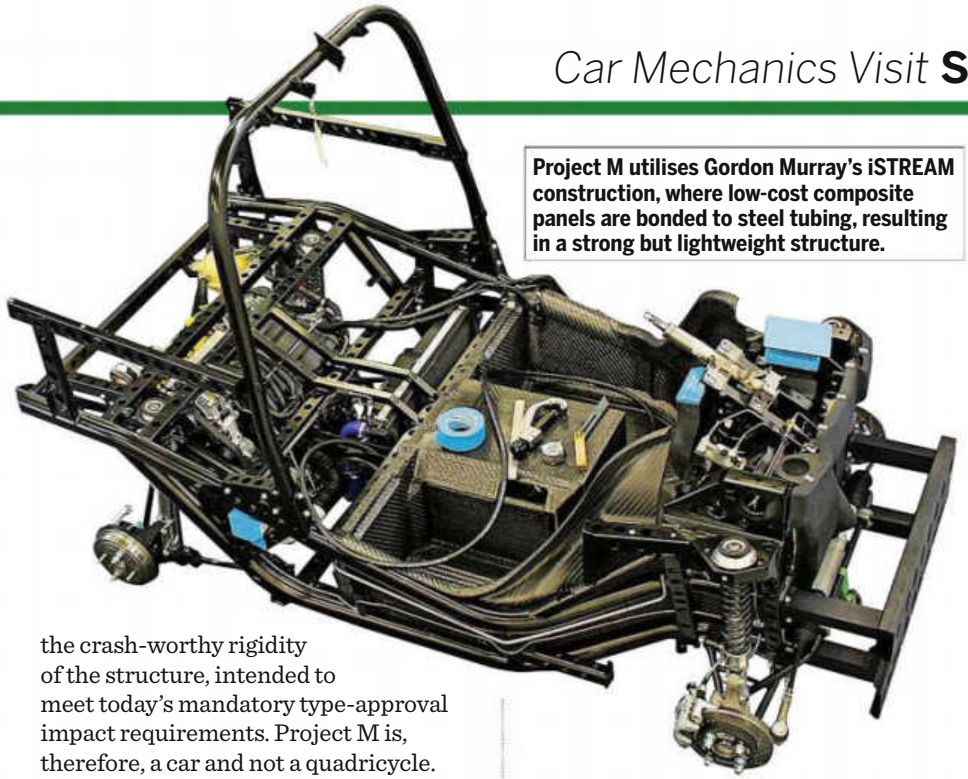
From now to 2050

Project M started life five years ago, as a collaboration with Gordon Murray Design of McLaren F1 fame. The aim is for the technical partners to combine expertise and stretch current efficiency technologies, by lowering the car's energy demand and depressing the theoretical build costs of a production version (which is not envisaged), especially for developing nations.

Strangely, the ambitions appear to have been set rather low. The brief to produce a vehicle of compact dimensions – smaller than a smart ForTwo and weighing less than 600kg – to carry three people and be capable of over 100mpg, is hardly ground-breaking. Certain current production diesel-powered cars have been proven to achieve more than 100mpg in real-world conditions already, while being better equipped and able to carry more passengers. Some petrol-hybrid production cars boast laboratory-obtained figures that exceed 100mpg with ease, although their ability to sustain those claims in the real world varies considerably.

How low can you go?

To dismiss the exercise as feckless and to judge Project M purely in terms of miles-per-gallon alone is to miss the point. The ultimate objective is to reduce real-world energy use, plus weight, dimensions, emissions, manufacturing excesses, running costs and wear-and-tear. For each of those factors, Project M's body design plays a crucial role. Just like the preceding T25 prototype, upon which it is based, Project M's weight-watching has abandoned the more traditional monocoque body construction in favour of composite outer panels. These are bonded to steel tubing, which augment



Project M utilises Gordon Murray's iSTREAM construction, where low-cost composite panels are bonded to steel tubing, resulting in a strong but lightweight structure.

the crash-worthy rigidity of the structure, intended to meet today's mandatory type-approval impact requirements. Project M is, therefore, a car and not a quadricycle.

Careful internal packaging has reduced Project M's dimensions; the driver occupies a central driving position, while a pair of passengers can be accommodated behind. The short length and narrow width permits the car to be parked sideways in a conventional parking bay, but, despite the flat floor, the upright stance hampers aerodynamics, even though a moderate 0.30Cd has been achieved during tests. As no exotic, lightweight materials are employed for the bodywork, the estimated retail cost of a production example has been predicted to be as low as £10,000.

Close to the edge – but safe

Offering its prowess in engine development, Swiss-based GEO Technology, founded by a former Honda F1 engine designer Osamu Goto, has looked at reducing inefficiencies of the chosen powerplant, an aging three-cylinder, 660cc Mitsubishi engine, which was fitted to the 'i' kei-class model, the UK imports of which ceased in 2011. Originally, the unit produced 72bhp at a dizzying 7500rpm, but because of the lightweight Gordon Murray Design bodywork, the detuning exercise has reduced both maximum engine speed and power to approximately 55bhp@5500rpm, without sacrificing performance too much. Strong acceleration between traffic lights, as well as reaching speeds in excess of 70mph, for European Whole Vehicle Type Approval requirements, were seen as important factors for not leaving the car excessively underpowered.

Apart from altering the fuelling, GEO Technology focused on reducing the engine's internal drag and friction, which accounts for around one-fifth of a typical engine's energy use. The reduced

'For Project M, the "M" stands for mobility'

maximum engine revs meant that softer valve springs can be used, reducing drag on the camshaft. However, the engineers could not overcome the shortcomings of the original piston design, the main source of friction. The standard part had to be redesigned, to make the skirt 30% shorter – this, coupled with one piston ring being deleted, reduced both the piston's overall weight and the cylinder contact area by 40%. The changes also improved the rotating parts' weight distribution and balance.

Shell's input was to not only finance the project, but also provide the lubrication expertise. While oil viscosity has reduced considerably in recent years (20w50 was standard in 1980; it is now 5w30), a lubricant had to be developed to not only reduce drag and friction, but also prevent metal-to-metal contact. The company remains tight-lipped as to the lubricant's precise specification while tests are ongoing, although it is approximately 0w12. Shell also reports that the prototype oil shares the technology of its current retail Helix Ultra lubricant and its V-Power diesel alternative, in that the base oil is engineered from natural gas, not crude oil. This technology ensures that the basic lubricant's viscosity is less sensitive to high temperatures.

The influence that the lubricant has on fuel efficiency is considerable. In 2010, the T25 prototype exhibited a 6.5% reduction in fuel use on the Urban Cycle, when using an enhanced lubricant, but Project M should realise more substantive improvements once testing is completed. However, Shell has also contributed its

The pistons had to be redesigned completely. The new, shorter pistons reduce weight by 40% and their inertial mass by 30%.

As a result of shortening the piston, the connecting rods were extended by 9%.

DLC (Diamond-Like Coating) technology, which is applied to the pistons, camshafts and tappets to reduce friction further and increase engine life expectancy.

While there are plans to unveil the prototype in the summer of 2016, Project M is still undergoing secretive tests and Shell is unwilling to release any pictures of the vehicle until then. However, Project M remains an interesting real-world concept for a low-cost city car that optimises conventional technology to be as efficient as possible, without affecting durability. While the concept is not intended to go into production, it is likely that some of its technological developments will be adopted by the wider motor industry within the next decade, even though it does not even pay lip-service to politicians' more ambitious aims for the middle of this century.

American champion

It was the first European Chevrolet to be fully designed and developed by GM, and one of the company's most popular models, but how does the Chevrolet Captiva measure up as a used car? **Rob Bradshaw** investigates.

The story of Chevrolet in Europe is an awkward one. For years, General Motors tried to introduce its most mainstream marque into the European market, initially as an exclusive brand focusing on more sporting models. There are, however, only a limited number of people in the market for a Camaro or Corvette, and when the models are left-hand drive only, those numbers dwindle further.

In 2005, GM had a brainwave. Having bought the assets and distribution rights to the bankrupt-in-Europe Daewoo Motors, the American giant set out to rebrand the existing Daewoo model range, along with its European dealer network, as Chevrolet. It would capitalise on the halo effect of the performance models to add kudos to the brand, and use the scale of the Daewoo network to raise awareness.

As an idea, it wasn't a bad one. But GM was about to run into some pretty serious financial difficulties of its own, which meant the Chevrolet brand was launched with no new cars whatsoever, just some hastily rebadged variants of the Daewoo Matiz, Kalos, Lacetti and Tacuma.

The first all-new Chevrolet, codenamed project C100, was due to be launched at the end of 2005. It was an SUV, a market where Daewoo had feared to tread, but which was right in the heartland of Chevrolet's Americana-themed branding. It would use a new 2.0-litre diesel engine, along with an existing 2.4 petrol, and would be offered as a five- or seven-seater. Developed alongside it would be a smaller SUV for the Opel/Vauxhall brands, which would become the Antara and share the new model's engines and chassis.

In the event, the C100 was a little delayed. It arrived in Europe towards the end of 2006, but delays in right-hand drive production meant the Captiva wasn't offered in the UK until mid-2007. The dealers loved it: in terms of quality, it was miles ahead of anything Chevrolet or Daewoo had offered previously. It had good profit margins and it was a decent car to drive – exactly what the market demanded at the time – and thanks to an aggressive pricing structure (from less than £15,000), demand exceeded supply.

There was, however, trouble at HQ. GM was about to become the victim of the USA's biggest ever application for Chapter 11 Bankruptcy Protection, under which the future of its European network looked uncertain. In the final reckoning, GM lived to fight another day, abandoning plans to sell off Vauxhall and Opel, and diverting a huge amount of cash into Chevrolet's product development in an attempt to turn the American brand into its mainstream player in Europe.

Over the next four years, the entire Chevrolet range was revamped. New models such as the Spark, Aveo, Cruze and Orlando MPV came along and raised the bar for the levels of quality expected by a Chevrolet customer. The Captiva, too, was given a significant nip and tuck: a new front end with Chevrolet's global 'split grille' was added, along with a raft of improvements to the interior and drivetrain that made it much more refined and a far better performer.

The 2.0-litre diesel was replaced with a 2.2-litre unit, and it was in this guise that the Captiva received the accolade of Towcar of the Year for the sub-£30,000 SUV class.

Specifications

Engine	Power (bhp)	Torque (Nm)	Combined MPG	0-60mph (sec)	Top speed (mph)	CO_2 (g/km)
2.4 petrol	134	220	31	11.1	115	217
2.0 VCDi	148	320	38	11.1	111	197
2.0 VCDi Auto	148	320	32	11.8	112	225
2.2 VCDi	181	400	42	9.3	124	174
2.2 VCDi Auto	181	400	35	10.6	118	208

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Interior

Most of the cabin components are reasonably hard wearing, except for the stereo system. Unlike other Chevrolets of the era, this is integrated into the centre console and can't be replaced with an aftermarket unit, but is prone to cutting out, crackly reception or a tendency to only work when it feels like it. Check it carefully, because replacement isn't possible outside of the dealer network. You can buy secondhand stereo units, but they need to be programmed to the individual car with dealer software. Later models had a much improved infotainment system with integrated sat-nav.

The 'leather' seats aren't entirely leather. The centre facing of the seat is the real deal, but the side bolsters are a leatherette-type material and are prone to cracking or wear where the seatbelt rubs against them.

The rear load bay covers can be a bit temperamental, too, jamming up or occasionally coming detached from their rollers, which can be an irritation – check this area.

Otherwise, not a lot goes wrong. The Captiva cabin is spacious, with the folding 'rock and roll' sixth and seventh seats being way above the class average for space.

Engine choice

2.0-litre diesel could average 38mpg and hit 60mph in just over 11 seconds.

Captiva engines are generally quite tough. The 2.4 petrol is a four-cylinder unit (so quite big for a four-pot) and has a chain-driven cam. It's a fairly common engine in the USA and South America, and comes from GM's engine plant in Brazil. Very little goes wrong with the 2.4, but it's neither economical nor at all lively to drive – petrol Captivas feel desperately underpowered and need to be worked hard, which has an impact on fuel consumption. Official fuel consumption was 31mpg on average, but the reality is often far worse.

Unless you cover low mileages, then the 2.0- or 2.2-litre diesels are a better bet, and don't tend to give a huge amount of trouble. The one exception to that rule is where turbos are concerned. Although not commonplace, there have been reports of turbo failure on some Captivas between 75,000 and 100,000 miles, the first indication being excessive smoke under load. Also watch out for harsh vibrations under hard acceleration.

There have also been isolated reports of timing chain failure on both the 2.0 and 2.2, although these seem few and far between. Even so, it's worth listening out for a slight clattering or ticking noise.

Another issue that raises its head from time to time is blockage of the diesel particulate filter, in common with most modern diesel engines. The Captiva seems to suffer far more than most, though, due to being subjected to regular short journeys where it doesn't get chance to warm up properly. The usual cure is a quick, hard blast down an open road to clear the DPF, but if this hasn't been done frequently enough then a replacement could be required and will cost upwards of £500.

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The move upmarket, though, was ultimately a bad one for Chevrolet. By 2013, there was a lack of distinction between the Chevrolet and Opel/Vauxhall brands across Europe. While the Captiva continued to sell well, as did the Spark and Aveo, Chevrolet's budget positioning made it hard to make a profit on the cars. With the need to return Opel and Vauxhall to profitability, the Chevrolet name was axed, although all the dealers were retained as authorised repairers and there are no issues in sourcing spares.

The departure of the Chevrolet brand from the UK is, in some ways, a good thing for the used Captiva buyer. Uncertainty keeps prices low, meaning that if you're in the market for a seven-seater SUV, there are some compelling reasons to consider one.

The base LS model (shown here) is pretty rare on the used car market – the LT, LTZ or LTZ+ models were stronger sellers.

Bodywork

The oldest Captivas are still less than nine years old, so extensive corrosion isn't really a problem. However, there was an issue with some early cars, which suffered from significant rust on the tailgate. The Captiva has a pop-up tailgate window, and on the affected cars the design of the seal allowed water to pool around the seam between the window and the bootlid, leading to rust bubbles above the numberplate. The matter was dealt with via the dealer network, not as a recall but as a service action, where vehicles were inspected and the bootlid replaced under warranty. However, some may slipped through the net, so check the area carefully.

Another issue with the tailgate relates to the split rear window, with some owners reporting an irritating fault where the back window pops open when the car goes over a speed hump or pothole. The issue is rectified by adjusting the latch in the tailgate, as the act of frequently opening and closing the glass pop-up part can move the latch slightly too low. Not a difficult job, but a bit fiddly.

Otherwise, there are no major issues to report, although you shouldn't ignore scuffs on the front bumper on post-2011 models with the double grille as being trivial. The issues may only be cosmetic, but bumper replacement involves removing, painting and replacing the entire front nosecone, which isn't cheap.

Also inspect the headlights on pre-facelift cars. There have been reports of pattern parts that don't fit properly and allow water to leak into the headlamp, leading to condensation and discolouration. This should also be looked upon as evidence of a past repair, in which case check the car carefully for accident damage and misalignment.

Running gear

Here's where you really need to be careful. There's no hard or fast rule, but both manual and automatic Captivas have a less than perfect record as far as gearboxes are concerned.

We'll start with the autos. These have been known to suffer from jamming into 'limp-home' mode for no apparent reason, which appears to be due to a conflict between the gearbox ECU and the engine management system. Clearing the code seems to work, but not permanently, leading to the problem returning anything between days and months later. Other than complete gearbox replacement (£2000 or more) nothing seems to fix it, so make sure you quiz an owner very carefully about their reason for sale. It should be noted that these problems only seem to have appeared in cars with less than 35,000 miles on the clock, so if you find one with a much higher mileage, chances are it is, and will remain, absolutely fine.

Manual 'boxes are also prone to failure, and it also tends to happen at a surprisingly low mileage, While those that have travelled further tend to be hassle-free. The problem here only seems to affect earlier 2.0-litre cars with the five-speed manual; post-2011 2.2s had a six-speed, which appears to not only be significantly more reliable, but is also much lighter and more pleasant to use.

Other things to be aware of include a hunger for driveshaft joints. The Captiva uses an on-demand all-wheel drive system

The Captiva cabin is spacious, with the folding 'rock and roll' sixth and seventh seats being way above the class average for space. Be careful, though, because while all LTZ and LTZ+ models were seven-seaters, the extra chairs were an option of the mid-spec LT and not available on the entry-level LS.

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which engages only when the rear wheels appear to lose traction, so the car is front-wheel drive for more than 90% of the time. It's a big, heavy car, so wear to the CV joints and front wheel bearings is only to be expected, and repair and replacement is no dearer than for a comparable car. Listen out for graunching noises from the front wheels or a high-pitched whistling that occurs at high speeds.

Finally, the power steering pump is a known weak point. Weeping from the pump can lead to MoT failure, and is the first sign to an owner that something is amiss. Bank on £300 to fit a replacement pump, or around £140 if you do it yourself, which isn't beyond the abilities of a competent DIY-er.

Electrics

The Captiva is prone to the odd electronic bugbear, the majority of which are related to the central locking and alarm systems. The alarm has a habit of going off randomly, or else thinking it's going off without making a noise. The latter is a potentially worse issue, as it can flatten the battery overnight.

Most of the problems are related directly to the locking system around the tailgate area. The rear of the car is susceptible to dirt being thrown up, and this can work its way into the locking mechanism and onto the alarm contacts. It's amazing how many baffling alarm faults with a Captiva have been fixed with a judicious application of contact cleaner and/or penetrating fluid.

Valuations

▶ The earliest Captivas are now over eight years old, so depreciation has played a part. That said, there's always going to be a strong market for seven-seater SUVs and the disappearance of the Chevrolet brand from the UK appears to have had very little impact on resale values.

The cheapest examples we've seen on the market are around **£4000**, although the majority of these are the unpopular 2.4-litre petrol, which is both expensive to run and not that great to drive. A half-decent diesel on a 57-plate, with around 100,000 miles on the clock, will go for around **£5000**. There's not a huge difference in pricing for the LT and LTZ trim levels, so it pays to seek out an well-specced LTX with leather. Autos tend to command a premium of £300-£400 at this level, and if you're based in an urban area then it's worth the extra money, as they're far nicer to drive in town.

As well as being better equipped and faster, post-facelift cars have a vastly improved ride and handling package (the early cars had a notoriously choppy ride). They are still in demand as used cars, with prices starting at around **£10,000** for a 61-plate with 45,000-55,000 miles on the clock. Most of the facelift cars (over 95%) are diesel, but it's still essential to make sure any car you're considering has the seven-seat package, as five seats were still an option on the LT.

Top book for a low-mileage 2014 Captiva, which would have been one of the last sold in the UK, is about **£21,000**, but unless you really need the remaining balance of the warranty, we'd recommend a well-maintained older car as a better value proposition.

The car's engine management system can also sometimes prove problematic. We've heard of cars where the EMS erroneously detects a fault as the car pulls away from a junction and automatically cuts off power, putting the car into 'limp-home' mode. Usually, this is cleared by stopping, getting out of the car, locking the doors and waiting 30 seconds for the ECU to reset itself, but the process is hardly ideal.

Other minor electrical niggles include temperamental rear wipers, which occasionally cut out halfway across the screen then suddenly start up again (a fault most probably related to the known rear screen latch issue), and power folding mirrors on LTZ and LTZ+ models that will click but not retract.

The Captiva has an on-demand all-wheel drive system, running in front-wheel drive mode most of the time.

Verdict

▶ It's not the best-known seven-seater SUV on the market, but the Captiva has a loyal following, with good reason. It's spacious, comfortable, well-equipped and half-decent to drive, and it also makes for a great towcar. That means the departure of Chevrolet from the UK hasn't really had a negative impact on values at all –a good late example is still a hot property within the trade.

Most *CM* readers, though, will be more interested in the lower end of the price range. The good news is that the Captiva is fairly durable and certainly not beyond the abilities of a competent home mechanic. If you're spending £5000 on a spacious, reliable, multi-purpose family car, there are far worse places you could put your money.

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Survival Guide

Ian Cushway searches out **new** and **used** part

Alfa Romeo 147

While pre-2005 examples are looking a little long in the tooth these days, there's value aplenty in the 147 range. Best of all, service parts cost pennies if you shop around.

The Alfa Romeo 147 wasn't voted European Car of the Year for nothing, and as a stylish family hatchback it still has plenty going for it. Launched in 2001, it's available in either three- or five-door guise, with a range of engine options, including the zippy Twin-Spark petrol unit and the talented JTD diesel. You can even buy one with a paddle shift gearchange.

All models were generously specced from the start, with air-conditioning being included as standard and alloys, cruise control and leather upholstery appearing on the range-toppers. And it doesn't feel at all cheap inside, with Germanic rubberised plastic adding a real quality feel to the car's cabin area.

Styling-wise, a landmark was the 2005 facelift, when the 147 took on various design cues taken from the 159 and Brera models. At the same time, the suspension was tweaked to further sharpen up body control.

Where it falls down against rivals like the VW Golf and Audi A3 is its skimpy rear passenger space and boot capacity. It's also had a bit of a bumpy ride when it comes to reliability, but that's something careful regular maintenance can help keep in check. What completes the Alfa value package is the fact that service parts cost buttons if you shop around at the independents.

Talented diesel is a popular 147 engine choice, especially in later 150bhp 16v Multijet guise.

Engines

While the entry 105bhp 1.6 TS is eager enough, the more popular choice is the 2.0 Twin-Spark and the frugal and flexible 1.9 JTD. The last of these was available as either 8v 115bhp, 16v 150bhp (from 2005) or 170bhp (in the run out Ducati Course special edition). The 1.6TS was also available with 120bhp in the Lusso, courtesy of variable cam timing.

Those Twin-Spark units aren't without their issues. They drink oil, perhaps as much as a litre every 1000 miles, so a close eye needs to be kept on the level. What doesn't help is the fact that the cylinderhead features oil jets to cool the pistons, which allows the oil to vapourise. It's also important to ensure the cambelt is replaced every 36,000 miles (72,000 or six years on the JTD).

When you're replacing the cambelt you should fit the newer metal tensioner, not the plastic one. And remember that the 2.0-litre 16v has a balance belt and tensioner that will also need replacing, otherwise the belt tensioner can break and the debris become trapped in the cambelt drive. A special camshaft locking tool is required if you change the cambelt yourself.

Oil changes need to be done annually or every 12,000 miles, preferably using Selenia 10w40 semi-synthetic, although the slow-burn HPX 20w50 brew may reduce oil consumption on high milers.

The variable valve timing variator on the TS unit can get noisy and make the engine sound like a diesel, especially if run low on oil. It screws into the end of the camshaft and costs £252.65 from a main dealer and £125.59 from Alfa Workshop.

When replacing the spark plugs, be aware that there are two different lengths and you need to be careful not to overtighten the smaller of the two; also, remember to refit the earth wire at the back of the engine. Because there are eight spark plugs, it's just as well they only need replacing every 60,000 miles. EB Spares sell a TS plug set for £81.60. Incidentally, if there's oil in the spark plug wells, replace the cam cover gasket.

JTD units are robust. If there are problems with cutting out, though, suspect the high-pressure diesel pump, which tends to be a main dealer only unit and costs £500.

Gearboxes are reasonably strong, although synchromesh can fail with age, especially on JTD models. Reconditioned units sell for around £550 from gearbox specialists, while used units sell for £100-£150. Some 'boxes also suffer shaft bearing noise, but stripping the 'box and changing the bearings solves the problem.

Autoboxes are good, but the Selespeed paddle shift option can sometimes stick in gear or fail to shift properly. It's not always the 'box at fault – the pump under the front wing, the actuator, trip switches or the three-piece clutch may also be to blame.

Alfa Romeo 147

2001-2010

Model	1.6TS	2.0TS	1.9 JTDm	3.2
Engine (cc)	1598	1970	1910	3179
Power (bhp)	105	150	150	250
0-60mph (sec)	10.6	9.3	8.8	6.3
Top speed (mph)	115	129	129	153
Average fuel (mpg)	34.9	31.7	47.9	23.3

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TOP TIP

Regular oil level checks are essential on Twin-Spark models, which can use as much as a litre every 1000 miles. Cars that do short trips or are driven hard tend to drink more of the black stuff.

Engine component prices

OIL FILTER
Main dealer £11.56
Independent from £3.90

TIMING BELT KIT
Main dealer £129.25
Independent from £77.00

SELESPEED ACTUATOR
Main dealer £2303
Independent from £1380

VARIATOR
Main dealer £252.65
Independent from £125.59

Suspension

Like the 156, the 147 is prone to bush wear, and because Alfa doesn't supply the bushes separately, main dealer replacements can prove pricey. It's common to find wear in the upper and lower arms, bottom balljoints, link rods, droplinks and anti-roll bar bushes (which can knock). The top strut mounts are also a weak point – they start squeaking, and if you notice uneven tyre wear at the front this could be why.

Unlike the 156, there's been little call for replacement steering racks, but if yours should go (symptoms being a knocking sound when turning the wheel from lock-to-lock) reckon on spending £215.94 from an independent and £270.72 from Alfa.

Suspension/steering component prices

NEARSIDE LOWER ARM
Main dealer £197.53
Independent from £86

STEERING RACK
Main dealer £270.72
Independent from £215.94

Brakes

Brakes are strong. However, some 147 owners have experienced ABS warning lights appearing, usually due to adjustment on the brake pedal switch. Setting it up properly is a tricky job requiring feeler gauges.

The only brake malady concerns sticking rear pads – simply free them off and apply a small quantity of copper-based grease to the back surfaces.

GTA

▶ The storming 250bhp 3.2-litre V6 GTA is the ultimate Italian hot hatch, although it's rare and its 24mpg fuel economy could rule it out for some owners. Again, oil use seems an issue and it's important to keep an eye on the cooling system, specifically the rad, as it has to do a lot of work. The car is nose heavy, so front suspension components wear quickly, and with so much power on tap, the diff takes a hammering. The Q2, Alfa's Torsen mechanical limited slip differential, is worth having if one's not been fitted as an option already.

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Sherburn Motor Spares 01977 684222 **www.alfa-spares.co.uk**
WAD Alfa Romeo 01902 401711 **www.wad-alfaromeo.co.uk**

Brake component prices

FRONT BRAKE DISCS (PAIR)
Main dealer £190.28
Independent from £69.48

FRONT BRAKE PADS
Main dealer £87.91
Independent from £31.14

Electrics

The driver's side window regulators can fail, and will cost £146.98 from a main dealer but as little as £75 from some of the independents. The wiper motors have been known to fail. The worrying thing is they cost £300 from Alfa main agents and they were on back order when we enquired, although independents can get hold of them for a lot less.

Electrical component prices

WINDOW REGULATOR
Main dealer £146.98
Independent from £75.00

WIPER MOTOR
Main dealer £300.53
Independent from £101.99

Miscellaneous

Rear exhaust boxes can rot out. When they do, prepare yourself for a £224.84 outlay from Alfa, although Euro Car Parts sells a Klarius replacement for £57.54.

Misc component prices

REAR EXHAUST BOX
Main dealer £224.84
Independent from £57.54

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Product Test

James Stanbury puts products through their paces

Booster Packs

James checks out **10** engine starters to see how well modern compact designs perform against traditional models.

All boosters now have some form of charge level indicator. Scrupulously top-up charging the unit every couple of months, or fully after use, should ensure it's always ready when you need it.

Most of us know that a booster pack is little more than a plastic box containing a small, but powerful, battery hooked up to a pair of leads and clamps. So what do you call a booster pack without a battery? Sealey is about to take the portable power market by storm with the batteryless E/START600, for which we've included a sneak preview on page 59. As the unit is quite different to traditional booster packs, we've not included it in the main test line-up.

So, have other boosters advanced much since the last time we looked at them in 2002? In short, yes. Now that lithium-ion technology is more affordable, some cutting-edge models use it in place of traditional AGM lead-acid batteries. Such models are easy to spot because they're a fraction of the size of traditional boosters – in fact, most will happily sit in a glovebox.

Slightly surprisingly, given that lithium-ion power tool packs can often be left for months without any apparent self-discharge, both traditional and lithium boosters require the same maintenance. Namely, a top-up charge every two to three months, and a full recharge every time the unit has been used.

It's also noticeable that isolators are now no longer the preserve of powerful top-end models. That's good news, because being able to switch off the booster leads is the only way of avoiding arcing while connecting up. Common sense tells us that any car's engine bay has never been a great place to start producing sparks, but as cars get more sophisticated, with ever more control modules being fitted, the level of damage an arc-based voltage spike can cause also increases proportionally.

TESTING CRITERIA

ISOLATOR

Although boosters are often considered the safest way of waking a dead car, it's possible that any spark that occurs while connecting the clamps could cause a voltage spike – which will not do a modern car's electronics any favours. So our first point only went to boosters with a proper isolator – in other words, the clamps are only made live once they're correctly positioned.

EXTRAS

It's common for boosters to have extra features, such as mains inverters, lights or even integral tyre compressors. We evaluate if the extras on the units in the test are genuinely useful or not. Only the most feature-laden products got both of the two points available.

VOLTS

Most car drivers will only be interested in 12-volt booster packs, but anyone with a van or commercial vehicle will value products that can output both 12 and 24 volts. One extra point went to any such boosters.

POWER

After trying out each unit in the test on a batteryless 2.3-litre petrol engine, we compared the engine speeds reached over set durations with official output ratings. Once satisfied we could arrange the products in an order of output, we factored ultimate output against price, and awarded up to three points to products that give the best balance of price against performance.

SIZE

In the past, it was impossible to reduce the size of a powerful booster, but advances in lithium polymer, capacitive technology and conventional AGM technology have resulted in higher output from smaller, lighter units. As nobody wants a huge booster pack gobbling up great swathes of boot space, we awarded up to two points to units that gave the most power from the smallest dimensions.

CHARGING

All boosters come with a mains charger, which always gives the best results because it charges a unit to its maximum capacity, but some form of 12-volt charger is desirable, too. That's because boosters deteriorate if left in a low state of charge. On a long trip, making use of the alternator once you've got the engine started is a great way of limiting damage to the unit's internal battery.

OUTPUTS

There are so many 12-volt accessories available these days that it's useful to have a fully portable 12-volt power socket – such as powering a tyre compressor, so you don't stretch wires halfway across your car from the dashboard. A 5-volt USB output is a bonus, too, to charge the many digital devices we carry. Two points were available for units with the most comprehensive selection of outputs.

EASE OF POSITIONING

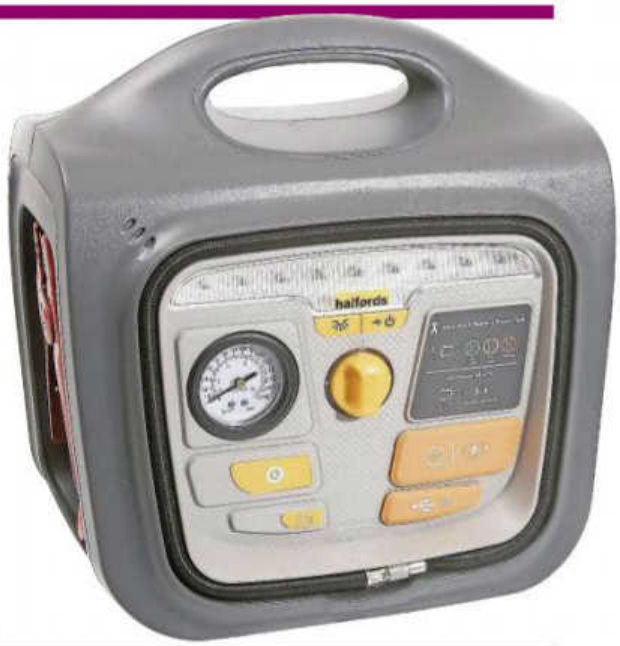
Short leads can make it difficult to position a booster safely while you nip in the car and turn the key, especially as the slightest bit of engine movement could upset your booster and drop it onto the floor. We awarded up to two points to units that are easiest to position, whether that's due to size, shape or simply long leads that allow floor standing.

HALFORDS POWER PACK 100

CAR MECHANICS BEST BUY

▶ Output-wise, this is only good rather than exceptional. Halfords are a little coy about the specification of the battery inside, but say the unit's fine for petrol cars up to 2-litres, which our tests back up. Aside from the respectable output, the unit is feature-laden and beautifully designed. The row of piercing LEDs, for instance, makes a genuinely usable portable worklight, while the integral tyre compressor's valve coupling is a foolproof screw-on type rather than the usual push-it-on-and-hope-it-seals arrangement. A low charge alarm helps prevent the usual booster malady of the unit being useless in an emergency because you forgot to charge it.

PRICE	£85.00
PRICE FROM:	www.halfords.com
CONTACT	08457 626625
WEB	www.halfords.com
PERFORMANCE:	10/14
IS IT WORTH THE MONEY?	5/6
OVERALL SCORE:	15/20



PHAZE 4-IN-1 JUMP STARTER

CAR MECHANICS BEST BUDGET BUY

▶ Halfords' second offering is lightweight and the cheapest booster here, both of which suggest the battery inside isn't going to be very heavy-duty. Unsurprisingly, then, boosting performance is a little compromised, but it'll do the works on most petrol engines under 2.0-litres. Plenty of well-designed extras keep the unit in the running, such as a strip of white LEDs that makes an effective emergency light. For powering accessories, the two 12-volt sockets are supplemented by a USB output for more sophisticated gadgets. Less impressive is the odd way the leads have to be folded around the unit to keep them neat.

PRICE	£39.00
PRICE FROM:	www.halfords.com
CONTACT	08457 626625
WEB	www.halfords.com
PERFORMANCE:	9/14
IS IT WORTH THE MONEY?	6/6
OVERALL SCORE:	15/20

CLARKE JUMPSTART 910

CAR MECHANICS RECOMMENDED PRODUCT ☑

▶ OK, this is an old-fashioned design, but the unit gets the basics so right that it's still well worth considering. Trouble is we've said the same in the last three or four booster product tests, which gives some idea of how long the 910 has been around. The 400 cranking amps on tap are enough to fire up most small and medium-sized petrol engines, plus small diesels, and the 1.2m, high-quality leads make positioning this unit easier than most. There's even an integral tyre compressor. Just the feeble bulb-based light and lack of an isolator let the side down.

PRICE	£71.98
PRICE FROM:	www.machinemart.co.uk
CONTACT	01992 565300
WEB	www.clarkeinternational.com
PERFORMANCE:	8/14
IS IT WORTH THE MONEY?	5/6
OVERALL SCORE:	13/20

SEALEY LSTART405

CAR MECHANICS RECOMMENDED PRODUCT ☑

▶ In stark contrast to the other three award-winners – all of which were traditional lead/acid based units – Sealey embraces the latest in lithium-ion technology to produce a booster that's the size of a VHS tape. Despite this, maximum output is a thoroughly usable 405 amps, which Sealey claims is sufficient for starting up to 4.0-litre petrol engines and 2.0-litre diesels. We think those ratings are slightly optimistic, but there's no denying this little box packs more punch than many entry-level units. At 60cm, the leads are a little short, but that's almost academic as it's usually a doddle to position such a small booster relatively close to the car's battery.

PRICE	£139.66
PRICE FROM:	www.tool-net.co.uk
CONTACT	01284 757500
WEB	www.sealey.co.uk
PERFORMANCE:	10/14
IS IT WORTH THE MONEY?	3/6
OVERALL SCORE:	13/20

CLARKE DUAL VOLTAGE JUMP START 12/24V

PRICE	£155.98
PRICE FROM:	www.machinemart.co.uk
CONTACT	01992 565300
WEB	www.clarkeinternational.com
PERFORMANCE:	9/14
IS IT WORTH THE MONEY?	2/6
OVERALL SCORE:	11/20

▶ So far, most of the boosters in the line-up have been best suited for personal usage, but this leviathan from Clarke is practically trade level: its large, powerful battery will easily revive one car after another before needing a charge, and the staggering 1000 amps of cranking current available makes us fully believe Clarke's assertion that petrol engines up to 6.0-litres are within range. In fact, it's really wrong to talk solely about cars – as the unit can output 12 or 24 volts, many commercials are catered for, too. Although there's nothing we can really criticise the unit for, we find it a little odd that, at just a metre long, the leads are shorter than those on Clarke's much cheaper Jump Start 910.

CLARKE JUMPSTART 4000

PRICE	£137.99
PRICE FROM:	www.machinemart.co.uk
CONTACT	01992 565300
WEB	www.clarkeinternational.com
PERFORMANCE:	8/14
IS IT WORTH THE MONEY?	2/6
OVERALL SCORE:	10/20

▶ Clarke's Jump Start 4000 fits between their Jump Start 900/910 and the powerhouse 12/24, but design-wise, the Jump Start 4000 is closer to the aged former. That's good news because, like the 910, the leads are generously long – 130cm in this case – and an isolator has been shoehorned into the 4000's cramped front panel. In fact, the only drawback to sticking with the 910's genes is the similarly feeble bulb-based lamp. The 38Ah battery ensures multiple uses between charges, and the 700 cranking amps available are good for most petrol and diesel engines.

COBRA JUMPACK CPP8000

PRICE	£79.99
PRICE FROM:	www.cobraelectronics.co.uk
CONTACT	01928 595 364
WEB	www.cobra.com
PERFORMANCE:	6/14
IS IT WORTH THE MONEY?	3/6
OVERALL SCORE:	9/20

▶ We thought Sealey's LSTARTs were small, but Cobra's latest makes them feel positively bulky. If the Sealeys were VHS-sized, this is more akin to a smartphone, albeit a rather fat one, measuring 2cm front to back. Can such a small unit really start a car? Yes, but with conditions. Ignoring the 360 amp initial spike, maximum output soon settles to 180 amps, but you don't get long at that for two reasons: first, the internal battery is only 6AH, and second, you can only boost for three seconds at a time, although we're not sure whether that's because the spindly leads get too hot or whether the battery simply cannot cope with more. Away from starting duties, the unit boasts a USB power output, plus a bright LED torch.

SEALEY RS131

PRICE	£77.98
PRICE FROM:	www.justoffbase.co.uk
CONTACT	01284 757500
WEB	www.sealey.co.uk
PERFORMANCE:	6/14
IS IT WORTH THE MONEY?	3/6
OVERALL SCORE:	9/20

▶ Another traditional model that's been around for a while, but still sells well enough to stay current. At first glance, this looks a much better piece of kit than the other evergreen, Clarke's Jumpstart 910. We like the compact size, the rugged protective edging, and the neat and tidy design. But aside from the aesthetics and the isolator, the Jump Start 910 is punchier, has much longer leads and has a built-in tyre compressor. One extra we did like was the plug-to-plug 12-volt power lead supplied, which makes it a doddle to maintain a car's electrics if you remove its battery.

◀ **Isolators switch the booster leads off or on. Keeping them electrically dead while connecting them to your car prevents arcing, which can ignite flammable vapours or generate a voltage spike that could seriously damage your car's ECUs.**

▶ **While all cars tend to run on 12 volts, many commercial vehicles require 24 volts. Boosters that can handle both voltages are obviously beneficial.**

THE NEXT GENERATION: SEALEY'S E/START600

▶ Initially, Sealey's rethink of the booster concept seems bonkers. The E/START600 does away with an internal battery and instead uses your car's battery as a power source. But surely you wouldn't be using a booster unless your car's battery was dead? And a dead battery isn't the ideal power source is it?

We tend to classify a battery as being dead when it hasn't got the power to start an engine. However, even a battery that won't be able to turn over a starter motor will, most likely, still have a huge amount of energy stored inside.

The E/START600 cleverly siphons out some of this residual energy over a two-minute period, then uses super capacitors to rearrange two minutes' worth of low-power low-voltage electricity into a much briefer burst of high energy at 12 volts – enough to start a typical 3.0-litre petrol or 2.0-litre diesel engine.

There are plenty of advantages to this approach. First, the lack of an internal battery makes the unit far smaller than a conventional booster, although not really any more compact than a lithium-powered model. With no battery to degrade, the unit also tends to last longer than a normal booster; the expected life is more than 10 years. And unlike a booster, no maintenance charging is required – the unit will work perfectly even if it's been sitting in a drawer for the last three years.

But will a flat battery have enough juice for the product to work? Almost certainly. Even seriously low batteries, such as those in long-term parked cars with power-sapping alarms and immobilisers, only drop to around 10 volts and the E/START600 can work off as little as five volts.

In the highly likely scenario that a battery really is absolutely dead, the E/START600 can be energised from two minutes on another car, either directly from its battery, the 12-volt power socket or even the USB output from a computer.

At around £130, the E/START600 only costs as much as an entry-level trade booster, such as Clarke's Jump Start 4000. It may well be the product that finally makes hefty old mains starter chargers a thing of the past.

DRAPER 40133

PRICE	**£137.95**
PRICE FROM:	**www.tooled-up.com**
CONTACT	**02380 494333**
WEB	**www.drapertools.com**
PERFORMANCE:	**7/14**
IS IT WORTH THE MONEY?	**1/6**
OVERALL SCORE:	**8/20**

▶ Trailing at the lower end of the group, this unit is simply too expensive. Price aside, it has a lot going for it. At 125cm long, the leads are both good quality and a decent length. The chemically-coated metal clamps are a step up from the usual clamps wrapped in a brittle and bulky plastic skin. And there's plenty of oomph available: the 900 amp starting spike settles to a very usable 400 amps, while the battery's 17AH capacity gives plenty of stamina. In short, it'll tackle most petrol engines below 3.0-litres and diesels below 2.4-litres. Unfortunately for Draper, so will many other units that cost less.

SIP RESCUE PAC 1600

PRICE	**£104.99**
PRICE FROM:	**www.sip-uk.co.uk**
CONTACT	**01509 500500**
WEB	**www.sip-group.com**
PERFORMANCE:	**6/14**
IS IT WORTH THE MONEY?	**2/6**
OVERALL SCORE:	**8/20**

▶ The original Rescue Pac was a feature-laden product with lights, flashing beacons, a pull-out torch and a built-in compressor. By comparison, this is as no-nonsense as it's possible to be. Forget lights of any sort – which is fair enough, they're hardly essential – but more important omissions, such as a 12-volt charger and isolator, and the relatively short 80cm leads start to rankle on a product at this price level. On the bright side, this is one powerful unit, with a similar level of punch to Clarke's Jump Start 4000, making it borderline suitable for a trade setting.

VERDICT

▶ Compared with some of the über-powerful units in our test, Halfords' Power Pack 100 might seem an odd choice for *Best Buy*. But remember that the aim of the test wasn't to find the most powerful booster pack, but to see which offered the most punch for the money. For the average motorist, driving a sub-2.0-litre car and who probably only needs some external starting power a handful of times a year, the Power Pack 100 is a great all-rounder. Plenty of boosters here have lights and tyre compressors built in, but Power Pack 100's seem to be properly engineered rather than just cheap add-ons. And we liked the audio alarm that sounds when charge levels get really low. Yes, it will drive you mad, but that's the point: it will make you charge the unit, so it's always ready when you need it most.

Our *Best Budget Buy*, Phaze's 4-in-1 Jump Starter, is a good low-cost alternative to the Power Pack 100. It's less powerful, much more basic and doesn't have a built-in compressor, but it offers an awful lot for its sub-£40 price.

Our two *Recommended* buys couldn't be more different. Clarke's old-school JumpStart 910 is another cheaper alternative the Power Pack 100, performing solidly but also showing its age in some ways. How different to Sealey's LSTART405, which kicks out amazing power given its size – even when put back in its storage pouch, complete with jump leads and chargers. Away from car-starting duties, its USB power output makes it a seriously heavy-duty power pack for keeping mobiles, tablets and other high-tech accessories topped up if you ever find yourself off-grid.

All prices are inclusive of VAT and were correct at the time of going to press.

Dealer's Diary

Our man in the trade, **Steven Ward**, goes into battle with the DVLA and ponders the mystery Zafira fires.

DVLA woe

Here we go again: yet another DVLA whinge. Generally, at the end of each week, we send a batch of V5Cs to Swansea for ownership transfers, to inform them of vehicles taken into the trade (V5C/3) and so on. Sometimes the DVLA will process these bits of paper correctly and, once in a blue moon, this will be done in a timely fashion. Naturally, you only realise this isn't the case when customers get angry.

In this instance, the customer was angry because they'd been fined £50 for failing to inform the DVLA of a change of ownership. They hadn't, in fairness, but that's only because we'd traded the vehicle on their behalf and taken care of the admin ourselves. We'd sent the V5C/3 off with a completed V5C for an unrelated sales car.

Understandably – and with our consent – the customer referred the DVLA to us. However, that didn't wash with Swansea, as in the eyes of the law the onus is on the registered keeper to inform the DVLA that they've passed the car to the trade.

We tried unsuccessfully to phone the DVLA and then wrote to them. We now had a real concern on our hands as the sales customer to whom the aforementioned V5C belonged had now gone eight weeks without a new V5C in their name. They were also getting angry. We concluded that the envelope that had contained both documents for the DVLA had gone missing.

A customer was fined £50 over a change of ownership.

How do you think the DVLA responded to our concerns and that of the fined customer? That's right, they passed the 'fine' to a debt collection agency. As you'd expect, this has escalated the issue out of all proportion. The debt collection agency couldn't care less about the issue, just the money.

You may just think we'd be better off paying the fine, but the margin in trading a car is wafer-thin and £50 is a huge percentage of that gross profit. What's more, this is a problem that was not of our making. Once we popped the envelope into the postbox, that was the end of our responsibility in both the eyes of the law and in practical terms. Don't forget that you are forbidden to send items to the DVLA by recorded delivery.

'They passed the fine to a debt collection agency'

This fight is ongoing as I write this, so watch this space for the outcome. We have two disgruntled customers, a DVLA that won't talk to anyone and a debt collector hellbent on getting their £50.

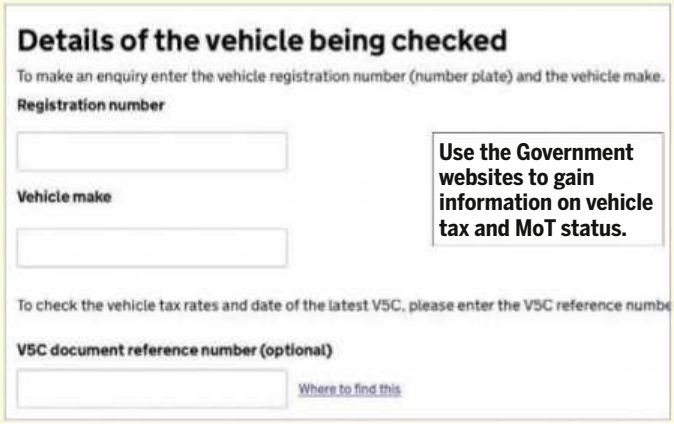
It's now a point of principle as much as profit, so let's see where we go next in the pursuit of justice.

Buying tips

Five minutes surfing the internet on the Government websites can give you valuable information about a prospective purchase. Being forearmed will show a salesperson you know what you're about and lead to a better deal. It's also free, unlike an HPI report, but don't think this can replace such a check; it's there to complement the HPI report and give more information regarding the car.

Use the DVLA website to check out a car's MoT history (**www.gov.uk/check-mot-history**) before going to buy it. Research what MoT advisories it's had previously. This will give you an idea of what to check and what the car is likely to need in the future. Don't assume that because something was highlighted on a previous MoT and it's not on the current one, that a repair has been carried out. MoT testers vary from station to station and, some say, day to day!

Check also when it was last taxed (**www.vehicleenquiry.service.gov.uk**). This will tell you when the car entered the trade for resale and give you a good the idea of how long it has remained unsold. If its been sitting for three months, then it's daft bid time. However, before insulting the salesperson, don't assume it has been at the same garage all that time – stock moves within the trade.



Use the Government websites to gain information on vehicle tax and MoT status.

Finally, check the mileage list tallies with the dates in chronological order. You'd be surprised how many traders get caught out by this. Once everything checks out, then get your HPI. Or, better still, get the vendor to show you their HPI check. After all, they should have done this before taking the vehicle into stock.

The rise and rise of auction fees

Have you noticed how auction house fees – often referred to as 'the out', which you must pay upon purchase – are getting more and more expensive? Even with my trade discount, the cheapest and nastiest of cars is costing hundreds to lift out. All the big auction houses level these fees.

It's a significant sum of money that you've been charged for buying blind. Also, as I've mentioned previously, the blindly efficient VAT man doesn't see these fees as being part and parcel of the purchase cost of the vehicle. I'll not dwell on this separate argument for fear of repetition and of going off on a tangent.

Well, I've actually got to the bottom of why 'the out' is costing us independent used traders so much. Before you start, it's not because of the rise in internet bidding, because we pay a premium for that, too, but at least that's an 'optional tax'.

The real reason is because of the auction groups' constant quest to land exclusive 'remarketing' rights to the big dealer group swappers. They are desperate to land the cars of national dealer groups and, as you'd expect, the big dealer groups are milking this desperation to the nth degree.

Following rigorous and detailed investigations conducted in various auction house cafés over several cups of tea, I've calculated what I believe is the sum of money a large dealer group is charged for selling a car; this cost was confirmed to me by the owner of an independent auction house in Leeds. Now this charge is not just for selling, but also for collection, valeting, bespoke signage on the windscreen and a guaranteed prime time slot for sale. That cost is...

Just £17. No wonder us traders are being bent-over when buying these main dealer swappers. It's just another reason why I prefer to deal with independent auction houses, which treat both big and small buyers – and let's not forget sellers – fairly. But getting good cars regularly from independent auctions when they cannot afford to buy the business of the big dealer groups is difficult. But it's one thing that is worth struggling for in the long-term interests of small dealers.

'Even the cheapest, nastiest car is costing hundreds to lift out'

Major auction house fees are accelerating wildly.

Zafire!

I saw BBC TV's *Watchdog* report on Vauxhall over unproven allegations claiming that Zafira B models were spontaneously combusting.

That got me to thinking: most customers of older cars and a huge number of garages fail to replace pollen filters. Likewise, sales preparation for most cars studiously avoids replacing these essentials. Now I'm not saying this is the cause of the Zafira fires, but it would make sense to me. Imagine never replacing a vacuum cleaner bag or never emptying one of your fancy bagless contraptions. Then you run said cleaner at full tilt for hours on end. Eventually, something is going to give. Usually it's the resistor pack that controls the blower speeds of the heater motor. If you're unlucky, it may burn out the motor itself.

We always replace pollen filters simply because they need replacing and we'll outline the reasons for the cost to the customer. Generally speaking, on most cars, changing the filter involves emptying the glovebox, removing it and then dismantling other bits of dashboard. Of course, to do this, you will be on your knees with a torch and a copy of the Autodata how-to diagram.

I usually get the job because I'm 'clean', whereas a mechanic may have oil or grease on them and you cannot risk them brushing up against doorcards, seat upholstery, trim or carpets. Then once you're dizzy from having your head upside down, you've got to vacuum the footwell out due to all the dry debris that's just came out of this 'tinder box' with the black-as-the-roads pollen filter.

Sure, the filters can be expensive, but that's no excuse. One Aston Martin specialist I deal with says it's the first thing they change on a car that's new to them and in for a service. There's no reason you should treat your daily driver any differently.

'Many car owners fail to replace pollen filters'

TOP TIP

At exhibitions or trade shows, if presented with a 'miracle' product being hawked by a geezer with a head mike, keep your wits about you. If the brand is unknown to you and seems too good to be true, then it probably is. It's not unknown for the product they are demonstrating to be drastically different from the product they are selling in secure packaging, just like those dodgy traders that set up impromptu auctions in empty High Street stores in the 1990s.

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Tea Break

Relax with a cuppa, while we reflect on how car parts have evolved over time.

Batteries

PART SIX: **Rob Marshall** looks at the increasing importance of batteries.

Flooded lead-acid batteries have changed a lot on the outside, but their internal operating principles remain the same.

Chemical means of storing electricity predate the motor car and were used predominately for industrial purposes. The initial breakthrough came in 1858, when French physicist, Gaston Plante, discovered that a current could be drawn from placing alternate plates of lead and lead peroxide into an electrolyte of sulphuric acid. While his findings, that the plates converted into lead sulphate and the acid's strength dropped as the battery was discharged, were hardly revolutionary, the fact that the chemical reaction could be reversed was a milestone: the rechargeable flooded lead-acid battery had been born. Despite the rather rudimentary chemistry, this basic principle is still vital to the batteries that are fitted to almost every car on sale today.

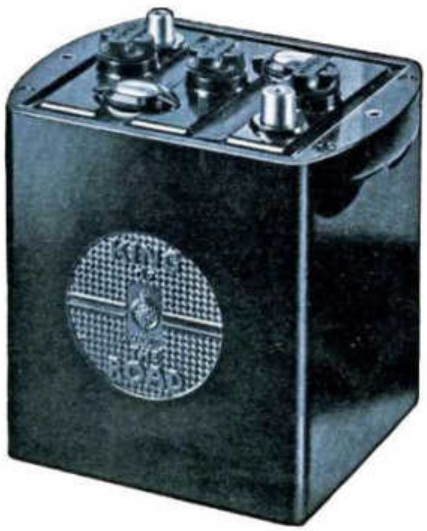
A battery was required on motor vehicles well before the starter motor appeared, in order to power the ignition. Unfortunately, the combination of trembler coil ignition systems feeding single- or twin-cylinder engines on a vehicle that was driven mainly on dirt roads, tended to shake the flooded battery's lead material from the plate grids, rendering it useless. While reliability gradually improved, especially after magneto ignition was introduced, automotive battery development was enhanced sufficiently to support Cadillac's introduction of a self-start system in 1910, which would supply not only the ignition but also the lights.

Battery development was limited by sluggish peacetime technology and the imperfect materials available for manufacturing. For example, the earliest battery casings were made from ebonite, which could resist the acid's destructive effects, but which added significantly to their already hefty weight. To reduce bulk, wood was used to replace the hard rubber for not only the casings but also the internal separators that prevented the plates from touching and causing a short circuit.

As in so many instances, the advent of World War Two hastened progress. Batteries became easier and cheaper to make. Reliability improved, too, not only because of a stronger grid and plate design, plus superior mounting to the case, but also due to advances in tyre, suspension and engine mounting design that reduced the battery's exposure to shock damage. In the post-war period, wooden casings made way for moulded plastic, some of which were translucent, which allowed DIY motorists to check the electrolyte levels by sight.

As lead-acid batteries have always deteriorated when stored, the arrival of dry-charged types, which possessed an unlimited shelf-life, was a major advance. They could be activated by the vendor filling them with acid, just prior to handover.

Early attempts to produce longer-lasting and maintenance-free lead-acid batteries started in the 1960s, with one of the main developments being the reduction of the lead's antimony content. While antimony adds strength to the plates, it increases the rate of charge loss when the battery is unused. In the 1970s, General Motors Delco subsidiary played a significant role in replacing the antimony entirely with a lead-calcium mix. This permitted the cells to be sealed completely, because topping-up the electrolyte level was no longer needed, at least during normal use. The gradual replacement of dynamos with alternators also reduced overcharging



Early batteries were made from rubber to avoid damage from road shocks and vibrations.

Cadillac introduced the electric starter on its models from 1910, which placed further emphasis on battery development.

◀ **The 1994 Volkswagen Golf Ecomatic was one of the first cars to feature a stop-start system, which was not to become mainstream for another 10-15 years. Fitted with a non-turbocharged diesel engine, it was fitted with two batteries, one of which took up a sizeable part of the engine bay.**

▶ **Hybrid cars tend to rely on lead-acid batteries to start their engines and manage the auxiliary electrical system.**

and electrolyte evaporation. Six-volt electrics gave way to the now common 12-volt system and the need for twin six-volt batteries to be connected in series – as used on many British cars, such as the MGB – was rendered obsolete.

However, a heavy battery that could leak acid, if subjected to extreme angles and forces, was inappropriate for motorsport. Here, the gel battery provided a partial solution, thanks to its semi-solid electrolyte. Unfortunately, the gel battery's inability to accept charge quickly made it unsuitable for mainstream motoring. Lead-acid batteries have also fallen out of favour as means of propelling EV electric cars, with nickel metal-hydride and lithium-ion batteries performing that function, although most examples on sale today are still reliant on a lead-acid power source for the vehicle's ancillary electrics.

Developments to enhance reliability, lengthen service life and reduce maintenance continued into the 1980s and 1990s, along with increases in capacity, driven notably by the popularity of high-compression diesel-engined cars that made heavier demands on batteries. The arrival of hybrids, not unlike EVs, from the late 1990s, stimulated further lead-acid battery development.

From the mid-2000s, the widespread introduction of stop-start technology brought about additional fast-track advances, as car-makers prioritised reducing fuel use and carbon dioxide emissions. The most significant recent arrival has been advanced glass mat (AGM) technology, which involves the electrolyte being absorbed within the mat that is bound tightly against the lead plates. The main advantages of this, over traditional flooded batteries, is increased capacity, enhanced reliability and the ability to store intense re-energising inputs, such as those provided by regenerative braking systems.

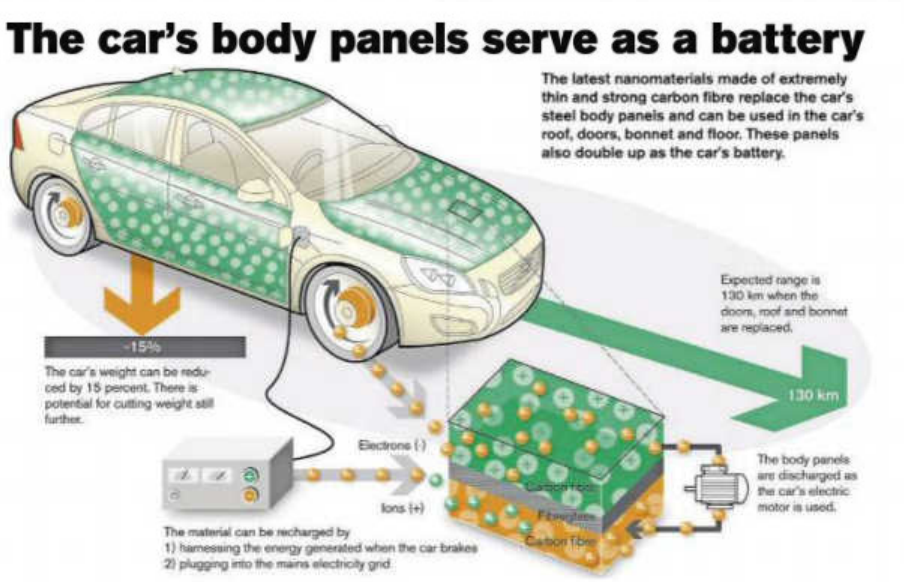
The proliferation of luxury accessories (dashcams, sat-navs, heated seats, electric supplementary heaters, et al) and electrical items that were once operated mechanically (multiple ECUs, power steering, fuel pumps, etc) has meant that the battery has been given the additional role of supplementing the alternator's output in the short term. This has resulted in more complicated battery monitoring software being fitted to recent models, such as systems that can shed electrical loads. This has meant that, in many cases, the battery and any replacement has to be coded into the vehicle's electrical system.

Over the past 15 years, battery development has been fast-tracked by new technology, introduced by car-makers, especially as their reliance on complicated electronics continues to grow. It is not unreasonable to expect battery engineers to face the same challenges as car developers in the future, to the make equipment lighter and even more efficient.

PREVIOUSLY

Part One (May 2014)	**The Wheel**
Part Two (Aug 2014)	**The Bodyshell**
Part Three (Nov 2014)	**Instruments**
Part Four (Feb 2015)	**Exhausts**
Part Five (Aug 2015)	**Air-conditioning**

A prototype BMW MINI E electric car from 2008, used a 12-volt battery to power the heater and the on-board electrical system.



Future lead-acid battery development is likely to follow increasing demands by motor manufacturers.

DIY Servicing

2011 HYUNDAI i30 COMFORT 1.4

Keep your Hyundai healthy

Introduced in 2007, the original i30 forged an enviable reputation for itself as being well-built and reliable. And it's a snip to service, says **Richard Gunn**.

Equipment required

› Jack › axle stands › oil tray › sockets and spanners › flat-blade and crosshead screwdrivers › wheel brace › antifreeze hydrometer › electronic brake/clutch fluid strength checker › wire brush › abrasive paper › copper grease › general purpose grease › spray grease › tyre pump › torch › torque wrench › rags for cleaning › disposable gloves.

Richard says

There have been very few issues to affect this generation of i30 and, aside from niggling faults, the cars have proved generally dependable. One thing to watch for is broken road springs. Although the i30 is no more prone to this than comparable cars, the woeful state of British roads means that such maladies are becoming more and more common.

RICHARD GUNN
Special Contributor

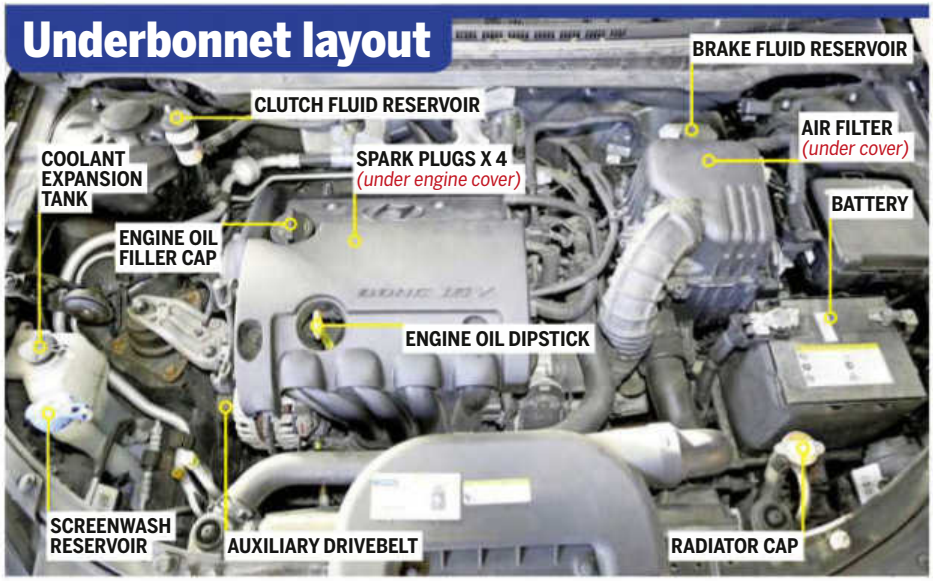
Overall difficulty rating

The Hyundai i30 is a relatively recent contender in the small family car scene, having been introduced in 2007. Despite being constructed by a South Korean manufacturer, it's quite a European vehicle in flavour. It was designed at Hyundai's Design and Technical Centre in Germany and built in the Czech Republic.

The i30 was launched in the UK in 2007 as a hatchback, followed the next year by the i30CW estate version. The petrol engines ranged from 1.4-litre to a sporty 2.0-litre, complemented by 1.6- and 2.0-litre diesel units. It topped *Auto Express* magazine's Driver Power Top 100 survey as the most satisfying car of 2010. Despite this, it only stayed in production for four years before being superseded by the second-generation, which is still manufactured today.

Our service subject here is a Comfort 1.4 first-generation model, one of the last of the original shape cars. In general, the series 1 i30s have proved pretty reliable and robust, and faults have been few and far between. Servicing is straightforward and perfectly viable for the DIY enthusiast without the need for specialist tools. All the engines have chain-driven camshafts, apart from the 2.0. That all adds up to making the i30 a good choice as a secondhand buy, or worth keeping hold of if you already own one.

Underbonnet layout



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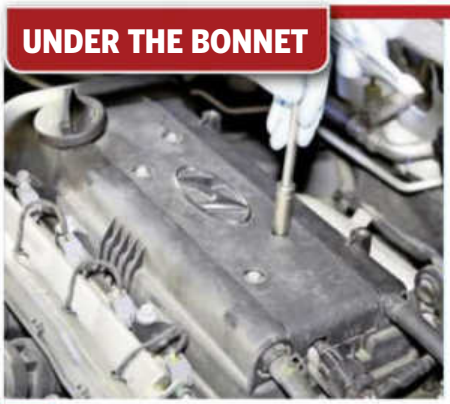
UNDER THE BONNET



1 REMOVE ENGINE COVER

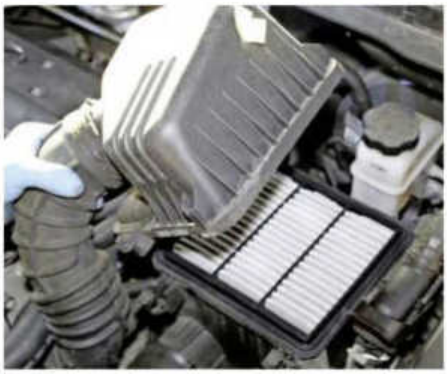
Hyundai has tucked some of the critical bits under a cover, although it's nowhere near as cumbersome as on other modern cars. However, it does need to be unbolted, rather than pulled away. Use a 10mm socket to undo the four easily accessible bolts. Underneath are the spark plugs.

2 REMOVE COIL PACKS

The coil packs – one over each spark plug – are held in place by a 10mm bolt. Undo the bolt so you can remove the packs, then disconnect the wiring. There's a small clip ahead of the connector that you push in to part the two. Once this is done, pull out each coil pack to access the plugs beneath.

3 CHANGE SPARK PLUGS

The spark plugs are NGK L2KR6B 10E items. Use a long socket to gently undo them, then, when they are free, fish them out with a magnetic grab or a length of old tubing over the tip. This will minimise the chances of any breakage as you extract them. Don't overtighten the new ones.



4 CHANGE AIR FILTER

The air filter is positioned so there's no major dismantling necessary. The box top is held on by four simple clips on its side – undo these and pull off the cover to expose the filter element. Clean the inside of the box with a damp cloth and clear any debris before putting in the new filter.

5 CHECK CLUTCH FLUID

The clutch fluid reservoir is tiny and looks almost like an afterthought, bolted onto the top of the right suspension strut. At least that makes it easy to check the level. Use an electronic fluid checker, if you have one, to ensure too much water has not been absorbed. Use DOT4 fluid to top up if required.

6 CHECK BRAKE FLUID

The brake fluid reservoir is on the other side of the bulkhead to the clutch reservoir – it's unusual for them not to be combined, these days. As with the clutch, check the level is between the 'MAX' and 'MIN' marks, and use an electronic fluid checker to verify that not too much water has been absorbed.

TOP TIP

Coolant should be changed every two years to maintain its strength (and thus its ability to do its job properly and withstand cold temperatures). Clutch and brake fluid should also be changed at the same interval.

7 CHECK COOLANT

The coolant expansion tank is on the right of the engine bay, but there's also a radiator cap. Ensure the level is between the two marks inscribed on the transparent plastic casing. However, if you wish to check the strength of the coolant mixture, do so at the radiator cap using a hydrometer.

8 TOP UP SCREENWASH

Next to the coolant expansion tank is the screenwash reservoir. It's likely to have diminished over the past few months, so now is a prime opportunity to make sure it's full. You can't see much more than the neck of the reservoir, so just add the correct mixture of screenwash and water until it reaches the top.

9 CHECK BATTERY

There's no main cover over the battery. Make sure the terminals are done up tightly, and give them a coating of protective grease to keep corrosion at bay. Lift the small cover to check the peepholes underneath, to verify the acid level inside covers the plates. Top up with distilled water if necessary.

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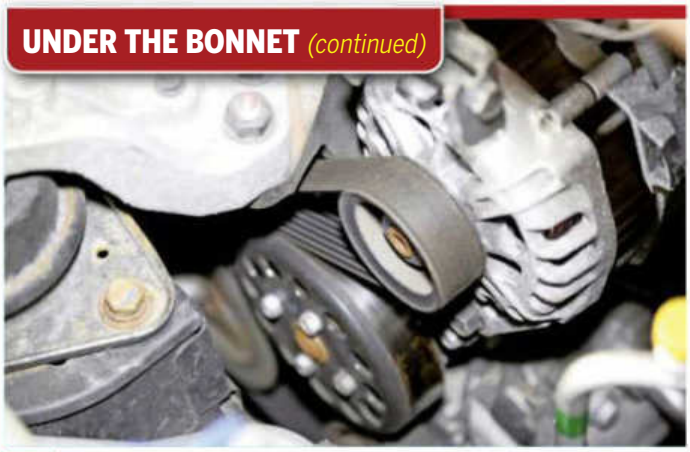
UNDER THE BONNET *(continued)*



10 CHECK AUXILIARY DRIVEBELTS

Have a look at all the drivebelts, keeping an eye out for fraying and tearing. Check to see there's not too much slack between pulleys – this can be done by trying to twist the belts at their centre points between pulleys; you shouldn't be able to do so more than half-a-turn.

UNDER THE VEHICLE – FRONT

11 DRAIN ENGINE OIL

There's no undertray, so accessing the oil drain plug is straightforward; it's on the bottom front of the sump. Use a 17mm socket to undo it, and do so when it's warm rather than scalding hot or cold and clumpy. Have a container underneath capable of holding about four litres. The copper washer on the plug should be replaced.

12 CHANGE OIL FILTER

The oil filter is up by the side of the sump and is similarly easy to access; using a filter wrench will make short work of it. When you put on the new one, make sure you smear the rubber sealing ring that should be on its top with fresh oil, to aid the sealing. The filter should be done up hand-tight.

13 REFILL ENGINE WITH OIL

Use 5w30 fully-synthetic engine oil. You should be able to fit in about 3.5 litres or a little more. We suggest filling around 2.5 litres, then starting and stopping the engine briefly. After that, top it up, making reference to the dipstick, until the oil reaches the maximum level.

14 CHECK UNDERBODY

Look underneath the car for any corrosion (unlikely) or damage (more likely, thanks to speed humps, etc). Inspect the exhaust and its mountings, ensuring everything is secure and isn't likely to drop off or knock on the bodywork. Also check the metal brake and fuel lines for rust and leaks.

15 CHECK GEARBOX OIL

The transmission oil level check plug is at the radiator end of the gearbox; you'll need to undo the three bolts holding on the plastic undertray for access. The gearbox plug requires a 17mm bolt. Dip in a finger or cable tie to make sure the fluid is up to the neck level. It shouldn't be too dark or smell burnt.

TOP TIP

The tyre pressures are listed in a sticker inside one of the front door apertures. On this model, with its 205/55/R16 tyres, the pressure is 32psi all around. The torque figure for the roadwheel bolts is 100Nm.

16 CHECK WHEELS & TYRES

Check the road wheels for cracking, kerbing, bulging or foreign objects stuck in the tyres. Also ensure they're road legal, with at least 2mm of even tread. Rock the wheels top to bottom; significant play points to suspension issues. Finally, spin the wheels and listen for the low drone of a worn bearing.

17 REMOVE WHEELS

The wheels on this car each have a locking wheel nut. Make sure you know where the tool is to undo them – it should be in the spare wheel toolkit, but if you're not the first owner of the car, it could have ended up anywhere. Without it, you won't be able to work on the brakes.

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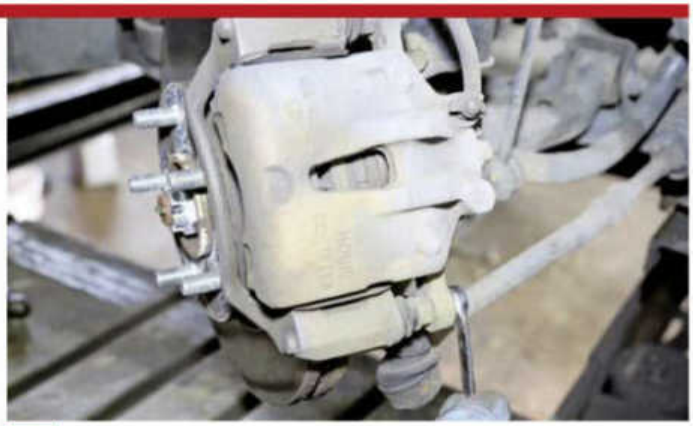
18 CHECK STEERING

With the wheels off, check the suspension and steering components, looking for perished rubber bushes, broken road springs and leaks from dampers and brake lines. The last of these are likely to occur around unions. Check the CV boots to make sure there are no splits letting in dirt, which will accelerate wear in the joints.



19 REMOVE FRONT BRAKE CALIPERS

Use a wire brush to clean around the brake assembly before you dismantle it. You'll need a 14mm socket or spanner to undo the two bolts on the back of each caliper before lifting them away from the discs. The pads should remain in place around the disc, so will probably need to be prised away using a screwdriver.

20 FURTHER CLEAN BRAKES

Once the pads and calipers are clear, continue with the cleaning process. Proprietary spray cleaner is a good idea, along with a wire brush. The clips in which the pads mount should be removed and cleaned; you can do so most effectively by putting them in a vice and using a wire brush.

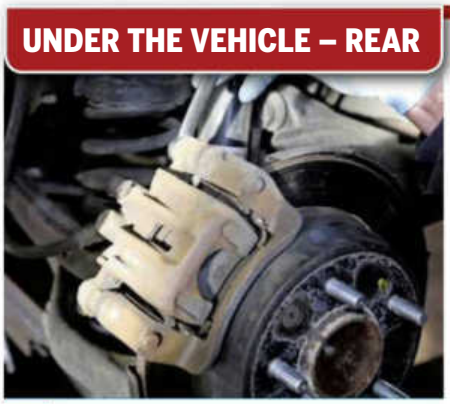
21 CLEAN BRAKE PADS

If there's at least 3mm of friction material on the pads and they're free from oil or grease contamination, they can be reused. These have a groove – compacted dust can be removed from this area using a hacksaw blade. Rub their fronts against abrasive paper and apply some grease to their rears and mounting lugs.

22 OTHER BRAKE ITEMS

Put the pad clips back in place and apply some grease to them, after which you can put the pads back in place. The caliper bolts will also need lubrication, to ensure that they slide easily, and you should apply some grease to the hub flanges as well, before you refit the wheel. Now reassemble.

UNDER THE VEHICLE – REAR



23 CLEAN REAR BRAKES

As at the front, the rear brakes are discs, so clean them with a wire brush. The rear bolts that need to be undone are also 14mm. After that, the process is very much the same as earlier: prise off the pads so they can be cleaned separately and carry out the same lubrication tasks.

24 FURTHER CLEAN BRAKES

Carry out more cleaning on the inside of the calipers, using a flat-blade screwdriver to scrape out compacted dirt. You can also use the screwdriver to scrape off any loose rust on the disc rim – spin the disc against it to do so. The mounting clips for the pads should also be cleaned.

25 ADJUST HANDBRAKE

There's a rubber bung on the wheel hub drum, which can be pulled off with small pliers. Turn the hub and use a torch to look for the cogged wheel through the hole. This is the handbrake adjustment and can be manipulated using a screwdriver. Turn it upwards until the drum no longer spins freely, then slacken off a bit.

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OTHER ITEMS

26 CHECK ALL INSTRUMENTS

Inspect the seatbelts for any damage and pull them hard to make sure they 'grab' properly. Try out all of the instruments and controls to ensure that they're working correctly. Also check the lights – you can always see if the tail-lamps are working by backing the car up to a wall and looking for their reflection.

27 CHECK ALL WIPERS

Make sure the wipers are up to scratch by not being up to scratching! In other words, check the rubber isn't perished or torn, which could result in the metal beneath marking the glass. The blades should be held securely but pivot freely. Also try the screenwashers and adjust their aim at the screen using a pin if required.

28 CHECK SPARE WHEEL

The spare wheel is under the boot floor and you should carry out the same checks as with the other tyres, making sure its condition is road legal and it's at the correct pressure. This spacesaver item should be pumped up to 60psi. Also check that the toolkit that sits on top of it is complete.

29 LUBRICATE ALL LOCKS

All the locks, hinges and catches on the car should receive a dose of oil or spray grease. It's something that often gets skipped at services, and can lead to such areas seizing up completely. To get right into locks, use an extension tube. Don't forget to do less obvious areas like the fuel filler cap.

30 CHANGE POLLEN FILTERS

While this wasn't done at this service, you'll find the two pollen filters concealed behind the glovebox. You'll need to drop the glovebox down by pushing in and then sliding its grommets. Remove the cover panel, slide out the filters and replace as necessary, making sure they go in the right way around.

31 CLEAN BODY DRAIN HOLES

While corrosion is much less of an issue on modern vehicles, it doesn't hurt to give your Hyundai a helping hand by making sure all its drain holes (such as those on the bottom of the door) are clear. You can use a bit of wire to clean them out.

SERVICE SCHEDULE

EVERY 12,500 MILES or 12 MONTHS

- Change engine oil and filter
- Check battery
- Check all hoses for leaks and condition
- Check coolant level and concentration
- Check brake fluid level and water content
- Check clutch fluid level and water content
- Top up screenwash
- Check auxiliary drivebelt condition
- Check all lights, instruments and controls
- Check windscreen wipers and washer jets
- Lubricate all locks, catches and hinges
- Check body and underbody for corrosion and damage
- Check exhaust system and mountings condition
- Check suspension and steering components
- Check tyre pressures and condition
- Check spare wheel pressure and condition
- Check front brakes; clean or renew as necessary
- Check rear brakes; clean or renew as necessary
- Check all brake lines for leaks
- Check transmission fluid level
- Check fuel lines and hoses

EVERY 15,000 MILES or 24 MONTHS

- Replace air filter
- Replace pollen filter

EVERY 24 MONTHS

- Replace coolant
- Replace brake fluid

Thanks to **Ellingworth's Garage** of Fengate in Peterborough, Cambridgeshire, for its help with this feature. This friendly, long-established and family-run business is happy to work on practically anything with an engine. For further info, ring **01733 343941**

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GENERAL

Dexron oil

Q I see that someone else has asked about using auto ATF in a Honda. Why can't Dexron be used in my Mercedes? Is it because of the heat not being the same or is it because it causes problems internally?
Graham Moore

A **From looking at the oil it is difficult to understand why Dexron could not be used to replace the Honda formula. However, the chemical formulation of the oil is quite complex. Dexron is actually an oil licensed by GM and intended for the GM range of autoboxes.**

The original Dexron manufactured in 1968 contained whale oil. This was replaced in 1972 by Dexron II, which used jojoba oil – the problem with this was that it caused corrosion to soldered joints, creating problems with the internal electronics of some 'boxes. Dexron III was introduced in 1993 and is suitable for any application requiring the earlier versions. Dexron IV arrived in 2005 and has a different formula and viscosity, so it is not suitable as a replacement for all earlier versions.

Honda transmission fluid ATF Z1 is a different type of fluid and classified as HFM (Highly Friction Modified). Although based on the same oil formula as Dexron III, it contains friction modifiers that are specifically manufactured to promote a smoother gearchange in Honda autoboxes. ATF Z1 also has greater shear stability, meaning it will not lose its viscosity in use as quickly as Dexron. Likewise, the Mercedes oil contains additives that have been chosen for their compatibility with the operation of the Mercedes gearbox.

GENERAL

DC clamp meter

The Uni Trend 203 DC/AC current clamp multimeter

Q Which DC clamp meter would be suitable for a home mechanic? The Clarke meter is, I believe, AC-only and I need one that will measure DC current in clamp mode.

A *CM* article a few years ago featured the use of a DC clamp meter to find the source of a battery drain. I halfheartedly tried to obtain one at the time, but gave up on discovering that the model described was from the US. I will welcome any info on models and/or suppliers.
Colin Wells

A **The Clarke CDM90 digital clamp multimeter has the following specifications: Max voltages: AC 750V, DC 1000V; Max current: 1000A; Max resistance: 2000 Ohm. This is suitable for performing various tests and measurements on electrical systems, vehicle electrics, mains applications, etc. It is available at this website http://bit.ly/1MInMGI for £29.99.**

Another unit designed specifically for the motor trade is the Uni Trend 203 DC/AC current clamp multimeter available from this site http://bit.ly/1laLzHT for £39.99. One of the customer reviews of this unit states that it was used specifically to detect a current drain on a vehicle and worked well.

FORD FOCUS

Washer worries

Q I have an electrical problem with my 2004 Ford Focus 1800LX estate. The front windscreen washer has stopped working, but the rear window washer operates correctly; they both use the same washer pump. Under normal conditions, when I press the washer switch, the wipers also start for two or three wipes, rest for a short while and finally do a 'drip wipe'.

So far I have removed the switch and put a meter across the windscreen washer terminals (pins two and three) My meter shows continuity when I press the washer switch. I refitted the switch and removed the washer pump and then put 12V across the pump and it operated. But with the pump still disconnected electrically, if I operate the washers, the wipers behave correctly (two wipes, a rest, then a 'drip wipe'). It appears that everything works as it should until it is put together.
Bob Hathaway

A **The system used to obtain rear wash and front wash from the same pump means that the polarity of the pump is reversed in operation to spin the motor in different directions. You have successfully operated the pump using a 12V feed, so you now need to reverse the polarity and ensure the pump works in both directions.**

There are two components that could be causing the problem: the wiper switch or the general electric module (GEM). I would start with the basics and connect a test light in place of the washer pump – this should illuminate when either the front or rear washers are operated. If this is the case, the pump is the likely problem; if it does not illuminate, it is most likely either the switch or the GEM.

READER FEEDBACK: Thanks for answering. Based on your answer I did further checks:

- I removed the washer pump and checked it worked, then reversed the polarity and checked again – it worked in both directions
- I connected a bulb in place of the washer pump and pressed the windscreen washer button. The test bulb did not light, but on operating the rear washer, the bulb illuminated.

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It was beginning to look like the pump was fine and the fault was with the switch or the GEM. I removed the switch and used a meter to check for continuity between the two pins that work the washer (pins 2 and 3). Annoyingly, when I pressed the button, I got continuity, but I still had a niggling feeling it was the switch and not the GEM (a bulb or the pump would put a lot more load on the circuit that a test meter would).

I decided to try swapping the switch, so I contacted my local Ford dealer and asked the price of a new switch; thinking if it is cheap enough I will just buy a new switch and see if it worked – it was nowhere near cheap enough! So after Googling a bit further I found a blog that seemed to describe the exact problem I had (see **http://bit.ly/1LeUKyG**).

In the blog it suggested that, if I had a wire running to pin 1 of the wiper switch, I could replace the fixed interval intermittent wipe with a variable interval one just by replacing the switch. On checking the wiring in my car, I discovered that pin 1 did have a wire running to it. I found a breakers that would allow me to try a variable wipe switch in my car; on trial-fitting, I pressed the washer switch, the washers operated and the wipers did two wipes, rested and then a drip wipe.

The next test was to set the variable switch to the minimal setting and switch on intermittent wipe. The wipers operated with about a one second interval. On dialling the variable setting to the maximum, the interval changed to about 15 seconds.

Not only have I restored the windscreen washer function on my car but I have upgraded the intermittent wipe to variable interval – all for the total price of £15!

Bob Hathaway

FORD FOCUS

Emission control

Q I don't think the engine in my 2009 Ford Focus Duratorq 1.8 TDCi has a Lambda/oxygen sensor, so how does it control the fuel/air mixture and the emissions?

Jason

A **The four-cylinder in-line turbo diesel engine in your Focus is fitted with direct fuel injection. The turbocharger has variable turbine geometry and an intercooler. It uses a high-pressure fuel pump for the generation of pressure in the fuel rail, with an integral transfer pump for the fuel supply; this runs the fuel rail at a constant fuel pressure. As it uses Piezo fuel injectors, it gives optimal metering of the fuel quantity and utilises variable pilot and main injection for optimisation of noise emissions.**

The engine management is controlled using a powertrain control module (PCM) for fuel-quantity regulation, control of the fuel injectors and exhaust gas recirculation. The PCM uses information gained from the camshaft position sensor (CMP) to determine the injection sequence. The knock sensor (KS) is used for reduction of combustion noise, and the electrical actuator for turbocharger guide vane adjustment for optimisation of boost pressure control. The engine also benefits from an actuator motor-controlled exhaust gas recirculation (EGR) valve with integral position sensor.

To sum up, unlike a petrol engine, the diesel engine does not use an O_2 sensor to regulate end emissions, relying more on the strict control of injected fuel and the running conditions of the engine to determine required fuel quantities and to strictly regulate end emissions.

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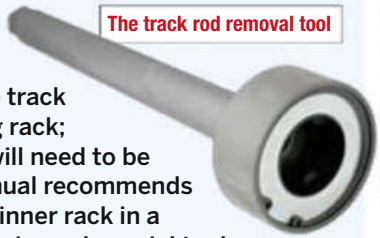
FORD FIESTA

Inner track rod joints

Q I have a 2009 Ford Fiesta 1.25 Zetec and it has passed the MoT with an advisory on the steering rack inner joints (not the track rod ends). Is this a DIY job and, if so, could you explain how to do it?

Yorick Rowe



The track rod removal tool

A **The advisory is due to wear in the balljoint knuckle at the inner end of the track rod where it connects onto the steering rack; the track rod end and the steering rack gaiter will need to be removed to access this. The Ford technical manual recommends removing the steering rack and supporting the inner rack in a soft-jawed vice. Strangely enough, although a universal special tool is available, Ford advises using pipe pliers for removal. When refitting, they quote a torque setting of 82Nm, but do not list a special tool to carry this out.**

In practice, I find removing the steering rack is not necessary and we always use a tool similar to the Laser 4765. Cheaper versions of this tool are available on eBay, although you may manage to complete the job using a pair of pipe pliers. Tightening to a specific torque setting using grips will not be possible, but instead I would use a thread lock such as Loctite 243.

Once the job has been completed, the wheel alignment should be checked.

FORD KUGA

Plastic vents

Q I have a 2010 Ford Kuga 2.0 diesel. Would you know what the black plastic vents situated under the two respective front seats inside the car are for? Are they linked to any gas emissions?

S Sharma

A **The two plastic vents are air ducts for the heating system to direct air into the rear of the vehicle. These ducts should run from the heater down over the centre tunnel and under the seat frame, opening up at the rear of the front seats.**

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JAGUAR

JAGUAR S-TYPE

Fuel algae

Q I have been running my Jaguar S-TYPE for three-and-a-half years and have been plagued with fuel starvation symptoms. On start-up, the engine runs fine until it reaches normal operating temperature, then it starts showing signs of fuel starvation.

In the early stages it appeared to be linked to the amount of fuel in the tank, so I kept it above a quarter-tank full. Then the problem gradually got worse and eventually it would hesitate even with a full fuel tank. Also I would occasionally hear a noise that seemed to come from the rear of the car – the fuel tank area. By this point, I was reasonably sure the problem was the fuel pump in the fuel tank and a secondhand in-tank fuel pump cured the problem.

It seem that the in-tank fuel pump would work normally for about the same length of time it took for the engine to reach normal working temperature, then I assume the actual fuel pump would heat up, causing part of the pump to expand and start touching the outer case. Then the fuel pump would start to run sporadically.

Another point: have you had any reports of algae growing in the diesel filter?

Michael Polglase

Diesel fuel algae can be a problem in low-mileage vehicles, bit it's not really algae.

A **The term 'diesel fuel algae' is widely used, but the substance is not actually algae. The substance normally found in the fuel filter is made up of polymer, asphalt and wax residues. One of the most common causes of this is using summer diesel in the winter and often occurs in low-mileage vehicles that have retained a tank of fuel for a long period of time. Summer diesel contains more wax, which crystallises in colder weather and blocks the filter. Another cause of is the bio-degradation of the fuel, which also causes the filter to become blocked.**

There is another cause more usually associated with marine diesel engines and this is water contamination. In the marine field, a product called Diesel Bug Treatment is commonly used to prevent or eradicate fuel spoilage organisms in the system. It is sold at this website http://bit.ly/1El9uri. Although designed primarily for marine engines, it can safely be used in any diesel engine.

JAGUAR S-TYPE

Pinking problem

Q On a trip around Devon, I noticed that the engine in my 53-plate S-TYPE 3.0 was pinking when climbing certain hills, which is not something I would have expected from a computer-controlled engine. I overcame this problem to some degree by using the manual settings on the auto transmission and keeping in as low a gear as possible. There's 72,000 miles on the clock, but the engine was replaced at 30,000 miles with a new unit supplied and fitted by Jaguar. The only fault code showing is 'P1111'.

Stephen Hayes

A **The code 'P1111' normally indicates that all systems are functioning correctly and that the diagnosis check is complete.**

As you say, an electronically-controlled engine should not be suffering from pinking. If this is the case, it may be that the one of the knock sensors is at fault; the sensor should send a signal to the ECM to adjust the timing to prevent pinking. The left-hand knock sensor is located within the V of the engine, on the inside of the left-hand bank as viewed from the driver's seat, while the right-hand sensor is located below the exhaust manifold on the outside of the cylinder block just to the rear of the alternator. The knock sensors should read 180-220KΩ when read with an ohmmeter. You should also check the continuity of the connecting wires.

Other possible causes are the ECM, the O_2 sensors, fuel pressure or air leaks in the inlet system, although given that no detrimental fault codes are present, the most likely cause is the knock sensor.

VAUXHALL COMBO

Fumes in cabin

Q I have a 2005 Vauxhall Combo van fitted with the Z17dth diesel engine. It has 99,000 miles on the clock. The problem I am having is with fumes getting into the cabin.

I have checked the obvious areas, such as the exhaust system, doors and seals, and split pipes. A suggestion I have had is that the EGR valve could be the cause of this problem, but, if it is, should it not show as a fault code? Another suggestion is that it is the auxiliary heater exhaust silencer. Where do you find this unit on the engine, what is its job and can it be serviced?

John A Petch

A **Having checked the door seals and exhaust, you can hopefully be confident that the fumes are not being dragged in through the rear door – this is one of the most common causes of reported fumes within a van.**

If the EGR valve were leaking, this should be fairly easy to spot and would leave a trace of black smuts around the leaking area.

If your vehicle has an auxiliary heater fitted, this is a separate unit which is fed from the vehicle's diesel supply and heats the cooling system. It is normally controlled by a timer to enable easier starting from cold and ensure that the vehicle's heater will operate as soon as it is needed. The exhaust from the auxiliary heater usually runs along the nearside of the vehicle and exits around the centre of the sill, although this can vary according to the system fitted.

I would check the underbonnet area of the van to ensure that all the rubber bungs are correctly in position, as any breaches in this area will allow fumes through and into the van. Also check that the rubber strip running along the top of the panel at the rear of the engine bay is secure and has no tears or missing areas – a breach in this area would allow fumes from the engine bay to enter via the heater and into the cab.

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VAUXHALL CORSA

Spare wheel

Q Last week, a one-year-old Corsa D was added to the family fleet. It's a five-door 1.4 SE auto. A very nice car, but it has no spare wheel, just a stupid repair kit and a tin of sealant. Sadly, this is the way most manufacturers are going to cut costs and weight to lower emissions. It's a crazy idea when you have a puncture, as it fixes only very minor damage and the tyre has to be scrapped anyway.

When ordering a new car, the Vauxhall Corsa brochure states there is an option to pay an extra £95.00 for a proper spare tyre/jack instead of a "one-size down steel spare wheel (in lieu of emergency tyre inflation kit)". Our Corsa SE has 16-inch alloy wheels with 195/55 R 16 tyres, so is this spare a 15-inch steel wheel with a 185/65R tyre? I have not been able to identify a size for the Vauxhall alternative option of a spacesaver wheel/tyre.

Advice is needed on obtaining an optional spare wheel for a Vauxhall Corsa D.

A good secondhand wheel/tyre is the best option for us, as the cost of a dealer-supplied spare tyre assembly is well over £200 new, and they are cagey about giving information on sizes. Please can you confirm the size of spare we should obtain or can you identify the correct size of spacesaver required? Are all Vauxhall spacesavers the same size, as claimed by one breakers yard? Presumably the same wheel bolts fit both the standard alloy wheels and the steel spares – Vauxhall do not mention any difference.

Stuart King

A **Having had vehicles brought to our workshop on the back of a low-loader because the sidewall of the tyre has been split, I agree with you completely. A can of puncture repair fluid is not a complete rescue package and the mess it leaves inside the tyre is not pleasant to clean up.**

From the information I can see on the Vauxhall website, the options are either getting an emergency tyre inflation kit in lieu of a spare wheel or a one-size-down spare wheel in lieu of the emergency kit. The one-size-down reference is slightly misleading and I believe it would be a spacesaver as opposed to a standard wheel. Unlike a standard wheel, the spacesaver has a higher inflation pressure, a much smaller footprint on the road and a lower maximum speed. The spacesaver that would be needed on your Corsa should, as your breakers have suggested, fit all Corsas with either 15-, 16- or 17-inch wheels. The spacesaver spares are designed to be used with the original wheel bolts.

VAUXHALL ZAFIRA

Broken cambelt

Q I have a 2003 Vauxhall Zafira 1.6 twin-cam. At a speed of 40mph, the timing belt split down the middle and parted amidst much rattling. With the crankshaft position 60° anticlockwise of TDC, I have turned the cams manually, with the front cam falling to the timing position on the sprocket. However, the rear cam falls to a slightly lower position, so that the timing mark is an inch lower than the horizontal and does not line up. Should I assume the valves are bent and remove the cylinderhead for inspection? Or is there another adjustment to allow a new timing belt to be fitted?

John Wilson

The cam locking tool

A **My first comment would be that the cams will not sit happily on the timing marks and need to be held in position using tool number KM-852. This is a cheap locking tool and available for under £15. Having said that, the Z16XE engine fitted to your Vauxhall is an interference engine and the possibility that no damage has occurred is extremely unlikely. I would expect to see damage to the valves and possibly the valve guides.**

VAUXHALL ASTRA

Metallic sound

Q I own a 2010 Vauxhall Astra H Sport with a 1.8 Z18XER engine and 21,000 miles on the clock. While I am driving with the window down, I can hear a metallic scraping sound. It's reminiscent of the noise you get when the brake pads and discs are running low, although these are perfectly fine. The sound disappears when I push down the clutch and comes back upon release. Other than this, the car runs perfectly, with no clutch slip or judder, just an irritating noise.

Do you have any ideas?

Andy Clark

A **As the noise disappears when the clutch is depressed, this suggests the fault may lie within the gearbox or final transmission. It is also possible the noise may be coming from the release bearing, which is suppressing the sound when depressed. With such a low mileage, I would be very surprised if the problem is a worn gearbox bearing or differential bearings, but given the symptoms this would be the most likely cause.**

My first move would be to check the gearbox oil to ensure that it is up to level and also to ensure that the oil has not turned grey, indicating wear in the gearbox. The gearbox level plug can be found in the diff located close to the driveshaft. From the factory, the level is slightly below the level plug, but in service should be topped up to the level plug.

As the noise is only heard when the window is down, it may be that it is a characteristic of the vehicle and not an immediate problem, but without hearing it myself this is difficult to say.

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SEAT IBIZA

Running fault

Q I have a 2003 SEAT Ibiza Mk4 6L1 1.2 petrol with engine code AZQ that has failed its MoT on emissions. VAG-com revealed two faults: the Lambda sensor and EGR valve.

A friend and myself set to work prepping the car for a retest by renewing the air and pollen filters, engine oil (Valvoline Durablend Synthetic 10w40), oil filter, Lambda sensor (an identical five-wire Bosch LS 7357), EGR valve (substituting the original Pierburg 03D 131 303 B for a Mapco 83800), spark plugs (Bosch FR HER 2 substituted with Bosch super plus +51 (FR7HC+)). The EGR pipe that runs back to the intake manifold was removed to decarbonise it. The new parts were then read into the system with VAG-com and checked for any fault codes, of which none showed.

A few miles after completing the work, the vehicle developed running problems, with the engine diagnosis warning light illuminating intermittently. Regardless, the car was put through the MoT again, but failed a second time on emissions.

Unsure if the new plugs were a suitable alternative to the originals, the old ones (which were in good order) went back in. Convinced there was a vacuum leak, the rubber seal between the EGR pipe and inlet manifold was renewed, along with another set of EGR mounting seals. The running problem persisted, so a garage hooked it up to diagnostic equipment and fitted a new Bosal catalytic converter. This time it passed the test, but still had the running fault. The mechanic checked over everything we did, but could find no faults.

The fault manifests itself as a jerky 'stuttering' or 'pulling back' like a hiccup and occurs at even/level speeds or when decelerating, but not during acceleration or at tickover. It has been described to me as hunting, but I'm not sure it's that. It also regularly stalls at lower speeds, particularly when reversing.

Once back in daily use, the performance got worse, with the car strangled of power and reluctant to accelerate. Diagnostics repeatedly showed an inlet manifold air leak, but none could be found. The car was passed on to another mechanic, who replaced the throttle sensor, cleaned the throttle body and checked for air leaks and other faults. It ran much better but the original stuttering and intermittent engine diagnosis warning light persists. The last time it was connected to a diagnostics reader it showed an inlet manifold air leak.

Occasionally exhaust fumes are evident inside the car. Do you think it is linked to the fault? Are there any other faults that could trigger an air leak fault code? Also, are the Bosch super plus +51 (FR7HC+) plugs suitable for this car?

M Sessions

A **The recommended spark plugs are NGK BKUR 6 – ET 10 or Bosch F7 HER 2. The electrode gap should be 0.8-0.9mm. But I do not believe your problems are related to the spark plugs, especially as you have replaced the originals with no improvement to the running conditions.**

There was a service bulletin on the AZQ engine regarding EGR valve problems and it was noted that when the EGR valve is replaced the ECU should be adapted to the new unit. As you have done this, we can hopefully discount this as the source of the fault, although given that fitting the EGR valve coincided with the start of the problem, it may be worth re-checking.

There was also a service bulletin with reference to the brake vacuum pipe. These were apparently found to be of defective material and prone to cracking along the length of the pipe. Having carried out work in the

SEAT ALHAMBRA

White gunge

Q I need advice sorting out the white gunge that has formed beneath the oil filler cap and on the dipstick of my 57-plate SEAT Alhambra 2.0 petrol. I know alarm bells should ring on hearing this, but the coolant level remains constant and the car passed a gas test, so I've ruled out the head gasket. It has fresh oil every 4000 miles, with the last change being just five weeks ago. A nine-mile daily round trip is probably the cause of the problem, but even after a motorway blast, it still has fresh droplets of condensation forming under the cap.

I've changed the filler cap seal and also the breather pipe. The old pipe was very gunged up, so with the new pipe fitted and after another motorway thrash, I checked to find there were still water droplets forming. Is the top of the engine likely to be so blocked that I will have to strip it down further and clean it out, or should I try a flush and do a few hundred miles with thin oil such as Mobil 1, followed by a refill using the correct grade?

Is this VW lump – an eight-valve unit, engine code ATM – known for this problem? I did the same run for years in a 2.3 Galaxy without this happening.

Richard Hill


White gunge on the oil cap

A **Whether or not this is a serious problem really depends on the amount of mayonnaise/white gunge you have below the filler cap. Condensation will form in this area because it is the highest point and the cam cover will be cooler than the rest of the engine. The hot air in the system will always contain a certain amount of water vapour and this will rise and then condense when it touches the cooler cam cover.**

Below the cam cover on your engine is a camshaft splash shield. This effectively prevents a great deal of oil movement just below the cam cover and oil filler area, meaning the condensation cannot get washed away by the hot oil. As you have replaced the oil breather pipe, it may also help to remove the cam cover and clean this out.

Provided you are confident that you have no coolant loss and that you have successfully ruled out the possibility of a head gasket failure, I would not be too concerned. You may find that this is one of those problems that you will never be able to eradicate entirely.

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engine bay, it is possible this has been knocked and is an unseen source of the air leak. The replacement pipe is part number 6Q1 612 041 AE.

There were also problems on the AZQ engine with regard to dirt causing issues with the throttle control valve. This is another area to check and it would be worth cleaning the valve to ensure that this is not the cause of the problem.

SKODA OCTAVIA

Tyre noise concern

Q I have a 2011 Skoda Octavia 2.0 TDI five-door MkII which I bought new. Up until 13,000 miles, it was very quiet, but over the next 3000 miles it developed a loud droning noise above 30mph, similar to a wheel bearing going. Myself and the dealer have both checked these and they seem OK. My Skoda dealer tells me it's due to the rear tyres 'saw toothing', as a result of a tracking problem. This is wearing the inside edge of both rear tyres and one is worse than the other (ie, too much camber), so I need to have it tracked.

I have read a number of articles that suggest I need a four-wheel geometry set-up rather than an alignment/tracking machine. Is this correct? Having looked on the internet, I understand this is a common problem across the VW and VW derivative range. On these models, I have been told that the rear tracking is adjustable as the Octavia chassis is based on the VW Golf MkIII or MkIV, which have a similar problem.

Can you recommend a facility where I can get the geometry set? Preferably this would be somewhere near Sheffield, but I can travel to the right place as this problem is spoiling my enjoyment of an otherwise great car.

Also, I understand Skoda have issued revised settings for the rear wheels on Octavias. Can you tell me what they are, as I have looked at various publications but cannot find anything and I would like to make sure the settings are right when I have it retracked?

The tyres I use are Dunlop SP Sport 205-60 R15 91V. Are these more susceptible to the problem than other makes of tyres? I read on the internet that somebody had fitted narrower tyres and rims and the problem was reduced. What is the rim size required for these size of tyres? I was thinking of getting some steel rims for when the tracking is done, due to potential damage to the alloys when fitting the tracking measurement devices.

Eddie Machin

A According to the data I have available, the JCT600 VW dealership at Meadowhead (0844 875 0683) should be able to carry out four-wheel alignment – they are about nine miles from you. I have never used this company, so can only offer this as a suggestion not a recommendation.

The settings have, as you correctly point out, been revised. The old values were: -1° 45min ± 30min, whereas the new values are: -1° 20min ± 30min.

Different tyres will have different wear characteristics, but as most tyres now employ the block tread to the edge, it is difficult to say which would fare better. One thing you can do to help eliminate the problem is to swap the front and rear tyres on a regular basis. Always retain the direction of rotation, swapping the tyres front to rear but retaining the tyres on the same side of the vehicle. If you have not yet tried this, I would recommend doing it before completely changing the tyres, as it may silence the noise. I would not recommend a narrower tyre, as it would change the ride and road-holding capabilities of the vehicle.

To fit your tyres onto a steel rim, you would need a 7J 15in rim, although modern alignment equipment is very good and should fit on your alloy wheels without causing any scratching or damage.

VOLKSWAGEN GOLF

Bouncing back end

Q I recently bought a 2003 VW Golf MkIV 1.6 estate. After driving the car for some time, I found it was jumping around at the rear after going over a bump on the road. I decided to replace the rear shock absorbers, even though the car had only done 35,000 miles. When I replaced the shock absorbers, only one was found to be leaking. After they were replaced, the problem has persisted.

I have also fitted new tyres to all four wheels. One of these tyres was the spare, which had not been used before and seemed in very good condition. I am not sure if this is the original 2003 tyre – the coding appears to indicate this. Should I be using this 11-year-old tyre and is it possible it could be causing the problem?

John Reid

The tyre date code

A The date coding should be on the side of the tyre in the form of a four-digit number within a slightly oval recessed area. The first two digits are the week number and the second two are the year, so 1511 would indicate that the tyre was made in the fifteenth week of 2011. Tyre deterioration will occur at a far slower rate if the tyre has been kept out of sunlight, although I would examine the body of the tyre carefully for any cracking around the walls.

Normally, I would have expected the new shock absorbers to have addressed your suspension problems. As this is not the case, I would check that both the rear springs are complete and that both appear symmetric. If there is any doubt about the tyre, this should be changed, but to test if this is the source of your problems I would swap the front tyres to the rear and road-test the vehicle to see if this has an effect.

The front bushes in the rear axle beam are known to wear, but I am not sure that this would cause the problem you are experiencing. However, it is worth checking the bushes are secure and not subject to excessive play.

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VOLKSWAGEN FOX

Central locking

Q I am experiencing problems with the remote central locking on my 2006 VW Fox. The doors can only be unlocked using the key in the driver's door lock – this will open both doors. It is also still possible to both lock and unlock the doors using the internal switch. The battery in the key fob has been replaced, but the buttons on the fob will neither lock nor unlock the doors remotely. The handbook suggests that I should resynchronise the key and explains the method for carrying this out. I have completed this procedure without success.

Do you think the problem is due to synchronisation or is it likely to be something else? Is there an alternative method that I can use to reset the remote or are there any other possible causes that are preventing the remote from working?

Also, after unlocking and entering the vehicle, when I turn on the ignition, the lower parts of the electric display on the clock/mileometer disappear, with only the top half of the digits showing. After driving for about one mile, the display then shows up in full.

Since this first happened, the display has been disappearing and reappearing. Is this related to the central locking fault? Could you advise how to rectify this without replacing the dash pod?

AJ Latham

A **Starting with your central locking problem, the method I have to synchronise the key fob is to press the unlock button for around one second, then lock and unlock the vehicle with the key. The system should now be synchronised and the remote should work. If this is not the case, the most likely reason is that either the system needs reprogramming or the key is not sending out a signal. In either case, a vehicle locksmith will be needed to check the signal from the key and reprogramme the system.**

The dash display is a fault within the LCD display and would not be linked to the central locking problem. The dash does not need to be replaced completely and there are quite a few companies who offer a repair service at a reasonable cost. The company at www.speedorepair.co.uk offers a repair service for £80, although never having used it this is only a suggestion and not a recommendation. A repair would be a better option than fitting a replacement dash, as this will retain the correct mileometer reading.

HYUNDAI SANTA FE

Oil choice

Q I have a 2002 Hyundai Santa Fe 2.4 petrol 4WD. My query concerns the transfer case (centre diff) and rear axle. The handbook recommends using API GL-5 80w90 oil for both. I have put Valvoline GL-5 80w90 LSD in the rear axle because I believe it is a limited slip differential. In the centre diff, I use Valvoline GL-5 80w90 normal diff oil. Is this correct or is the centre limited slip?

The transfer case (centre diff) also has a slight leak on the driveshaft seal, but at the moment doesn't leave an oil stain on the drive. I regularly top it up and was wondering about trying Wynn's Gear Oil Treatment/Stop Leak. Is this OK if it is a limited slip differential? I will eventually replace the seal when I can get one and have the time.

The handbook also states that the transfer case and rear axle oil should be replaced when they have been submerged in water. I recently went off-road and got the vehicle wet (but not stuck in water), so I may look at replacing the oil in both.

N Lett

A **As you say, the rear diff is a limited slip unit, but the transaxle is just a standard unit. As the centre unit utilises a standard gear set-up, using the Wynn's treatment will do no harm.**

Replacing the oil seal should be a straightforward job. Once the driveshaft has been removed, the seal can be levered out of position. Hyundai do recommend using a special tool (part number 09431-21200) to fit the seal, but using a suitable large socket to evenly push the seal in position should do the job. Ensure the seal face is lubricated before refitting the driveshaft.

HYUNDAI i30

Correct tappet clearance

Q Could you tell me what the correct tappet clearance should be on my Hyundai i30 1.4 DOHC engine?

David Cullen

A **According to my data, your vehicle should have the double overhead cam engine with a code of G4FA. If this is the case, the tappets are hydraulic and need no adjustment.**

Thanks for your very prompt reply. I should have asked what the initial or static clearance (or lash) was, as this engine's tappets are apparently

HYUNDAI ix35

Follow up information

After running Chris Rhodes's *Help!* query in the November 2014 issue, with reference to his Hyundai ix35 tailgate not locking, I received this email from another reader.

There was a question about the Hyundai ix35 boot not locking. If the car has the keyless entry system the boot will unlock whenever the key is within about two metres of the boot door. I thought this was a fault until I tried to open the boot without the key in my pocket and found it locked.
Keith Lacey

I sent this information on to Chris Rhodes, who confirmed that this was the situation and that when approaching the vehicle without the keyless fob, the vehicle remained locked.

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adjusted initially by shims and this initial gap is taken up by oil pressure when the engine starts. In my opinion, my tappets are noisy, but I need to check this static gap before I consider it might be a problem with oil pressure or worn cams.
David Cullen

The initial settings should be: Inlet 0.17-0.23mm and exhaust 0.22-0.28mm. The clearance should be set cold. The hydraulic adjustment should prevent any tapping noises and I would check the cam face for any wear marks. If the camshaft looks smooth and with no visible problems, I would recommend using a lifter-free additive. I have had very good results with such products in the past. If this proves successful I would leave it in the system for a short while before carrying out an oil and filter change.

NISSAN

NISSAN MAXIMA

Non-start

Q Can you help me with my 1999 Nissan Maxima QX 2.0 V6 SE automatic saloon (A32 Series), which will not start. I took it off the road with the idea of starting it up every couple of weeks. All went well for a month, until I decided to take the battery off to give it a charge as it was getting sluggish.

I ended up not reconnecting the battery for two weeks, when I was going to give it another run. However, after reconnecting the battery, the car would not start – it doesn't even try to fire up. The starter motor will turn over all day long (I have bought a jump-start pack), but all I get is a smell of petrol.

I've owned this car for 10 years, it's done 86,000 miles and been regularly serviced. During my ownership, it has never refused to start and has always done so immediately. However, during those 10 years, I've only disconnected the battery once, for about 5-10 minutes to replace it with a new battery, and there was no trouble restarting. This all points to the fact that the non-starting issue is caused by me disconnecting the battery for a longer period.

I've had an auto lock specialist confirm that it has nothing to do with the immobiliser, as it is recognising the ignition key. All warning lights go out when the starter motor is turning (the engine malfunction light does not stay illuminated). Fuel is getting to the spark plugs, but they are not producing a spark. All the fuses and fusible links have been checked and are OK.

I'm thinking it may be a faulty crankcase sensor or an ECU issue, but I would welcome any ideas you have.
Terry Dawson

A **Have you checked the plugs for a spark or are you making the assumption that they are not sparking because the engine does not fire? If, after testing for a spark, you discover that the plugs are actually firing, I would then ask how long did the engine run when it was last working? If the engine did not reach running temperature, there is a possibility that the rich mixture used during start-up has washed the bores and you are now suffering from a lack of compression. To eliminate this, I would remove the spark plugs and carry out a compression test. If this is the case, a small amount of oil down each bore should restore the compression sufficiently to allow the engine to fire.**

According to the data I have, if as you suspected (but have consequently disproved) the immobiliser was at fault, fuel should not be injected. If the plugs are not sparking, I would inspect the crank sensor and also check all the earth points on the engine and battery. Although the engine management light is not on, the next step would be to read the faults codes.

This should be possible on your vehicle without diagnostic equipment. First, locate the ECU, which is below the centre console; you should be able to locate it by removing the side trims in the footwells. Unless it has previously been removed, you should see a sticker across the side which reads 'CAUTION DO NOT FORCE PAST STOP AFTER PERFORMING SELF DIAGNOSIS TURN SELECTOR FULLY COUNTERCLOCKWISE TO STOP'. Pull the sticker back to reveal a screw. Turn on the ignition and gently turn the screw clockwise until you feel it stop. Wait for 2-3 seconds and gently turn the screw back counterclockwise. As the sticker advises, do not force the screw past the stop. You should now see the EML blinking out the codes. The slow flash is the first digit and the fast flashes are the second digit. The codes will continue to flash until the ignition is turned off.

A list of meanings for the codes can be found at: http://bit.ly/1ZZh22M. Alternatively, you can email me with the codes for an explanation.

Have a problem vehicle? GET IN TOUCH...

If you have a problem vehicle, *Car Mechanics* has the answer in the shape of our technical editor STEVE ROTHWELL. Contact Steve, as detailed below, for FREE advice on all car-related problems. Please help Steve to help you by giving as much information on the symptoms as you can.

As *Help!* is a free service, some complex questions may require more time and resources than we can reasonably allow – when this is the case we will let you know.

Steve will reply to all queries as quickly as possible, but please allow up to 28 days for a reply. Difficult/complex questions or those requiring research may take a little longer – please be patient.

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Please include your postal address

These *Help!* pages are dedicated to the late RODNEY JACQUES, who answered Q&As here from 1995 to 2012.

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Diagnostics Doctor

Dave Peacock answering your engine management queries

VOLVO S60

Hesitant & no cruise control

Q I've had a couple of engine management issues over the last 10 months with my 2003 Volvo S60 2.0 petrol turbo auto with 138,000 miles. I think these are separate problems, but I'll let you decide.

The first problem was with the cruise control. It seemed uneven – not a misfire as such, but you could feel it pushing and pulling a little. There were no engine management lights or messages.

Just after this happened, the car had a major service at a local garage, including a gearbox oil change (it hadn't been serviced for two years as it had only done about 5000 miles in this time). When we explained the issue with the garage, they recommended a throttle body clean. As there were no engine management lights, I thought I'd drive it for a while and see if the service had cured the problem.

About a week after we got the car back, it started occasionally nearly cutting out at junctions. The revs would suddenly drop, then pick up. Shortly after this, an engine management light came on. By the time I got it to a garage, the running had deteriorated: very uneven, lack of power, then surging.

The garage read the codes with a generic reader and got 'P2188 – Too rich at idle'. They recommended a new Bosch MAF sensor, although they didn't guarantee this would fix it. When I drove the car away the engine management light was off, but came on by the time I got home, and the car's performance had deteriorated again.

After another look with a different code reader, the garage said that it was saying 'Too rich cylinder bank 1'. They thought that it would be worth eliminating the coil packs, and lent me a new coil pack to try on each cylinder over the coming week. I worked along all five cylinders, but it made no difference.

After looking at the Volvo forum online, I decided to take the car to a local Volvo specialist with the Volvo Vida/Dice software, to see if any more information could be obtained. They also recommended a fuel filter change (which had not been done at the recent service). After connecting the Volvo software, the codes didn't point to anything any more specific than the previous reading. As the mechanics had experienced similar symptoms with other Volvos, they recommended getting the throttle body module tested. When the throttle body was removed, the garage found a small quantity of oil in it and thought that it would be worth cleaning the throttle body and refitting it before send it away, in case this solved the problem.

After the throttle body was refitted, that car seemed to be cured: smooth running, working cruise control, no engine management lights. The

GENERAL

What is Lambda?

Q I was wondering if you could explain, in layman's terms, what Lambda refers to in MoT emissions tests? I understand the CO and HC. Is Lambda to do with fuel mixture?

Gareth

A **Sort of. Lambda is not a genuine measured value, rather a calculated value that uses the exhaust gas composition to indicate the efficiency of the combustion process. Lambda 1.000 is optimum efficiency; higher than that indicates lean combustion, lower indicates rich combustion.**

PEUGEOT 206CC

Anti-pollution fault?

Q I have an 03-reg Peugeot 206CC with the 1600cc engine. Driving along recently, I heard a 'chime' coming from beneath the dash, followed by the engine management light illuminating – not flashing – and the warning 'Anti-Pollution Fault' in the central console display. This warning went out, but the engine management light stayed on. After about a quarter-of-an hour, the warning reappeared. The car still drives OK, with no noticeable drop in speed or performance.

Thinking there might be an issue with emissions, I took out the Lambda sensor and it was reasonably clean, but I gave it a once-over with a very fine brass-bristled brush and replaced it, but this made no difference.

For what it's worth, about half-an-hour prior to the incident, I had put 17-18 litres of petrol in the tank, which brought the gauge up to the ¾ mark.

John

Why does the engine management light keep illuminating on a Peugeot 206CC?

A **You need to get the fault codes read, which will tell you why the warning light is coming on. You can buy a code reader for less money than paying for a garage to read the codes for you – search on the web for a basic code reader. If you have a smart phone it is even cheaper, since you can get an adaptor to allow your phone to be your code reader for less than £10.**

Incidentally, it's not a good idea to clean Lambda sensors with a wire brush. I hope yours survived.

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only remaining issue was a slight hesitation when starting from cold or after standing for an hour or so. Once warmed up, the car drove faultlessly.

The second problem started about two months ago. During a long run to London, the engine management light indicated: "ABS/anti-skid system service required" and the cruise control stopped working. The following day, the message disappeared and just the engine management light stayed on. The next time we restarted the car, cruise control started working again.

I called out the AA to check the codes and the mechanic said the stored code indicated the speed sensor was faulty. He reset the light and the car continued to drive fine (apart from the hesitation from cold) for the next few weeks.

A suspected fault with a Volvo S60's throttle body turns out to be something else entirely.

As we thought the ABS issue had been resolved, we asked the local specialist to take another look at the throttle body, to see if we could resolve the issue of hesitation from cold. He found a little more oil in the throttle body, but wasn't sure if it was excessive. He sent the throttle body module for an extended test and it came back clear. At this point it was running better than when it went to the specialist, but a slight hesitation was still noticeable.

Shortly after receiving the car back last week, the ABS message returned momentarily before going out again. There was no engine light this time. A few days later, the engine management light and message were back, and the cruise control stopped working again. I drove the car from Southampton to Manchester and back and even though the ABS message and engine management light were on the whole way, it drove faultlessly, although it still hesitates slightly from cold.

I have it booked with another specialist to have the ABS code read. I am concerned that the ABS module is faulty, which I understand is very expensive. However, I think the ABS and hesitation problems are separate.
Andy

A Well, I wouldn't let the garage who fitted a MAF and suggested the HT coils as a possible cause for a rich-running fault do any more diagnostic work on your Volvo! If a cylinder misses due to a spark not occurring then the exhaust oxygen goes up, but the rich mixture code reported is caused by the oxygen going down! The MAF could have caused the fault.

Your letter leaves me uncertain as to whether or not you have had the throttle body tested. I suspect the engine hesitation is due to the throttle body unit, so that has to be given the all clear before proceeding further. The cruise control and ABS light faults should be cured by checking the speed sensor wiring and connectors – if these are OK, change the speed sensor.

The first garage is officially off the list of repairers for diagnostic problems on our Volvo! The throttle body was sent for an extended test last month and was found to be working fine.

Since I wrote, the car has been to another Volvo specialist in Southampton. They read the codes with a Bosch ESI[tronic] 2 machine, and found three codes listed: '6814 – boost pressure for exhaust-gas turbocharging leakage', '510F – Vehicle speed sensor faulty' and '990A – Engine control unit internal error detected'. A couple of minutes later, another printout quoted code: '0022 – Wheel-speed sensor front right plausibility'. The ABS/speed sensor error turned out to be an offside front broken ABS sensor ring, and the turbo fault was a split turbo intake hose, discovered after a smoke test.

Unfortunately, I don't know whether the turbo code was present when the car was in the garage that tested the throttle body. However, after virtually a whole year, the car now drives perfectly: no hesitation and loads of power. No one has ever mentioned any codes relating to the turbo before.
Andy

The offside front wheel sensor is, I believe, the one used as a speed sensor pick-up.

The split pipe was a bolt out of the blue. I suspect you had a fault with the throttle body, which was solved by cleaning and complicated by having a split pipe superimposed on that.

You have found an excellent Volvo garage, with good diagnostic facilities and, more importantly, abilities.

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Diagnostics Doctor

Diagnostics Doctor is a **FREE** helpline service for *CM* readers – including trade readers – who are struggling with diagnostic/engine management related faults. **Dave Peacock** of the Nottingham-based diagnostic company ECU Testing Ltd will answer all your queries. We need as much detail as possible: **MAKE**, **MODEL**, **YEAR** and **ENGINE CODE** of your vehicle, and the type of management system installed Obviously, Dave will not be able to assess the vehicle up close, so his answer will be on the basis solely of your description. This is a **FREE** service and it may take some time to respond to certain problems. If you would like to receive a personal response via post, please enclose an **SAE**.

Write to:

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CAR MECHANICS
BAUER MEDIA, MEDIA HOUSE
LYNCHWOOD
PETERBOROUGH PE2 6EA

e-mail: dpeacock760@gmail.com
website: www.ecutesting.com

Common abbreviations

ATS	Air Temperature Sensor
AFM	Air-Flow Meter – not a MAF type (see below). It could be, for example, a vane type
CAS	Crank Angle Sensor
CPS	Crank Position Sensor
CTS	Coolant Temperature Sensor
ECT	Engine Coolant Temperature
ECU	Electronic Control Unit
EGR	Exhaust Gas Recirculation – meters exhaust gas back to the intake manifold
EML	Engine Management Light
EMS	Engine Management System
FCR	Fault Code Reader
HT	High Tension – ignition output to the spark plugs
IAV	Idle Air Valve
ISCV	Idle Speed Control Valve – usually operated by a motor controlled by the ECU
LOS	Limited Operating Strategy – if the ECU detects a malfunction, it runs a programme to allow the car to still go, but at reduced efficiency
MAF	Mass Air-Flow meter
MAP	Manifold Air Pressure
MIL	Malfunction Indicator Lamp
PCV	Positive Crankcase Ventilation – takes crankcase gases and recycles back to the inlet system
TBPS	Turbo Boost Pressure Sensor – used by the ECU to regulate turbo output
TPS	Throttle Position Sensor
VSS	Vehicle Speed Sensor
WOT	Wide Open Throttle

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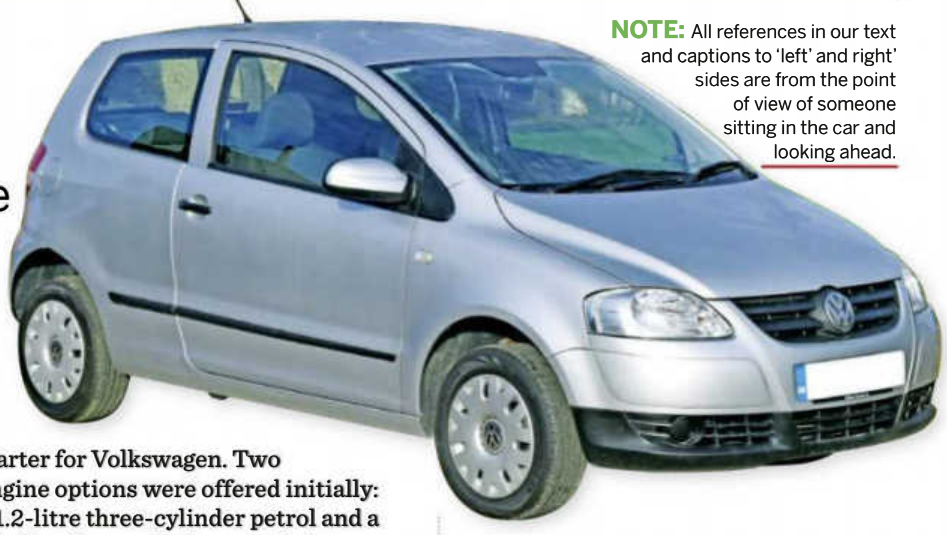
Electronic Diagnostics

VW FOX 1.2-litre PETROL

Tracing and fixing faults in electronic engine management systems

Volkswagen's three-door Fox was intended to be cost-effective to buy and run, but how does it shape up diagnostically? **Kim Henson** and **Dean Birch** investigate the 1.2-litre three-cylinder version.



NOTE: All references in our text and captions to 'left' and right' sides are from the point of view of someone sitting in the car and looking ahead.

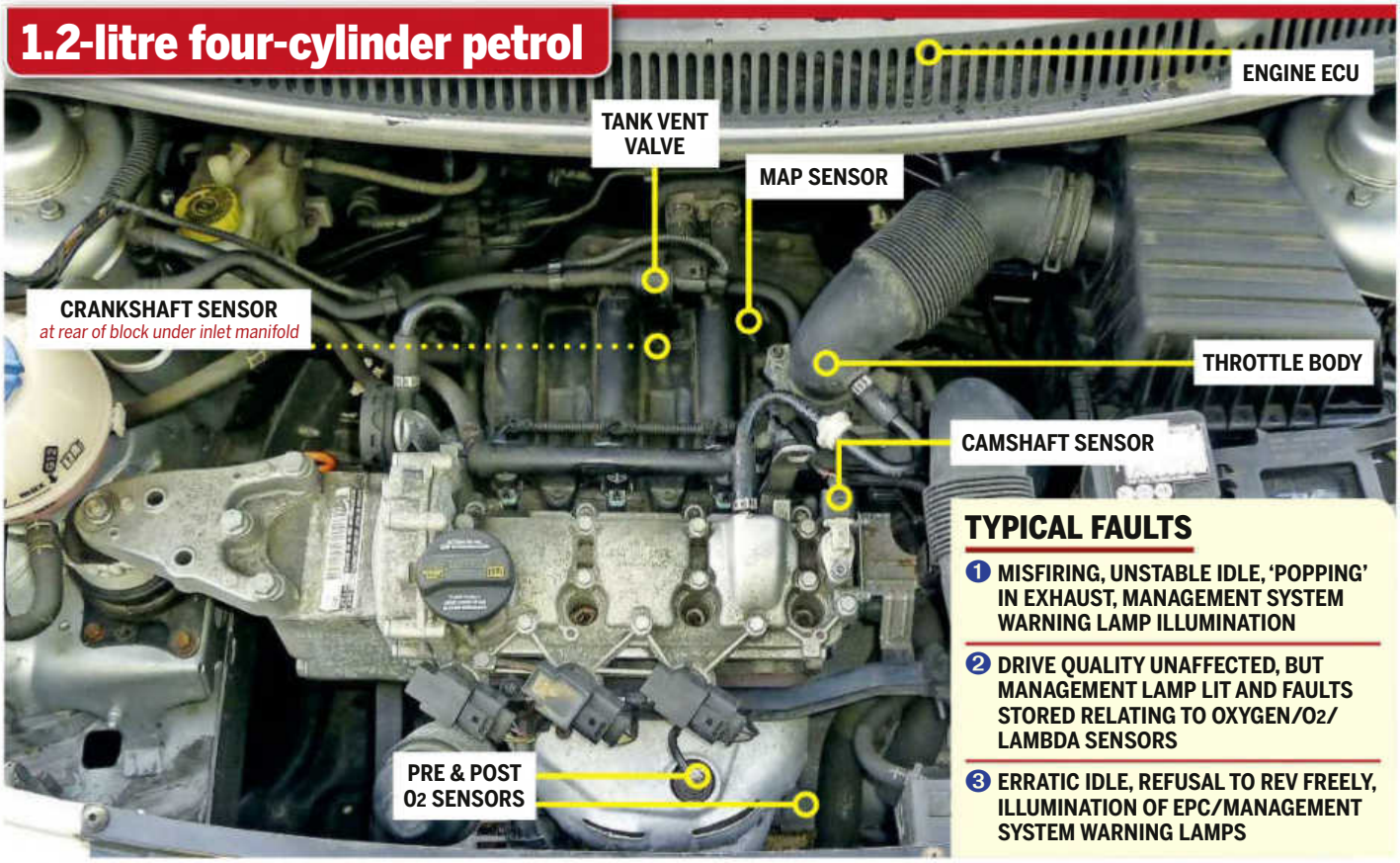
Over the years, many vehicles have been given the name 'Fox', including an NSU motorcycle from the late 1940s. The name became available to Volkswagen after the company acquired NSU two decades later.

Based on the platform of the contemporary Polo, but introduced as a deliberately inexpensive entry-level car, the Brazilian-built, three-door Fox arrived in Britain in the summer of 2006, replacing the Lupo as the range starter for Volkswagen. Two engine options were offered initially: a 1.2-litre three-cylinder petrol and a 1.4-litre four-cylinder petrol. A more powerful 60bhp 1.2-litre Fox was sold from 2010 to 2012, before the model was replaced by the new VW Up!, which went on to win the World Car of the Year award for that year.

Our guinea pig Fox for this month's diagnostic feature is a three-cylinder, six-valve 1.2-litre petrol version with a BMD engine code, dating from 2008. The 1198cc engine in this model produces 54bhp and 108Nm (80lb ft) of torque, with typical real world fuel consumption of between 45-50mpg.

Our guide to this VW's engine and its Simos 9.1 management system is Dean Birch of Onboard-Diagnostics (info@onboard-diagnostics.co.uk).

1.2-litre four-cylinder petrol



TYPICAL FAULTS

1. MISFIRING, UNSTABLE IDLE, 'POPPING' IN EXHAUST, MANAGEMENT SYSTEM WARNING LAMP ILLUMINATION
2. DRIVE QUALITY UNAFFECTED, BUT MANAGEMENT LAMP LIT AND FAULTS STORED RELATING TO OXYGEN/O2/ LAMBDA SENSORS
3. ERRATIC IDLE, REFUSAL TO REV FREELY, ILLUMINATION OF EPC/MANAGEMENT SYSTEM WARNING LAMPS

Preparation

Underbonnet access on this Fox is excellent, with plenty of room around the power unit.

Before you commence any diagnostic operations, establish the past maintenance history of the vehicle. If you are unsure of when it was last serviced, carry out a full service on the vehicle at the outset. One important aspect that's often overlooked is regular renewal of the fuel filter, as advised by Volkswagen; the filter is located under the rear of the vehicle on the right-hand side (see Photo No 3). Use only the correct type of filter, at least to Volkswagen original specifications.

Also ensure that the oil and air filters are high quality items – again, at least to VW OE specifications. The same applies to the spark plugs, which need to be clean and have their gaps set correctly. Closely inspect the breather hoses, ensuring that there are no splits or dodgy connections – if their condition is in any doubt, renew them.

Engine management

The Simos 9.1 management system used on this Fox incorporates these primary components:

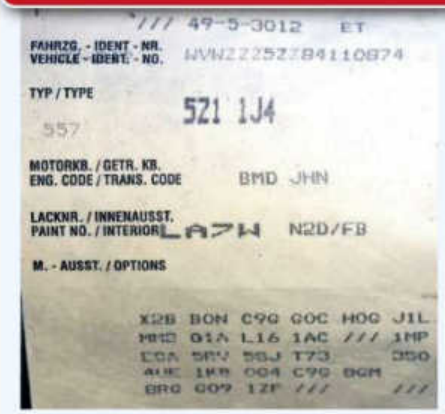
- A Simos 9.1 engine controller (incorporating two harness plugs, and totalling 121 pins).
- Three multi-holed injectors.
- Three ignition coils.
- Digital cam and crankshaft Hall-Effect sensors.
- A four-pin MAP sensor with integral air temperature reference.
- A fully-motorised throttle body.
- A six-pin accelerator pedal position sensor.
- Separate fuel and main ECU relays.
- Two oxygen sensors.
- A single piezo knock sensor.
- An in-tank fuel pump assembly.
- A single conventional coolant temperature sensor.

Fault 1:

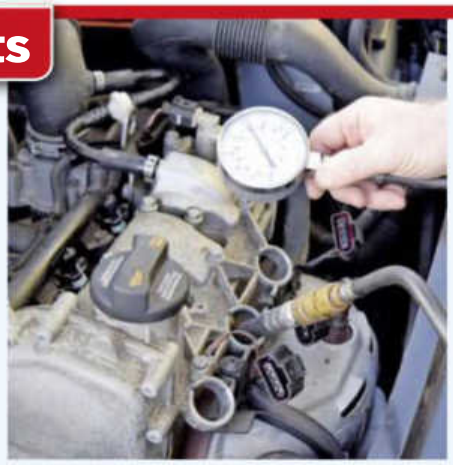
Mechanical problems within engine

Symptoms of our first fault will vary in severity depending on the depth and progression of the problem. They include an unstable tickover, misfiring, 'popping' in the exhaust, illumination of the management warning lamp (which may flash to indicate a misfire), and diagnostic interrogation revealing stored fault codes with 'P0300' designations, relating to cylinder problems. Random misfires would be suggested by a 'P0300'

Typical VW Fox faults



1 In the boot floor, near the spare wheel well, there should be a paper label providing valuable data about the car (VW PR Codes), including the car's VIN, specification, equipment levels, etc.



2 A compression test gives a good indication of the engine's mechanical condition. This cylinder showed a healthy 175psi; a minimum reading of around 150psi should be observed for each cylinder (see *Fault 1: Mechanical Problems Within Engine*).

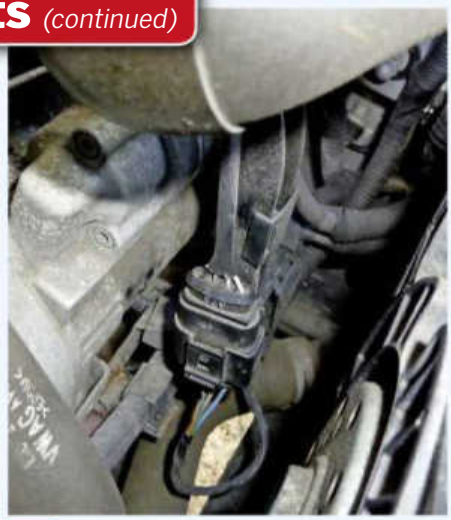
3 The fuel filter is underneath the vehicle, on the right-hand side, at the rear. Renew the filter as recommended by VW. After installation, ensure the filter is securely attached and that there are no fuel leaks from the filter or hose connections.

4 Here, we're using a purpose-designed tool to remove one of the three ignition coils without damaging it, having released the electrical harness from the coils. If you don't have the proper tool, the coils should release fairly easily.

5 Each individual coil should be closely examined for condition, including corrosion and other damage. The use of coils from different manufacturers within the same engine should not be a problem, as long as they are all reputable makes.

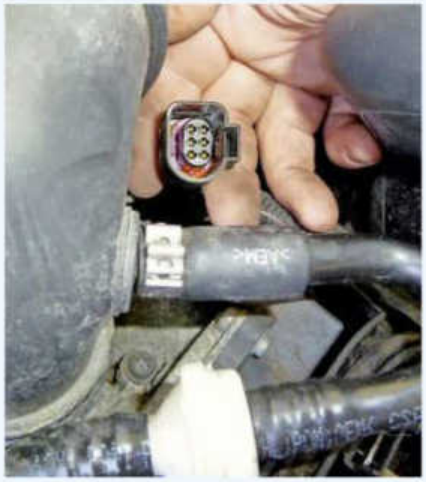
Typical VW Fox faults *(continued)*

6 To remove the ECU, which is located beneath the scuttle, take off the screen wipers and the scuttle's brittle plastic cover panel and its rubber sealing strip. The photo shows the ECU from beneath the left-hand side of the scuttle.



7 Towards the left-hand side of the engine compartment is the wiring connector, marked '373', for the upstream oxygen/O2/Lambda sensor. Make sure the wiring and connections are secure (see *Fault 2: Oxygen/O2/Lambda Sensor Wiring*).

8 Located directly within the inlet manifold, beneath the throttle body and on the left-hand side of the engine bay, towards the rear, is the MAP sensor and its harness plug assembly. Ensure the assembly is secure and undamaged.



9 The gold-plated six-pin harness plug connects directly to the throttle body. Connection problems within the loom in close proximity to the plug are often encountered (see *Fault 3 Throttle Body Ailments*). Components for repair are available from VW dealers.

10 This important earth connection is found immediately behind the left-hand headlamp and close to the battery tray. Make quite sure there is good electrical continuity here. If in doubt, separate, clean and reassemble the joint components.

11 A valuable test for the fuel injector circuit is to establish the electrical resistance of each injector in turn. Here, we are using a multimeter to get the resistance readings. In this vehicle's case, the indicated 12.1 ohms is a healthy reading.

code, but 'P0301', 'P0302', 'P0303', etc, indicate specific problems with one or more individual cylinder.

In our experience, very often the operator or repairer of the vehicle will have treated such fault codes as being applicable to ignition or fuel-related difficulties. In such cases, the car may be fitted with new coils, fuel injectors, etc, which have made no difference to the engine's poor running.

If fault codes indicating cylinder misfires are stored, you should carry out a compression test. This will help to identify mechanical ailments within the engine, including poorly-sealing exhaust valves, to which this engine is prone, or piston/ring/cylinder problems. There's no point renewing ignition components to try to cure an engine which is low on compression.

Ideally, you should see compression pressure figures of above 150psi, and the readings should be very similar across all cylinders. Low figures require investigation. If the compression figures are healthy, spark and fuel-related diagnostic work will be required.

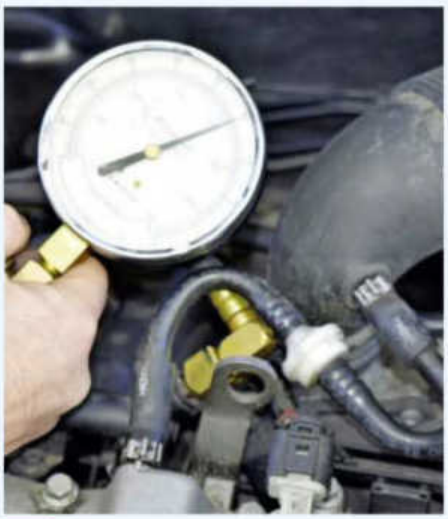
In the early stages of such mechanical problems, you may notice little or nothing wrong, yet the management system can flag up misfires by the storing of fault codes. This is because the computer determines misfire events by calculating engine speed from the crankshaft sensor, analysing each cylinder's contribution to the crankshaft speed, and determining which cylinder is not pulling its weight.

Some of the more sophisticated

Technical specs

Actual values

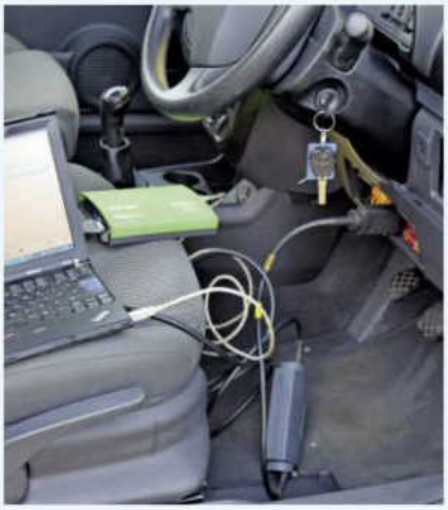
Component	Value
Fuel pressure	4.0 bar at idle
Injector resistance	12-15 ohms
Cam and crank sensors	5.0 volts
Lambda heater circuit resistance	2-5 ohms
Tank vent resistance	20-25 ohms



12 The fuel pressure can be assessed by connecting a pressure gauge via the Schrader valve at the left-hand end of the fuel supply pipe for the injectors. Before running the engine, ensure that all connections are tight, to avoid fuel leaks.

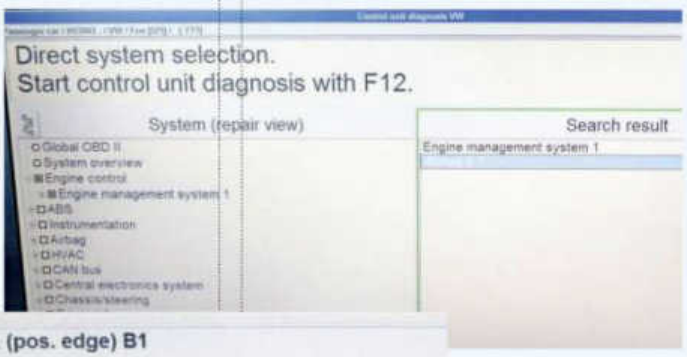
13 This important collection of electrical relays is positioned beneath a cover panel towards the right-hand side of the dashboard assembly. Make sure all the relays are fully engaged within the board.

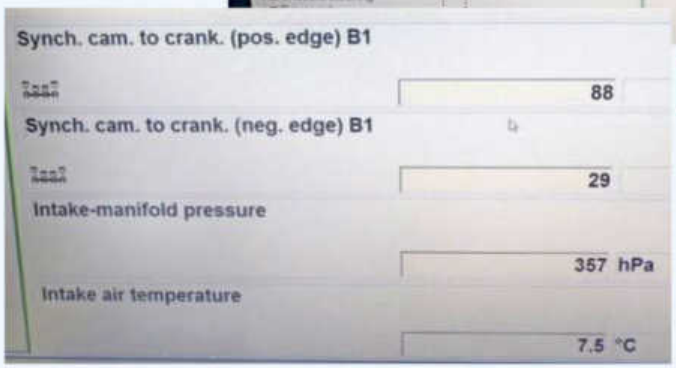
14 This fusebox assembly, with the car's diagnostic socket located at its centre, is located under the fascia on the right-hand side. It is normally hidden by a plastic cover panel, which has been removed for this photo to be taken.



15 This is the Bosch KTS tool, which is connected to the Volkswagen's diagnostic socket and a laptop, so that data can be viewed by the operator on the screen. The on-screen commands guide the operator through the various checks.

16 This screenshot has been generated on the laptop screen by the KTS diagnostic tool and shows a selection of live data.





17 This screenshot indicates available systems with which the KTS tool will be able to communicate. Not all these systems are actually fitted to the vehicle under review – it just depends on the build specification for the particular car.

diagnostic tools enable the operator to display live data and, from available parameters, look at misfire counts, indicating which cylinders are in trouble.

Fault 2:

Oxygen/O2/Lambda sensor wiring

Our second problem on this Fox can result in illumination of the engine management system warning lamp, although in terms of driveability there may be nothing amiss. Fault codes may be stored, indicating difficulties with 'Upstream/downstream Lambda circuit', 'Lambda heater circuit malfunction' or 'Lambda sensor signal implausible', etc.

The sensors are positioned in pre- and post-catalytic converter exhaust system locations, and these should be checked. However, there have been instances of ailments with the sensors' wiring rather than the units themselves. Difficulties often arise at the point where the sensor wiring joins the main loom in the vicinity of the gearbox. Here, the cables and connections are exposed to the elements and, over time, can suffer from corrosion and/or breakage, usually close to the harness plug.

To carry out a detailed inspection, first raise and securely support the front of the car, then closely scrutinise the wiring from underneath the vehicle.

Tool of choice

▶ For this feature, Dean is using the Bosch KTS tool, which provides a full range of diagnostic functions for this Volkswagen.

Do check the wiring and connections before considering renewal of the oxygen/O2/Lambda sensors (see Photo No 7).

Fault 3:

Throttle body ailments

Symptoms for the third fault include erratic idling, refusal of the engine to rev freely and illumination of the Electronic Power Control (EPC) and management system warning lamps. Effectively the engine has switched into 'limp-home' mode. Sometimes the engine will idle fine for a while, then a glitch occurs and the running speed will fluctuate. Fault codes may be stored relating to 'Throttle body signal implausible' or similar.

If the loom is gently waggled in the vicinity of the throttle body, it may be possible to produce the running symptoms described, indicating a wiring/connection problem.

The harness plug connections should be gold-plated (see Photo No 9), and it is important to ensure they have not been damaged by over-zealous probing, with spread pins that do not make full contact.

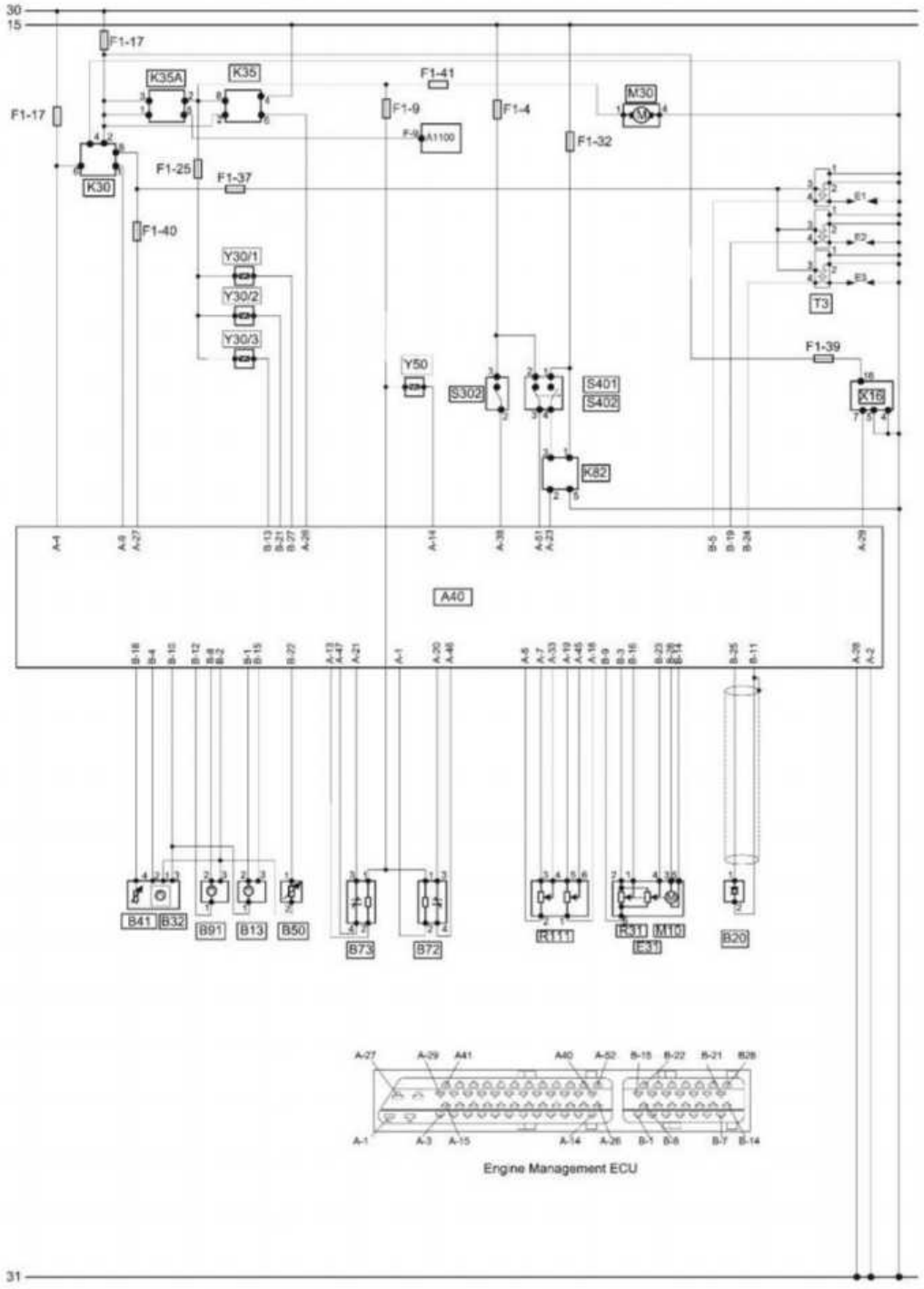
VW dealers can supply the relevant cables with already-crimped connections, the plastic shells for the connector assemblies and the weather seals.

It is essential that sound, weatherproof connections are made in this area. With this Fox's drive-by-wire throttle activation system, if the computer sees any irregularity in the signals received – even small voltage discrepancies – it is designed to play it safe and set engine operation to 'failsafe' or 'limp-home' mode.

Simos 9.1 circuit diagram

Diagram drawn by Keith Ravenhill

15	IGNITION SUPPLY
30	BATTERY SUPPLY
31	GROUND SUPPLY
A40	ENGINE MANAGEMENT ECU
A1100	CENTRAL ELECTRONICS ECU
B13	CRANKSHAFT POSITION SENSOR (HALL-EFFECT)
B20	KNOCK SENSOR
B32	MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR
B41	INTAKE AIR TEMPERATURE SENSOR (INTEGRAL WITH MAP)
B50	COOLANT TEMPERATURE SENSOR
B72	PRE-CAT OXYGEN SENSOR
B73	POST-CAT OXYGEN SENSOR
B91	CAMSHAFT POSITION SENSOR (HALL-EFFECT)
E1-3	SPARK PLUGS
E31	THROTTLE VALVE CONTROL UNIT
F1-	FUSES
K30	MAIN RELAY
K35	FUEL PUMP RELAY
K35A	ADDITIONAL FUEL PUMP RELAY
K82	BRAKE LIGHT SUPPRESSION RELAY
M10	THROTTLE VALVE CONTROL MOTOR
M30	FUEL PUMP
R31	THROTTLE VALVE POSITION SENSOR (DUAL)
R111	THROTTLE PEDAL POSITION SENSOR
S302	CLUTCH SWITCH
S401	BRAKE LIGHT SWITCH
S402	BRAKE PEDAL SWITCH
T3	IGNITION COIL ON PLUG
X16	J1962 DIAGNOSTIC CONNECTOR
Y30	MULTI-POINT INJECTOR
Y50	PURGE VALVE



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DIAGNOSTICS

FAULT-FINDING & DIAGNOSING AT MAIN DEALER LEVEL

CASE STUDY

2002 Mercedes-Benz C200 Kompressor

Fuel trim

Customer complaint:
Engine warning light on dash

Report from
Jack Moore

A scan of the ECU revealed the following fault:

'29 P1137 Mixture Adaptation 1 (Additive) Mixture too rich at idle'

The camshaft variators on the C200K are prone to letting oil into the wiring harness, damaging the Lambda probe.

This fault indicates that the fuel trim has moved outside of its permitted parameters. In this case, when the term additive is used in relation to fuel trim, it refers to fuel trim at idle. Fuel trim is the amount that the ECU alters the air/fuel mixture from its fixed values.

In theory, the ECU should operate with an ideal air/fuel ratio of 14.7:1. The Lambda value, calculated by the amount of oxygen present in the exhaust, would be 1 (Lambda voltage 0.45V). This would also correlate with a fixed injector opening time, eg, three milliseconds.

In practise, however, various factors can have an effect on the Lambda value, including reduced fuel pressure, air leaks in manifolds or vacuum pipes, clogged air filters, dirty throttle valves and clogged or faulty injectors. To compensate for the effect of these various factors, the ECU monitors the Lambda value and adjusts the air/fuel mixture accordingly. Thus, if a Lambda value is above 1, indicating a lean mixture, the ECU will increase the injector opening time to enrich the mixture; this increase (or decrease) in opening time is called the fuel trim.

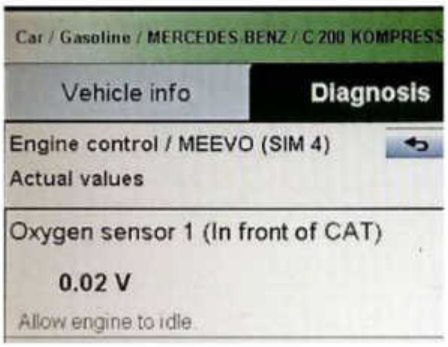
On reading the live data for the Mercedes, the Lambda voltage was falling to 0.02V and failing to fluctuate correctly according to the mixture. On a healthy engine, the Lambda voltage will fluctuate above and below 0.45V. When reading live data for a Lambda probe, you should be able to influence the signal voltage by creating an air leak, restricting the intake air or disconnecting a vacuum pipe.

This should be noticeable immediately by a change in signal voltage. The Lambda voltage on this car refused to change no matter what was done. The usual wiring checks were carried out and the loom checked for oil, as these Mercedes are prone to these issues. All seemed OK.

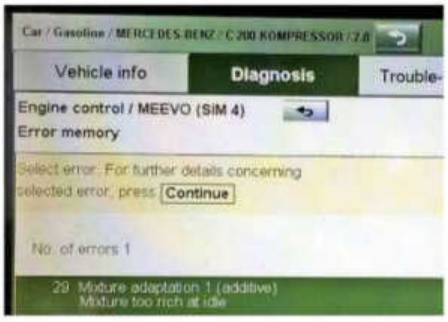
Another tip when checking a Lambda probe is to call up the Lambda voltage live data for the probe in question. Connect a wire to the signal wire of the probe and, while holding the wire in one hand, touch the battery positive with your other hand. You should see the live data change as you touch the battery pole – if it changes, it indicates that the wiring is good and the ECU is capable of reading a signal.

The ECU in this car had been getting an erroneous 'lean mixture' reading from the Lambda. The ECU continued to enrich the mixture, trying to correct the lean reading, but, when this didn't work, a fault was stored and the warning light illuminated. There are limits to how much the mixture can be altered with fuel trim and, under normal conditions, the engine will operate within these parameters.

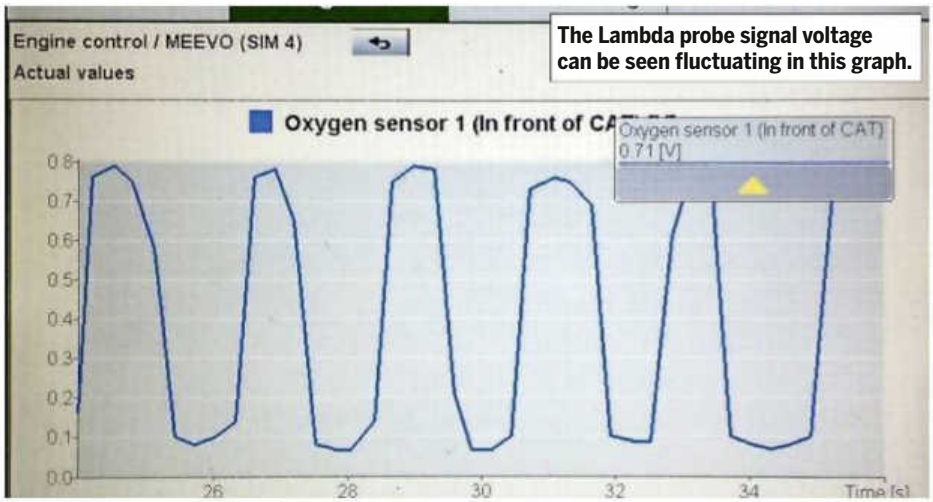
With the new Lambda probe fitted, the voltage was fluctuating nicely. The customer also noticed an improvement in fuel economy and lower exhaust emissions. Everyone was happy.



These are live data readings showing the Lambda probe signal voltage.



A Bosch KTS scan tool was used to retrieve the fault codes on the Mercedes.



The Lambda probe signal voltage can be seen fluctuating in this graph.

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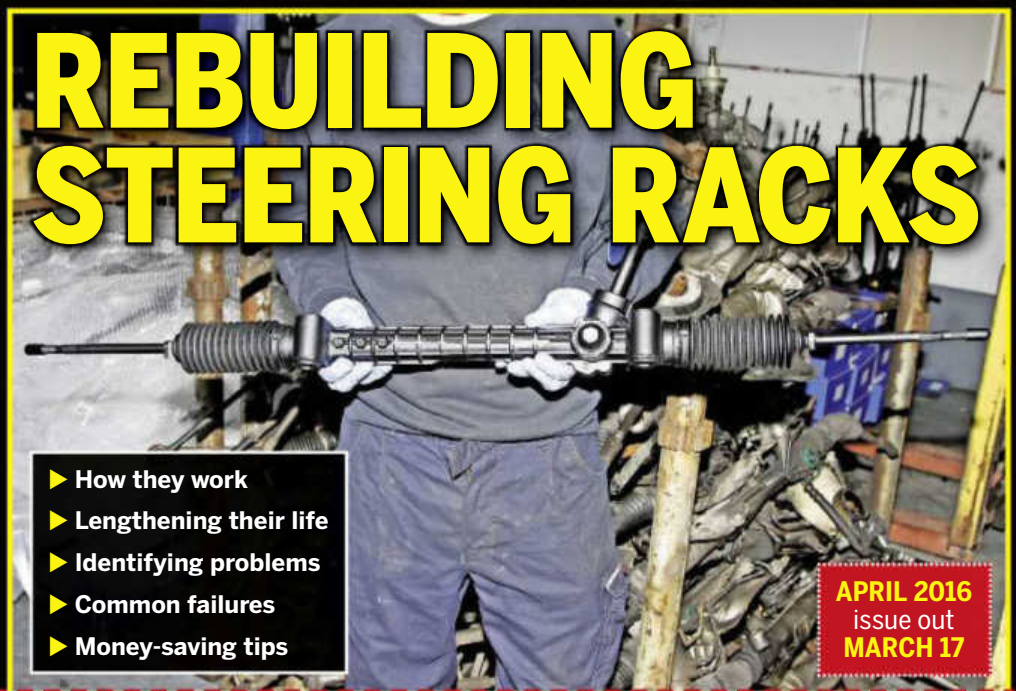

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Ian Seabrook
Special Contributor

Cheap motoring

Does budget motoring have to be absolutely horrible?

Regular readers will recall that, back in 2014, I was running around in a fabulously quirky Daihatsu Sirion. When the need arose for a super-cheap set of wheels, I set about finding another. Alas, the Sirion was rather rust prone, which is what claimed mine. You don't see many first-generation Sirions for sale any more.

Then I remembered Perodua. This Malaysian firm joined the UK market back in 1997, with its Daihatsu cast-off badged as the Nippa. Initially it was known as the Daihatsu Mira, with a lineage dating back to the diminutive Domino of the early 1980s. As with the Mira, there's a frenetic three-cylinder engine and nowhere near enough suspension travel. The Nippa is sold as the Kancil on its home market – you can see why they changed the name for the UK – and production ended in 2009, with more than 722,000 built. The only car Perodua offers in the UK now is the Myvi, which is a rebadged second-generation Daihatsu Sirion.

I scoured the classifieds and one car stood out. The pictures were tiny, but this 2001 Nippa claimed to have fewer than 24,000 miles on the clock. The asking price? £350. I managed to haggle this down to £300 when it was pointed out that the MoT was due to expire within a month.

With the deal clinched, and even though I hadn't seen the car, I jumped aboard several trains to make my way to Bootle on Merseyside. The seller was a delightful elderly gentleman who sadly had to accept that his driving days were over. There was history to back up the minuscule mileage and, on further examination, it seemed the first owner had been having the car serviced annually, even though it had often only been covering 700 miles in a year. The cambelt had recently been replaced, too. Bonus.

Homeward bound

I began the 120-mile drive home with some trepidation. For a start, the Nippa really is tiny. The gearlever was resting against my leg when I was in fifth gear. The ride is atrocious, too, and Liverpool boasts many utterly dreadful roads.

Surprisingly, the Nippa was happy at motorway speeds. I dread to think how many RPM it's doing at 70mph (there's no rev counter, naturally), but it's a real sweet spot and the engine seems turbine-smooth. It's just drowned out by wind and road noise.

As I drove along, I could consider all the features the car does not have.

Small it may be, but also hugely practical.

The simple air filter can be changed in just seconds and no special tools are needed.

Only slight issue with the Nippa is that there's only just room to access the spark plugs.

No air-conditioning, no central locking, no electric windows, no power steering – just what you need to get from A to B.

As I left the motorway behind and headed onto the A-roads of Wales, I discovered that it's an absolute hoot on a twisty road. Dreadful ride, yet fun in the bends. Truly, it feels more like a classic Mini than the official BMW Mini. It's actually only 30cm longer than a Mini, yet comfortably seats four adults, has five doors and a surprisingly large boot. As my wife loved the Mini we owned previously, I felt confident she would like the Nippa. She's not one for mod cons.

The interior certainly shows the cheapness well – this was a £5000 car when new – and the plastics are utterly horrible. Having just bagged a car with 24,000 miles for £300 though, I didn't much care. Beggars can't be choosers. It just amazed me that such a capable, low-mileage car could be purchased for so little money.

Simple service

The car came with service items, so I took the hint and gave it a quick service. What a joy! The oil filter came undone by hand, and while there's not a lot of room in the engine bay, you can get at most things pretty easily. The spark plugs are a little tricky, though, as there is only just room to get in a socket over the slam panel. On the other hand, just a handful of clips hold the air filter in place, so replacement takes no time at all. With fuel injection and electronic ignition, there's not at lot else to do. The brakes were inspected and deemed to be absolutely fine.

I put the Nippa in for its MoT, where the only failure point was a torn steering rack gaiter. I'll concede laziness, but as the garage had the car and could get the part that day, I left them to it. I also purchased a pair of wiper blades that I fitted myself.

In Ian's garage

2001 Perodua Nippa EX
My wife's daily driver. Super cheap.

1995 Citroën XM 2.1TD SX
My daily driver. Surprisingly reliable.

1992 Honda Prelude 2.0i auto
Fun machine, handles like a dream.

1980 Citroën Dyane
Has just had a minor engine rebuild.

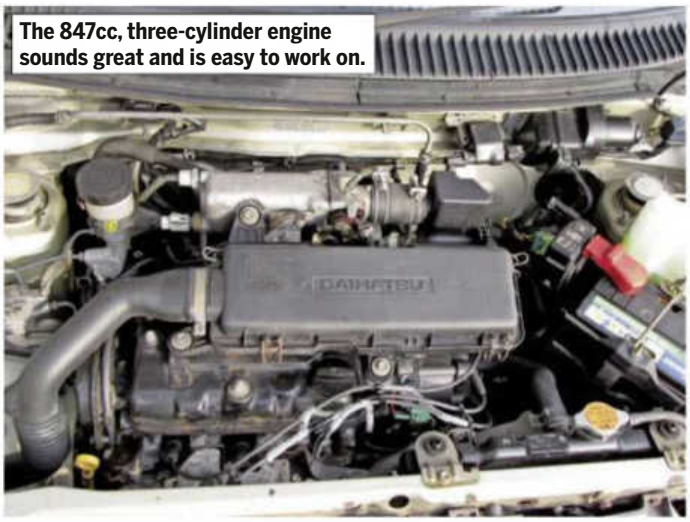
Having been treated to engine oil changes more frequently than every 1000 miles, the internals still look brand new.

They cost £15, the gaiter £8.37, £20 labour and £35 for the MoT. I now had a 24,000-mile car with a fresh test certificate for the grand total of £387.04 once VAT was added. Remarkable.

This car is only used as a runaround, so has only covered 1500 miles in the six months since purchase. However, it starts every time, has proved very practical at carrying around garden waste and even logs, and is delivering well over 50mpg. Motoring simply does not get any cheaper than this. Why spend more? Well, maybe if comfort is paramount...

I'm not sure whether you'll see this car in *CM* again. It isn't generating much in the way of copy, as it tends to just work and has very little on it that can go wrong. It may be short on refinement, but it is very easy on the wallet. Will I regret those words? Time will tell.

Interior plastics aren't the finest. Hard to complain at this price.



The 847cc, three-cylinder engine sounds great and is easy to work on.

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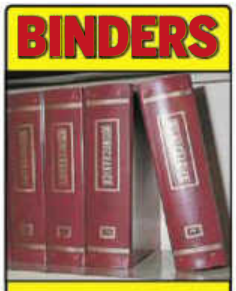

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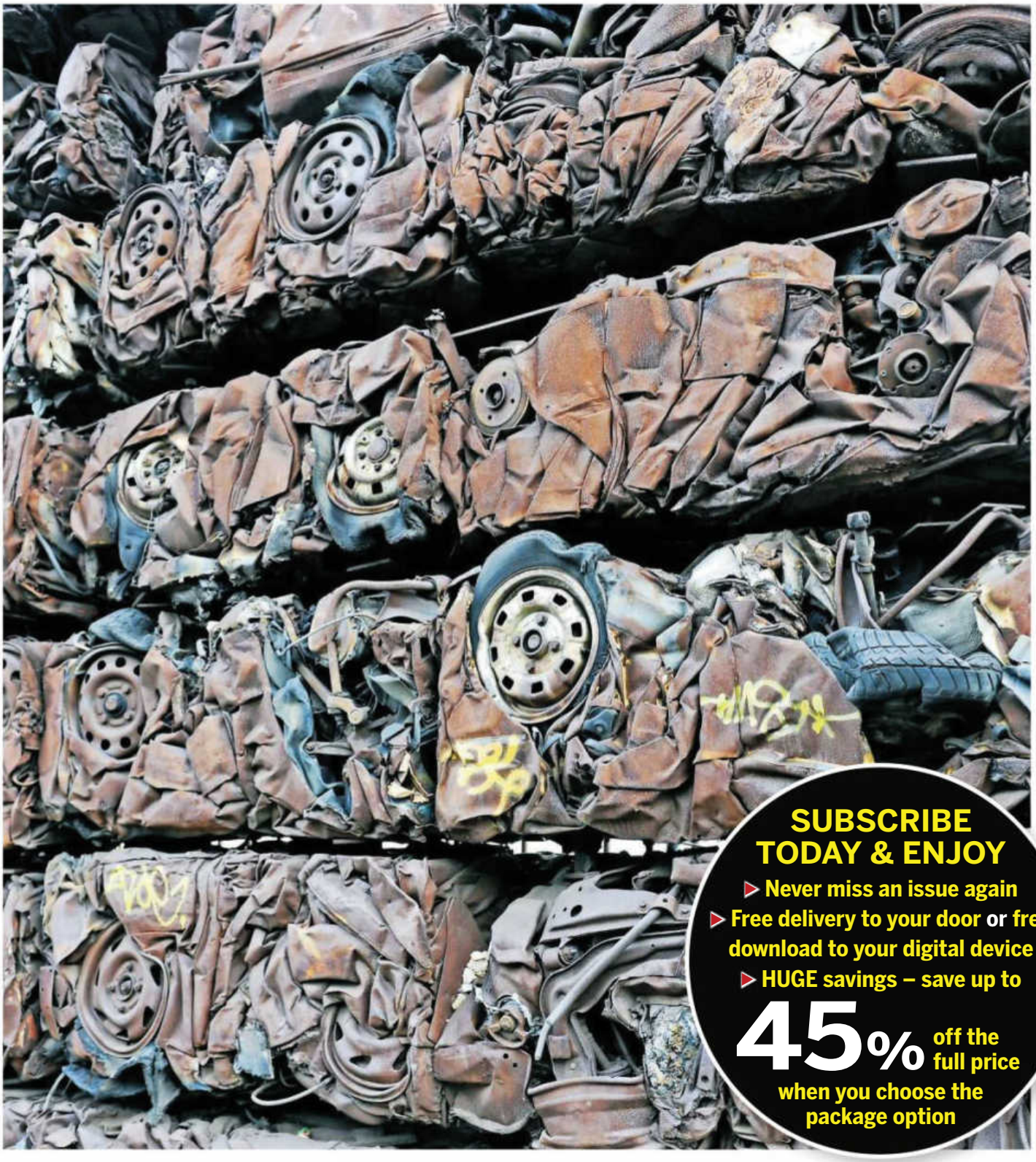

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Ted Connolly

Ted ponders the difference between a monkey and a toad.

Monkeys in uniform

EVERYONE dreams of making a mark in life. Something you would be remembered by: designing a famous building, composing a memorable song, achieving a moment of sporting greatness. As a writer, it would be to coin a saying that would go down in history.

There are some wonderful sayings recorded from the likes of Oscar Wilde and George Bernard Shaw. Wilde's pearls include "I am so clever that, sometimes, I don't understand a single word of what I am saying" and "Work is the curse of the drinking classes."

Groucho Marx was a genius at one-liners, whether rehearsed or, as I prefer to believe, ad-libbed. Here's a few of them: "I worked my way up from nothing to a state of extreme poverty", "I refuse to join any club that would have *me* as a member", "A black cat crossing your path signifies that the animal is going somewhere" and "Getting older is no problem. You just have to live long enough."

George Bernard Shaw once remarked: "People who say it cannot be done should not interrupt those who are doing it." Other astute Shavian observations are: "The only way to avoid being miserable is not to have enough leisure to wonder whether you are happy or not" and "Those who can, do – those who can't, teach."

At the risk of tampering with the words of the great man, I would like to add the following: "And those who can't teach become car park wardens."

Now, let's get this clear, I am not talking about the generally nice people who check council car parks and the like to make sure you've got a ticket. I'm referring to the more odious types who guard car parks and threaten all manner of nasty things if you dare stop there for more than a second.

Recently, the trouble-and-strife had occasion to visit a block of offices and stopped off in what appeared to be a public parking area. Within about three seconds, a monkey dressed in a uniform waddled over and demanded to know what she was doing. She explained that she was looking for number 12 (referring to the address of the office). He almost snarled: "No, not number 12. Number one, you can't park here. Number two, if you don't move, I'll clamp ya."

The man was downright rude to the point of being aggressive. It is regretful to admit that I would have told him what to do with his clamp – regretful in the sense that it takes me down to the same level as him, but I'm guessing you know what I mean.

It is a sad indictment that society has reached such a stage that car parks have to be guarded by people whose knuckles scrape the ground. Is a parking space really that valuable? And how on earth could anybody not only perform that job, but actually relish being nasty with it?

These car-clamping cowboys are not entirely stupid, because they know that provided a notice is put up to warn motorists of the consequences of parking, then they are (just about) entitled to apply a clamp. The trick is, of course, to put up a notice so small that you have to park and get out to read it.

Which reminds me of another brilliant saying: "Don't read the small print, you'll never like it."

Toad Connolly

Some people grow old, but never grow up. To a degree, I fall into that category. It's not that I am irresponsible, because I've always worked, had a mortgage, paid my bills and all of the other palaver that makes me a contributing member of society, but there is a certain part of my character that defies maturity.

Here is an example. My wife and I were recently at a large agricultural show and had a spiffing time looking at the livestock, displays of wood-turning, old tractors, classic vehicles, etc. There was also a craft tent and my wife disappeared inside and reappeared with a gift. It was a Mr Toad made from material and about a foot high. In case, you haven't heard of this fellow, he is one of the characters in Kenneth Grahame's novel *The Wind in the Willows*.

Mr Toad and me have quite a lot in common: we're both short, dumpy, brash, opinionated and given to outbursts of erratic behaviour. Oh, and there's something else: we're both mad-keen on cars. In Mr Toad's case, he drives round recklessly, laughing hysterically and tooting his very large horn, delighting in scaring all and sundry with its blast (*There's actually an attraction at Disneyland called* Mr Toad's Wild Ride, *where you are a passenger in his speeding car. Fact!* – **Ed**).

I'm not quite in the same league as that, but, when I drive the Connolly Minor, my personality does seem to change and I giggle stupidly and, although not behaving recklessly, drive with a feeling of freedom and gusto.

Our Minor, being an old car, has old equipment and one is a rather large horn which is so grimy that I can't make out the maker's name. Anyhow, we had a short break and took the Morris. The journey involved lots of country lanes and, at one point, negotiating a narrow, hump-backed bridge. You are supposed to toot your horn on an approach to such a situation, I believe, so I pressed the horn. The hooters in modern cars are insipid things, but the horn in the Minor really is something else. It measures about six inches in diameter, at least, and I swear that the Queen Mary would get out of the way if the captain heard it.

The initial blast sounded so good that I assumed the personality of Mr Toad, laughed with abandon and kept my hand on the button. For about 15 seconds, the peace of the English countryside was obliterated by the Minor's horn. And then – nothing. It stopped working.

At our destination, the owner of the place we were staying asked why I had the bonnet up and was playing with fuses. I felt obliged to tell her the truth and produced my very own Mr Toad to back up my tale. She looked at me with barely-disguised disbelief that anybody my age could be so childish, tutted and walked off.

> *'In the Minor, my personality seems to change'*

Well, I have now confessed my misdemeanours in public. The thing is, I've got to sort out the hooter. The fuse is OK, so I suspect I've burned out the horn itself. Now, the law insists that I need a warning instrument in the vehicle, but I don't want the Minor to lose her original voice.

I am sure there are specialists out there who can repair the horn, it's just a case of locating one. It won't be cheap, because I will probably have to post it off and it is a rather bulky and heavy item.

But then, everything comes at a price – especially an old boy determined to act like a young one.

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