

Steel suspension arm - shown here in a form comparable to the later aluminium unit - is little or no heavier, and arguably slightly lighter. Go figure...

JOINT DECISION

Worn front-suspension ball-joints can be an expensive problem in later 944s - and all 968s - but some simple lateral thinking can save the day. And lots of cash, too

Words and photography: Chris Horton

If less really is more, then never more so than when it comes to automotive suspension design. There have been some hugely ambitious ideas in this undoubtedly challenging field, but almost invariably simple is by far the best. And they don't come much simpler - or, dare we suggest, much better - than the Porsche 924, 944 and 968.

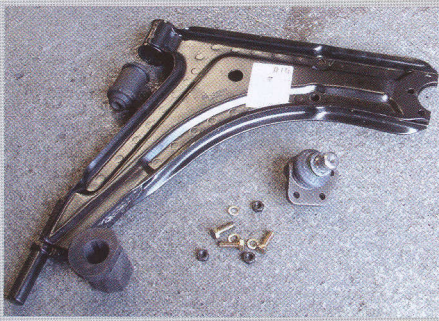
These three front-engined classics have a number of obvious differences, but their suspension systems - and in this context their Mark 1 VW Golf-derived front-suspension systems - are effectively identical. A MacPherson strut - a combined coil spring and telescopic hydraulic damper - provides vertical location, and a roughly 'L'-shaped lower arm, pivoting from two points on the chassis (and sometimes known as an 'A'-arm), offers both lateral and longitudinal location. (There's an anti-roll bar, too, of course, but that needn't concern us here.) It all looks remarkably uncomplicated,

but as any enthusiast for the cars will attest - as well as those who have successfully raced them - it works pretty well perfectly.

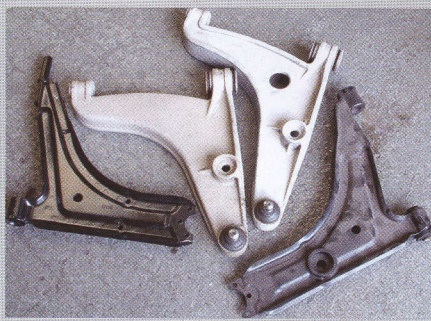
What's more, it usually continues to work perfectly for many years and many tens of thousands of miles. Eventually the dampers will start to leak, or the struts' mounts on the inner wings might wear out, but that's about it. And neither fault is either unique to the model, or difficult or expensive to put right. Likewise the lower arms' mounting bushes seem to have a life quantifiable in geological terms. The only real problem you're likely to encounter is (eventually) the inevitable wear and tear in the single ball-joint by which the lower arm is attached to the strut and hub assembly. (There's also the possibility that the ball-joint pin, projecting upward into the base of the stub-axle assembly, can crack, but this is normally only in cars that have been lowered and/or used for a great deal of high-speed circuit driving.)

And that ball-joint wear, it has to be said, can be not only a pain, but also an expensive pain. The earlier models - see opposite page - have pressed-steel lower arms identical to those on the Mark 1 Golf, and the riveted-on ball-joint can be removed and replaced with an even simpler bolt-on item for £10-£15 per side. Even a complete new steel arm will cost only around £30-£35 all in. (All these figures include VAT.) But the later cars - again see opposite - have lower arms made from aluminium alloy, and theoretically non-replaceable ball-joints. This means you must either buy a complete brand-new arm (around £400 a side from Porsche, or about £175 from an independent), or else find a competent specialist to machine out the old joints and fit new ones. (See panel on page 107.)

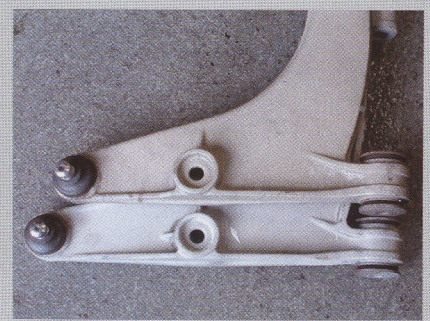
Alternatively, and thanks to the efforts of the Porscheshop in the West Midlands, you can now 'reverse-engineer' your later car to accept the pressed-steel lower arms and their replaceable ball-joints. Faced with an increasingly loose and noisy front end on his 1985/2 944 (fitted with aluminium wishbones), that's precisely what this writer did, saving upwards of £300 in the process. In truth, this particular set-up's similarity to the Volkswagen Golf made this a relatively simple substitution process, and later vehicles do require a little more in the way of modification, but the principle remains exactly the same even for a 968. Read on to find out how we did it - and how you can, too! **!**



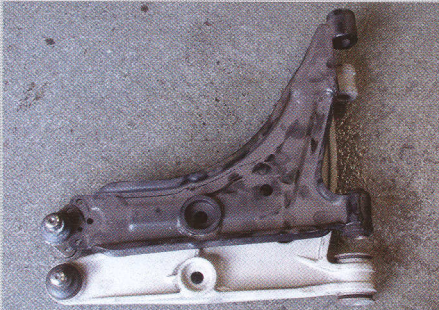
This is all the hardware we needed to convert each side of our 1985/2 944's front suspension to the earlier type, with a pressed-steel control arm and a replaceable ball-joint. Arm is exactly the same as a Mark 1 Golf's, and fits either side of both vehicles



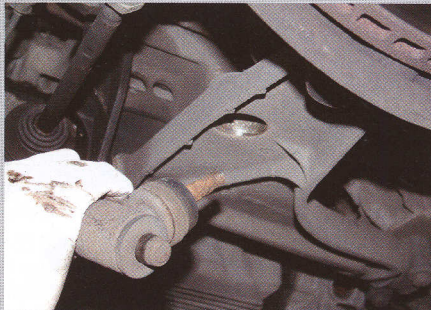
Vital to know differences between arms you'll find in 924, 944 or 968. Left to right: standard Golf Mark 1 or 924; early alloy arm from a 944; later aluminium arm from a 944, S2, Turbo or 968; and Porscheshop-modified pressed-steel arm for all those later cars



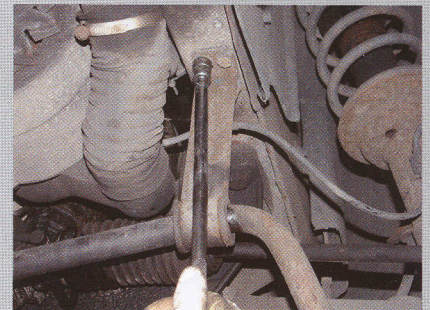
Close-ups make it clearer still. Here you can see difference in length between early-type (top) and late-type (bottom) aluminium arms. The apparent increase in wheel track was prompted by switch to negative-offset steering (see p107)



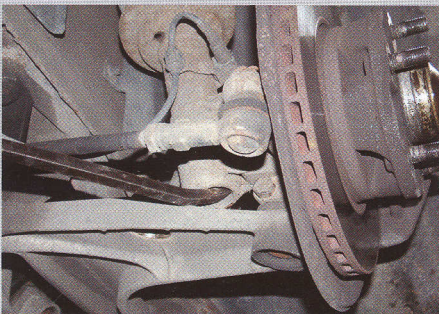
And this shot shows how Porscheshop has modified Golf-style steel arm to fit any of the later cars - including 968: £135 each. Note laser-cut (and TIG-welded) plate to place ball-joint in correct position, plus modified rear mounting point to the chassis



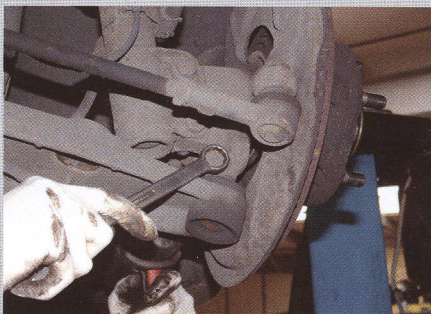
First step in replacing our car's arms was to remove anti-roll bar by undoing M8 nut securing each connecting link up through moulded recess. Broken stud on one side meant we ended up replacing that entire assembly - and rubber mounting bushes, too



Next we unscrewed two M8 bolts securing anti-roll bar to each of the two chassis longitudinals. They may be seized in their threads, so take care not to break them, spraying with penetrating oil and then winding them a little way back in again



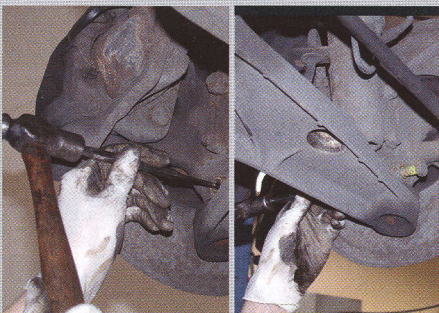
To confirm wear in bottom ball-joint place a bar between base of strut and control arm - whether steel or aluminium - and lever them apart. Even slight movement will be obvious. Don't be misled by loose wheel bearings or worn dampers, though



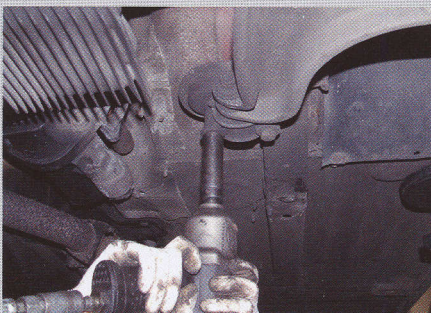
Grooved pin on ball-joint is secured into stub-axle assembly by means of an M10 pinchbolt (17mm spanner) and locknut. Here Porscheshop's Gavin Burns is using an impact wrench to loosen locknut, but ordinary socket wrench (and breaker bar) will do

BUSH ADMINISTRATION

If you're taking the trouble to 'upgrade' your later car with early-type pressed-steel suspension arms, then why not fit polyurethane mounting bushes, too? These Superflex items (below) are claimed to offer improved location and durability, no significant increase in NVH (noise, vibration, harshness), and easy installation. They look good, too, and at around £42 for this set (plus postage) they're not expensive. We ordered these after the work shown here had been done on our 944, but we'll be fitting them soon and then monitoring their performance and longevity. More on 01749 678152, or else at www.superflex.co.uk. The company also offers a kit of essentially similar bushes for the front upper wishbone fitted to pre-1989 928s, and that too is a subject we hope to look at in some detail in the near future.



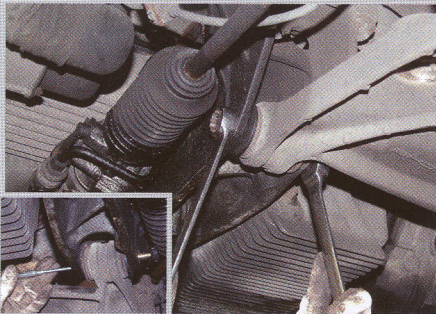
With locknut removed the pinchbolt can be driven forward through stub-axle forging by means of first a hammer and then a hammer and punch. Yellow paint suggests that this is the first time this one has been disturbed in this car's 170,000km to date



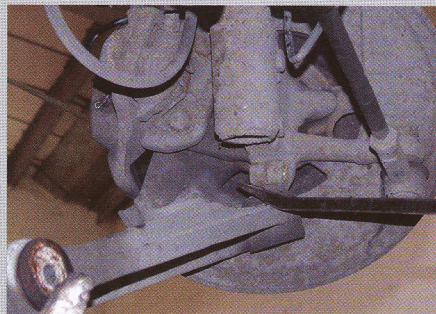
Rear end of control arm is secured to the chassis longitudinally by two M10 (17mm spanner) bolts passing up through a combined metal-and-rubber mounting block. They'll be tight, but again a socket wrench and long breaker bar ought to do the trick



944 & 968 FRONT SUSPENSION FIX



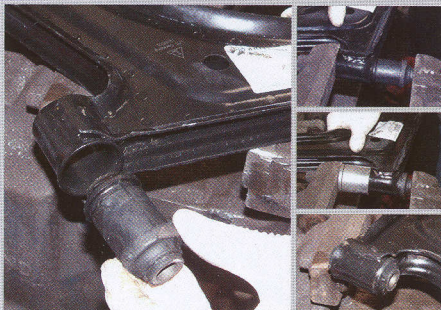
Front end of each arm is attached to engine-bearer crossmember by a single M12 (19mm spanner) bolt and self-locking nut. Former is then driven forward, again with a punch if necessary - but do be careful not to damage the adjacent steering-rack gaiter



To detach control arm first pull it straight down away from chassis mounts, and then use a prybar to lever pin out of stub axle. This shouldn't be tight, but if it is all you need do is gently drive a suitable wedge - a screwdriver, perhaps - into vertical slot



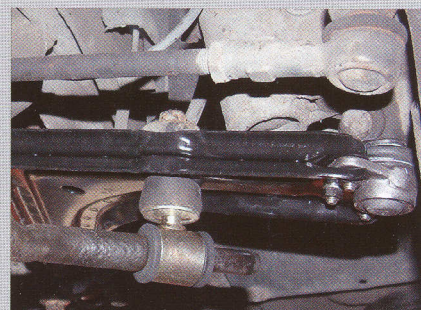
The original-equipment steel arm has ball-joint secured to its outer end by three rivets, but after-market replacements such as this use conventional bolts, washers and locknuts. Make sure they're tight, but not over-tight



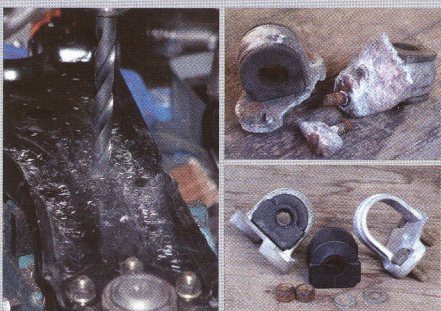
New bush for front mounting is pressed into eye on arm. Make sure it goes in the right way round, and help it on its way with WD-40. Socket provides clearance for end of the bush as it starts to emerge from the eye - but don't push it through too far



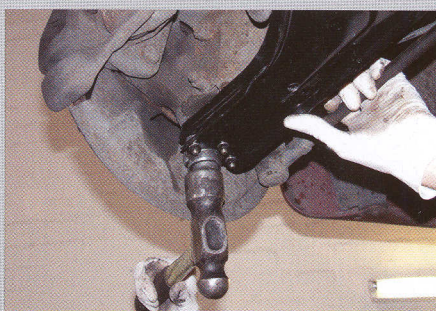
Similar procedure for the bush at rear end of arm. Square-cut face on the rubber needs to sit against underside of chassis, so align it with what will be the upper side of the wishbone. Don't worry if it's not straight, though; that can be adjusted later



In earlier cars anti-roll bar is attached to steel suspension arm by means of aluminium casting with rubber insert, but later 944 and derivatives - and the 968 - has a simpler eye-and-stud arrangement. This leaves you with two routes



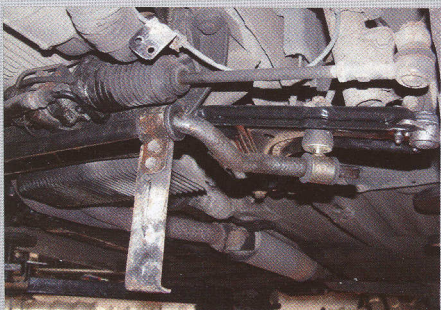
Drill new steel arm for single eye-bolt, or else buy a set of new 9245-style brackets and bushes (above, right). They're pricey, though (about £30 a side all in; steel control arm costs only around £15) and can subsequently corrode quite badly, as shown here



Begin fitting new suspension arm by tapping ball-joint pin upward into eye at base of stub axle. Don't use excessive force, though. If it's tight find out why - surface rust, perhaps - and maybe repeat that wedge trick with a screwdriver blade or similar



Align bush at rear end of arm with underside of body, and secure with a new or second-hand bracket. You can't use original because it's part of mounting assembly. You'll need front-wheel alignment checked (and set) for correct caster



To fit anti-roll bar (here with set of new bushes) first offer up eye and stud at each outer end through newly drilled holes in suspension arms, with rubber bushes above and below. Or fit those aluminium bracket-and-bush assemblies. Next attach 'L'-shaped brackets to the chassis and tighten bolts



And that's about it. Check all the nuts and bolts for tightness and refit the wheels, have the front-end geometry reset, and you'll be ready to go. New ball-joint may last no longer than original, but replacing it if and when necessary should now be a 20-minute job - or even less! Now to tackle those oil leaks...

USEFUL CONTACTS

Porscheshop 0121-585 6088;
www.porscheshop.co.uk

Euro Car Parts 020 8956 5050;
www.eurocarparts.com
(standard steel arms and bushes)

Hartech 01204 302809;
www.hartech.org.uk

Superflex 01749 678152;
www.superflex.co.uk

Paragon Products (US) 1-800-200-9366;
1-361-289-8834; www.paragon-products.com
(retailers for Wrightwood Racing's Charlie Arms)



All of these are telephone-dial wheels, but varying offsets (and widths) mean they aren't interchangeable

WHEN NEGATIVE IS A POSITIVE

Fabricated steel control arms were fitted to all 924s, to 944s prior to the 1985/2 model year, and to all 924S models. Light-alloy arms were fitted to all 1985/2 and later 944s (including the 944S, 944S2 and 944 Turbo), and all 968s.

The company claimed the alloy arms were both stiffer and lighter than the steel items, with an obvious benefit to unsprung weight. But it's possible it made the change simply because it could. And there was no harm in getting rid of

a stack of Mark 1 Golf-derived hardware.

Easier to explain is why those light-alloy arms themselves subsequently changed, gaining about an inch between the outer ball-joint and the pivot points on the chassis. For the 1987 model year it was decided that, in the interest of stability under heavy braking (and ABS was now an increasingly common option), all of the four-cylinder cars should have what is known as negative steering offset. (The 924, by then obsolete, had this desirable characteristic from

the start. And the - in this sense, anyway - mechanically similar 924S always had it, too.)

Negative steering offset places the major components of the front suspension such that a line drawn down through the pivot axis will touch the ground at a point outside the centre line of the tyre. Any tendency of the car to pull to one side as a result of an imbalance in braking efficiency will be minimised by the leverage exerted from this pivot point on the wheel with less braking force applied to it. And here an additional inch or so was all that it took.

In addition to extended control arms the later cars also had modified steering knuckles with a larger-diameter stub axle (and larger-diameter wheel bearings), 25mm longer track rods, and modified top mounts on the inner wings to accommodate the increased angle of the struts. In fact, kingpin inclination was increased by around four degrees to 20 degrees from vertical. The offset of the wheels was also modified to bring the centre line of the tyres closer together again - but without reducing the overall track.

This explains why from 1987 the standard 944's telephone-dial wheels appear to have more prominent centres and, despite being nominally the same width and design as the earlier rims, look plain silly on an earlier 944. And why the earlier wheels can't be fitted to the later models: they stand out way beyond the wheelarches, and would also tend to cancel out the effect of any negative steering offset. 12

FROM THE 911 & PORSCHE WORLD ARCHIVES

The question of 924, 944 and 968 suspension arms, and more specifically their ball-joints, is a subject we've examined before. In the November 2001 edition (*Strong-arm tactics*, pages 54-60; call 020 8655 6400 for back copies) we ran a detailed feature discussing the various options from Hartech in Lancashire, Glasgow-based independent engineer Craig Gilmour (who since appears to have moved from the address we have; can anyone tell us where to?) and, from the United States, the machined-from-billet 'A'-arms from California-based Wrightwood Racing. (These are also known as Charlie Arms, after their 'inventor', Charlie Spira, and will fit only the later cars.)

Hartech's and Gilmour's approach was - and in the case of Hartech remains - to machine out the old, worn ball-joints and then to install new proprietary items, finally and more or less permanently sealing them into position - as did Porsche in the first place - with an epoxy adhesive. Porscheshop, too, offers its own aluminium arm, overhauled locally in a similar manner, for £159 plus VAT (exchange). Wrightwood's approach, meanwhile, is rather more elegant - if also more complex - and is basically a completely redesigned arm with a replaceable ball-joint (essentially nothing more than a Rose joint with a pin through it), together with more precise spherical pivot points in place of the

standard rubber bushings. It even offers the option of a billet caster-adjusting block.

The route you choose is up to you, and there's no doubt that those Wrightwood arms are an exquisite piece of engineering that no self-respecting trackday car should be without. They're quite pricey, though, at \$1595 a pair all in (plus an extra \$750 or so for a pair of those caster blocks), and while the current strength of the pound against the US dollar takes some of the sting out of that you still need to factor in the duty payable to bring them legally into the UK. But the simple fact is that even those seemingly low-tech steel arms we fitted to our own car do the job probably 80 or even 90 per cent as efficiently. And at around £130 a pair for 1985-86 cars, and £270 per pair for 1987-95 models, will allow you to spend your go-faster budget on many other equally worthwhile modifications. 12

TIGHTENING TORQUES

It's important to tighten threaded fastenings to the correct torque, and never more so than when it comes to suspension systems. The relevant figures for the work described here are shown below. Note that although neither the official Porsche manual nor the Haynes equivalent seems to mention it, it's good practice to tighten the bolts for the suspension arms' pivot points on the chassis only after the vehicle has finally been lowered to the ground, and the arms have as a result assumed their normal working position.

Control arm to crossmember (ie forward mount)	65Nm
Control arm to body (ie rearmost mount)	46Nm
Control arm to steering knuckle (ie ball-joint)	50Nm
Anti-roll bar to body	23Nm
Anti-roll bar to steel control arm	23Nm
Anti-roll bar to light-alloy control arm	25Nm
Wheel nuts (steel/titanium)	130Nm/130Nm