

Beam me up

HID upgrades can be a minefield. Fortunately our resident electronics boffin, David Bywater, is here to set the record straight.

Words: David Bywater Photos: Elliott Roberts & David Bywater

One of the more popular and simple upgrades for most cars is to fit a high intensity discharge (HID) kit. There are a wide range of kits available, but many people don't appreciate all the issues surrounding them. Please note that this article relates to HID bulbs which are often called xenons. Do not confuse them with cheaper 'xenon white light' filament bulbs.

Most cars are fitted with halogen headlights as standard, HID being an expensive option on all but the highest specification vehicles. They

don't have a filament like a conventional bulb, but use a high voltage to strike an arc. They generate more light for a given current consumption – a 35W HID will give more light than a 55W halogen – and having no filament makes them more shock resistant. As a result, the aftermarket has filled the upgrade gap with a range of kits for the DIY mechanic to install.

I replaced an Audi B5 S4 that had factory xenons with my B7 A4 that only had halogens, and wasn't impressed with the resulting lighting downgrade. Time to experiment with some of the HID upgrade kits. As the S4 had

xenons only on the dip beam, I was used to my night-time drive being a white lit road with yellow scenery, so I just bought one H7 HID kit to upgrade the dip beam.

An H7 HID kit generally comprises of two parts for each bulb – the replacement bulb itself and a ballast. The ballast is an inverter which generates a strike voltage for the bulb of about 23000 volts. Count the zeros and be careful what you touch when the light is turned on, or it's going to smart in the morning! Some early kits split the ballasts into two parts, but they all seem to be integrated these days.

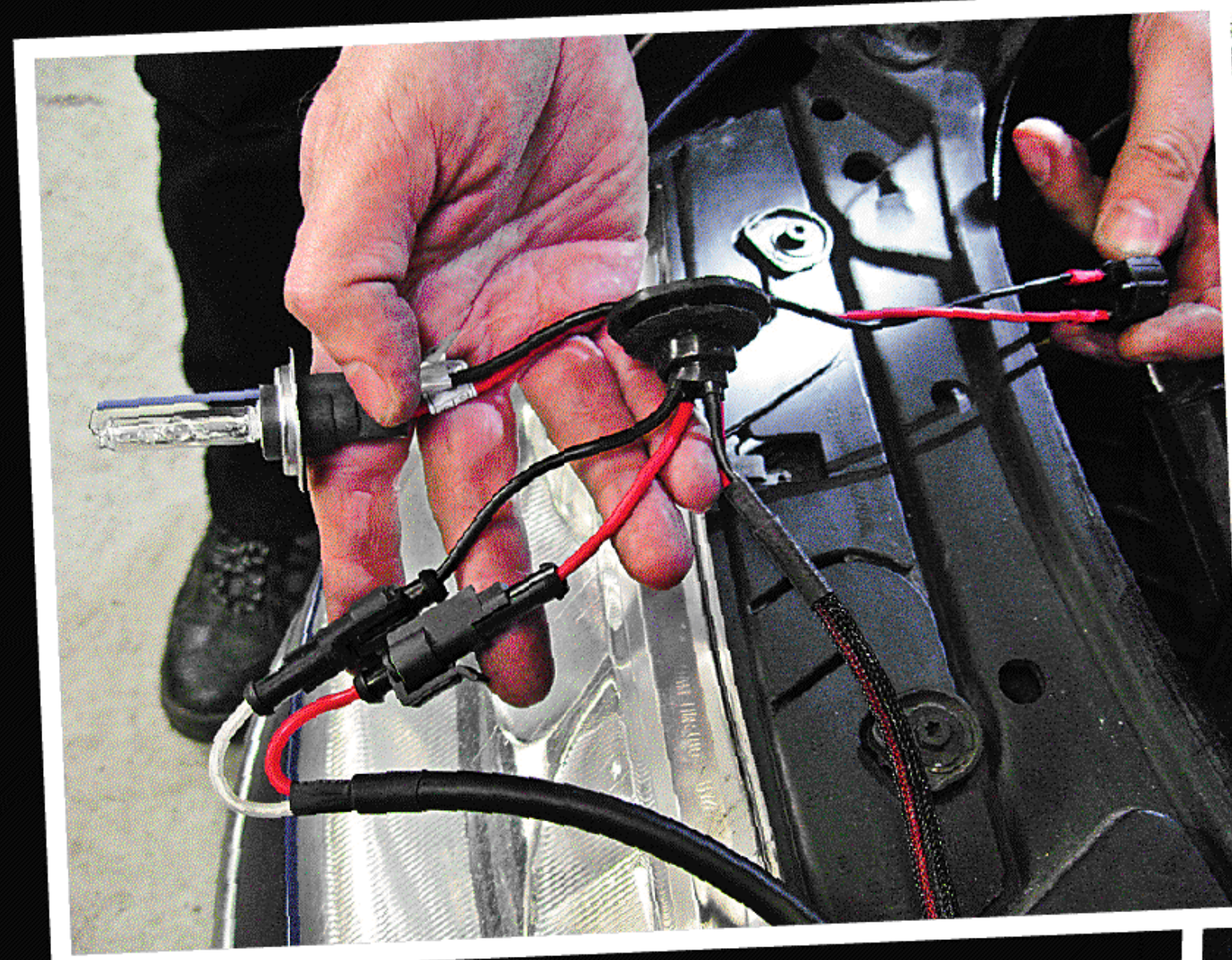
FITTING AN AFTERMARKET HID KIT

In order to show how easy an HID installation could be, two H7 HID kits were temporarily fitted to a B5.5 Passat. When we first looked at the car, there seemed to be enough room to work around behind the headlights, so the first bulb was fitted – the offside dip beam. This was for no better reason other than it was nearer to the driver's seat!

Once the air intake and light cover had been removed, it was easy enough to remove the existing bulb by twisting the connector slightly anticlockwise (viewed from the rear). This model of headlight has a metal clip mounted on the front of the

connector body, sandwiched by the back of the bulb, effectively turning the bulb into a bayonet fitting. Unfortunately this design means that the replacement bulb wiring loom had to be dismantled (by taking the contacts out of the connectors) so that the loom could be threaded through the small hole in its middle of the clip. Also, when fitting the new bulb, the lack of the body of the connector made handling the clip much more difficult.

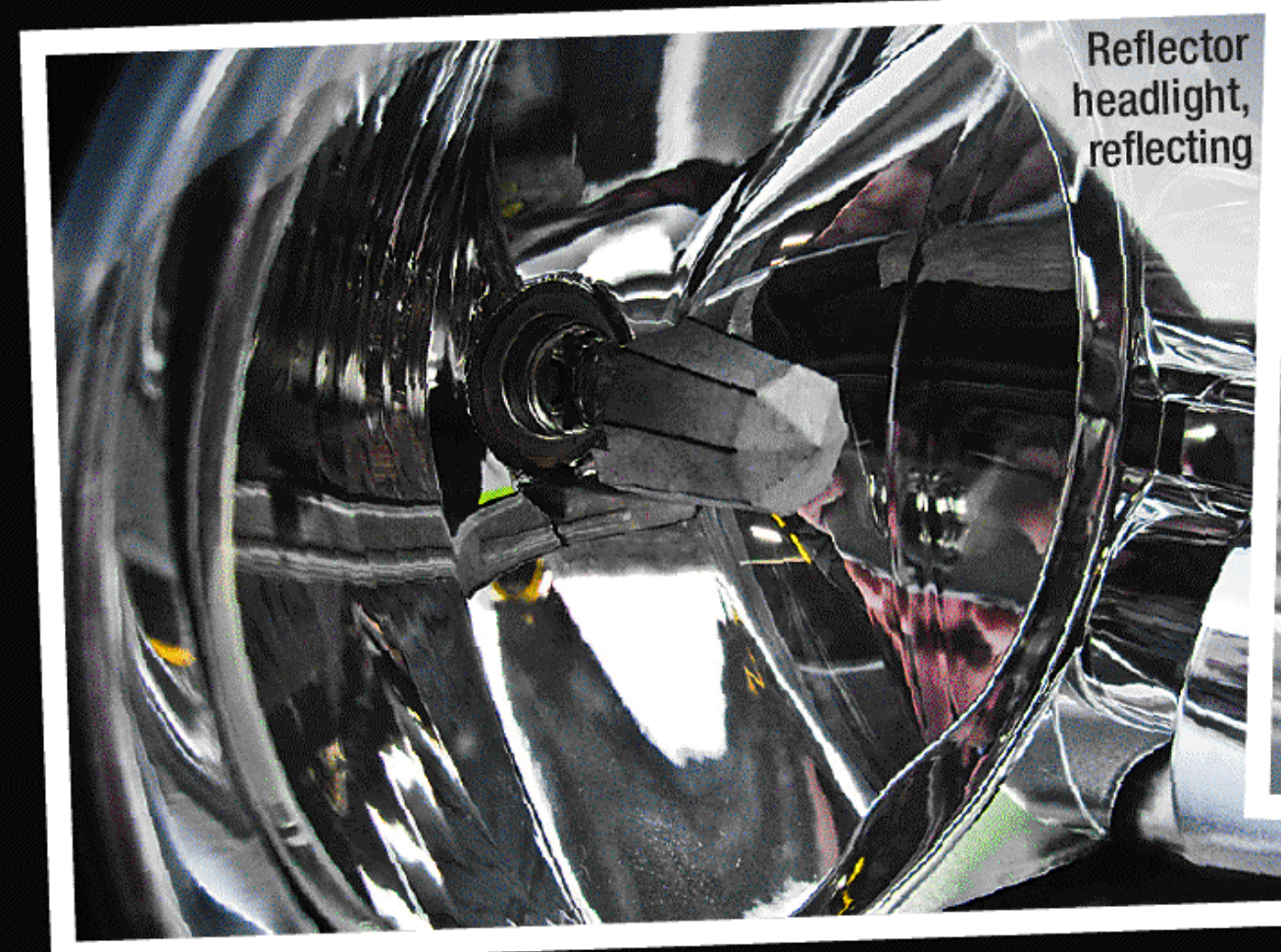
You can see how the wires from the ballast plug into the original connector and the bulb plug into the ballast.



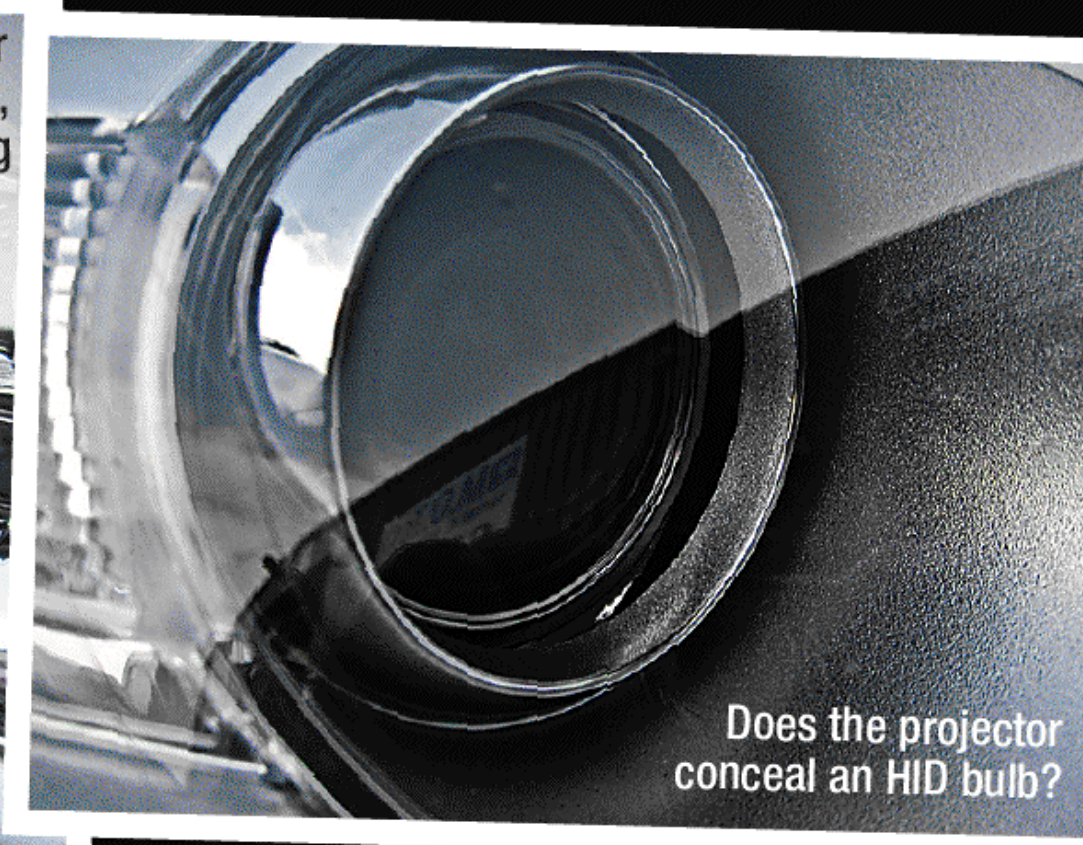
Left: Wiring is relatively simple when you spread it out in the correct order



Below: Ballast units need to be handled with care



Reflector headlight, reflecting



Does the projector conceal an HID bulb?

SELECTING AN AFTERMARKET HID KIT

The first thing is to decide which kit you are going to buy. The bulbs in the kit need to match the type that is fitted to the car as standard – in the case of the Audi, an H7 kit was required. Because the Audi has bulb failure monitoring, I chose a kit with digital ballasts (sometimes called CANBUS ballasts, although they don't connect to the vehicle

data bus!). These seem to be programmed to have a start-up characteristic that is closer to that of a halogen bulb, and as a result, many vehicles that are fitted with bulb failure systems will work happily with them. You also need to decide what colour of bulb you want to run with. This is shown as a number with a 'K' after it. Aftermarket kits are commonly

supplied with 6000K or 8000K bulbs. Basically, the higher the number, the more blue the bulb. A 30,000K bulb will look positively purple, and may not be as effective at lighting the road ahead. Many OEM bulbs are around the 4000K mark, so I bought a kit with 6000K bulbs – the closest that was easily available on the day!



HID bulbs are often visibly longer than regular halogens



If you need to read the manual then you'd best ask a grown-up to fit the kit

Aftermarket HID bulbs come with one of two types of mounting flange – either metal (like the original bulb) or thermoplastic. The plastic flanges are thicker, and some types of bulb mounting clip can struggle to hold them

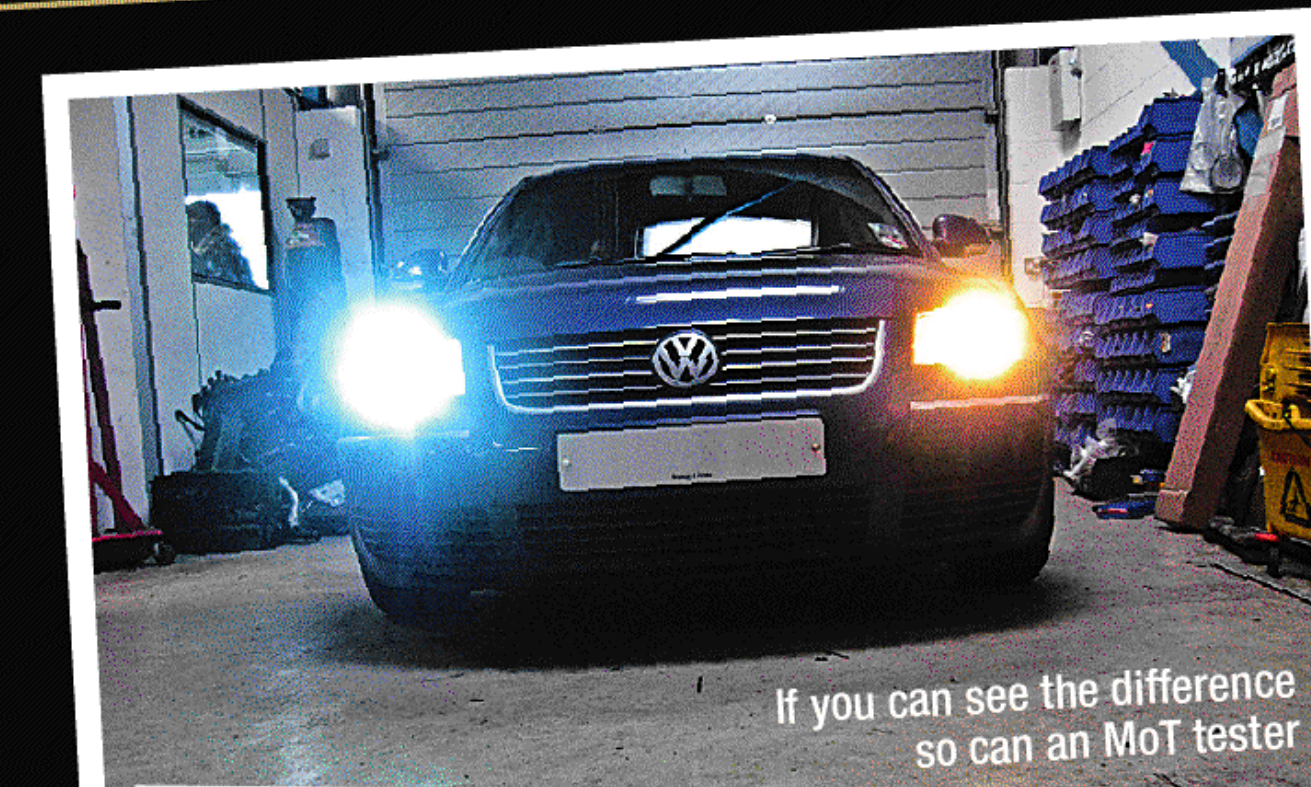
in place. It's not normally a problem if the clip goes right over the back of the bulb, but some holders just have clips that pinch the sides of the flange. With these, sometimes it's more effective to pull the retaining springs back so that the tips push against the back of

the flange. It's not quite how it was meant to be done, but actually is far more secure. Depending on your car, you may find that you need to take the headlights out to make sure that the bulb is properly secured. The Audi (and Passat we used for the photos) is so tight at the front of the bay that the lights had to come off anyway.

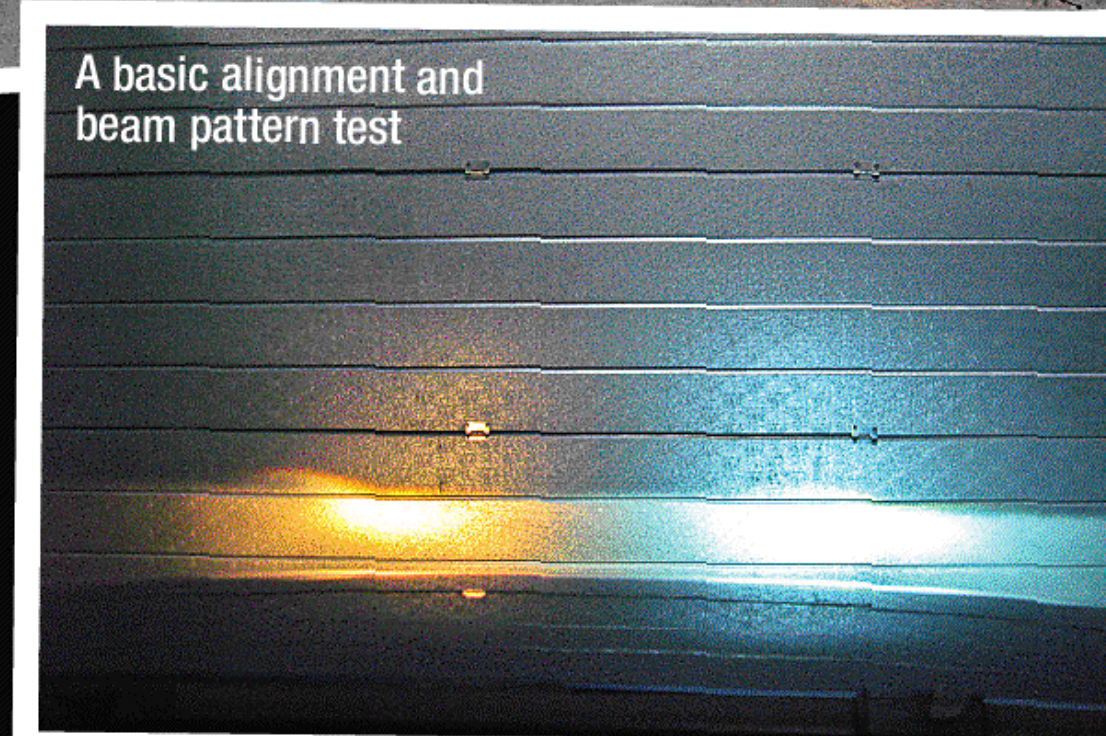
Some headlights are based on a projector design. These can be identified by a hemispherical lens just in front of the bulb, behind the outer headlight cover. If you can see the bulb through the front of the headlight, it's not a projector. Some xenon replacement bulbs might be long enough to touch the back of the lens (which would be a problem), but I've never had an issue with this.

It is vital to make sure that the ballast is plugged into the connector correctly. The negative connection on the ballast is black, and will plug into the common contact of the connector, which is likely to be brown. Positive on the ballast is red, but the colour of the corresponding wire on the connector depends on the vehicle model, and which light is being replaced. Be warned, if you are not sure about polarity, use a voltmeter to confirm which way round the OEM connector is wired.

We took a photograph of the single bulb upgrade shining on the back of the unit door. This shows that the beam of the xenon light is comparable with that generated by the halogen bulb in the other headlight.



If you can see the difference so can an MOT tester



A basic alignment and beam pattern test

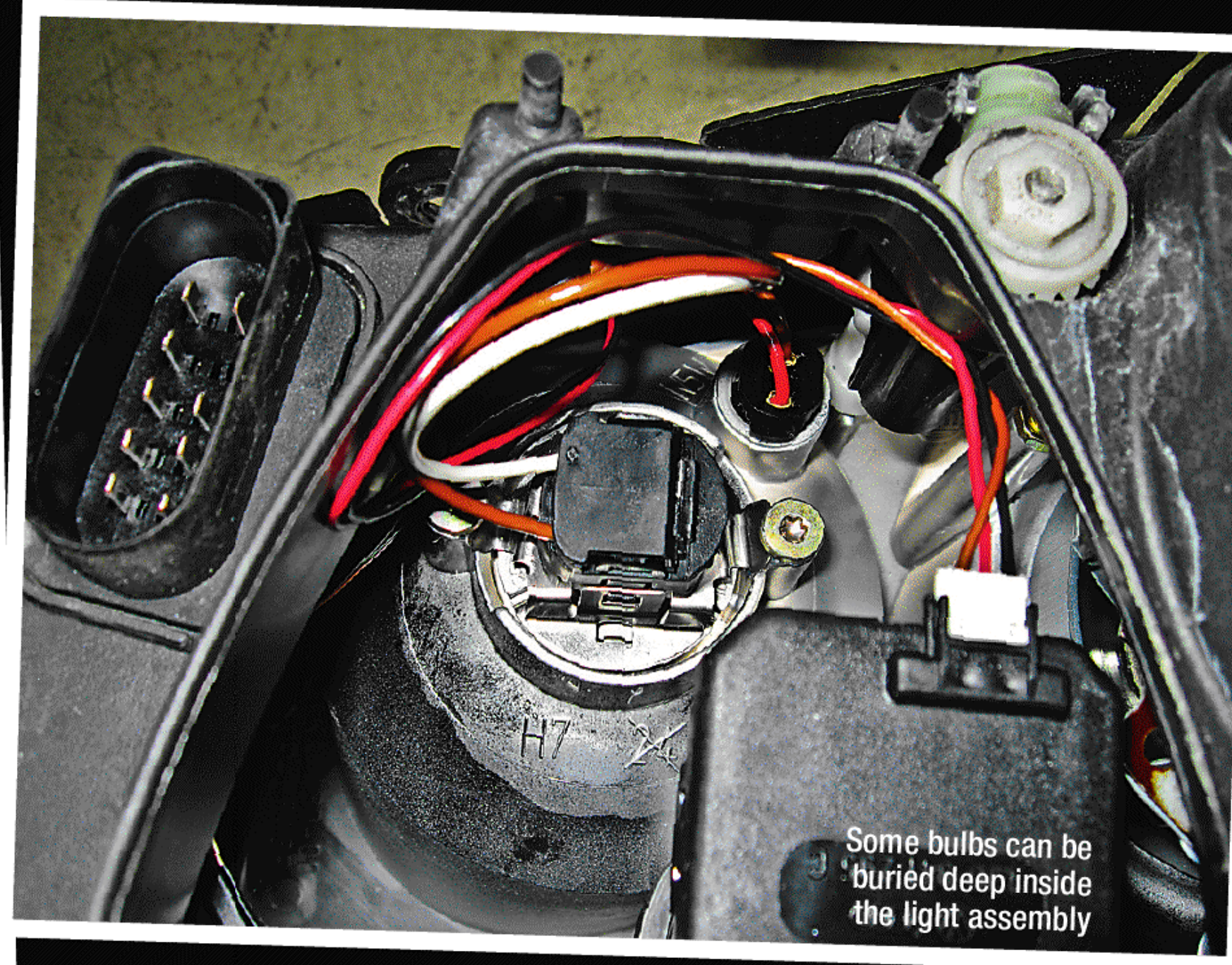
step 2 continued....

The next bulb to tackle was the full beam on the same side. After a bit of fiddling, and remembering how tricky the retaining clip was to handle during reassembly, the decision was taken to remove the headlights from the car. On the Passat B5.5 this means removing the front bumper shell. All you need are a set of Torx drivers, a coin (for the clips securing the bottom edge to the under-tray), and a little space to spread things out in. With the bumper on the floor, it was simple enough to remove the four headlight retaining screws per side, lift the lights out, and change the bulbs on the bench. Remember that when the lights are refitted, the beam alignment must be checked and corrected.

Once the lights are back in place, the ballasts must be secured. Remember that you need to allow space for any parts you have not refitted yet, such as the air intake. Keep the ballasts out of the way of excess water or too much heat.



Some kits are easy to fit than others. Passat setup resulted in headlight removal



Some bulbs can be buried deep inside the light assembly

3

LEGISLATION

You may have noticed that many of the adverts for HID kits state that they are not for road use. This is because all external light units on a vehicle have to be approved, which is shown by an 'E' mark on the lens. Lights have to be offered for independent testing by the manufacturer and the resulting approval is only valid if the light is used in the manner that it was tested. Consequently, a light that has been signed off with a halogen bulb should not be used with a replacement xenon bulb.

At the moment, a headlight can pass an MoT if it is fitted with an aftermarket HID kit. If the beam is a suitable colour, well-shaped, correctly aimed, and not over-bright, an MoT tester can accept it. The car does not conform to 'Motor Vehicle Construction and

Use' legislation (naughty) but it can still pass an MoT. However, at the end of the year we are expecting the MoT test to change to specifically fail a vehicle fitted with an aftermarket HID kit, to take care of this anomaly. You might say that if a projector headlight is fitted with a 3000K HID kit it won't be easy for an MoT tester to spot a well-hidden ballast, but I couldn't possibly comment.

The approval outline for gas discharge headlights (xenons) says that they have to fulfil four criteria:

- 1) The reflector and lens or projector has to be designed for use with that type of bulb.
- 2) The headlight must have a washer or wash/wipe function fitted.
- 3) There must be an auto-levelling mechanism.

4) The dip beam light must stay on when full beam is enabled.

If you look at the photographs for the beam patterns, you can see that there is an obvious difference. A halogen dip beam pattern (for a right-hand drive car) is shaped like a laid back 'L' – level to the front of the light with a triangle rising to the left – while the HID pattern has the top of the triangle levelled off. There might be some HID kits that can change the pattern of the light in which they are fitted, but I've never seen one.

Essentially, if you want to have an approved headlight that gives the correct pattern, you'll have to buy a whole suitable replacement unit. It's not an insoluble problem if you own something like a Mk4 Golf, but is a bit more restrictive if the car is older.



Ancient beam pattern is very uneven...



Modern setup is far more consistent...

4

BEAM PATTERN PROBLEMS WITH H4 BULBS

It's easy to assume that the bulb you have chosen will work perfectly in your car, and this is generally true for single-function bulbs. However, lamps that take an H4 bulb need to be able to give both a dip and main beam pattern.

There are two common types of aftermarket H4 HID bulbs. One has a single arc, thus requiring only one ballast. This type of bulb has an electromagnet to move the arc position when the selection changes from dipped to main beam. The other type has two arcs, in two sub-bulbs. These require two ballasts per bulb and, as a result, means the kits are inevitably more expensive.

Both types of kit normally come with an extra wiring loom and a relay block. These are powered through a new fuse directly from the battery, with the relay block being triggered by a connection to only one of the original headlights. There are two ways to wire an OEM H4 headlight – with a common ground (VAG, Ford) or with a common supply (Toyota). The ballast is polarised (must

be connected the right way round), and the HID manufacturers use the relay block as a solution to avoid people from choosing the wrong style of H4 kit and blowing it up.

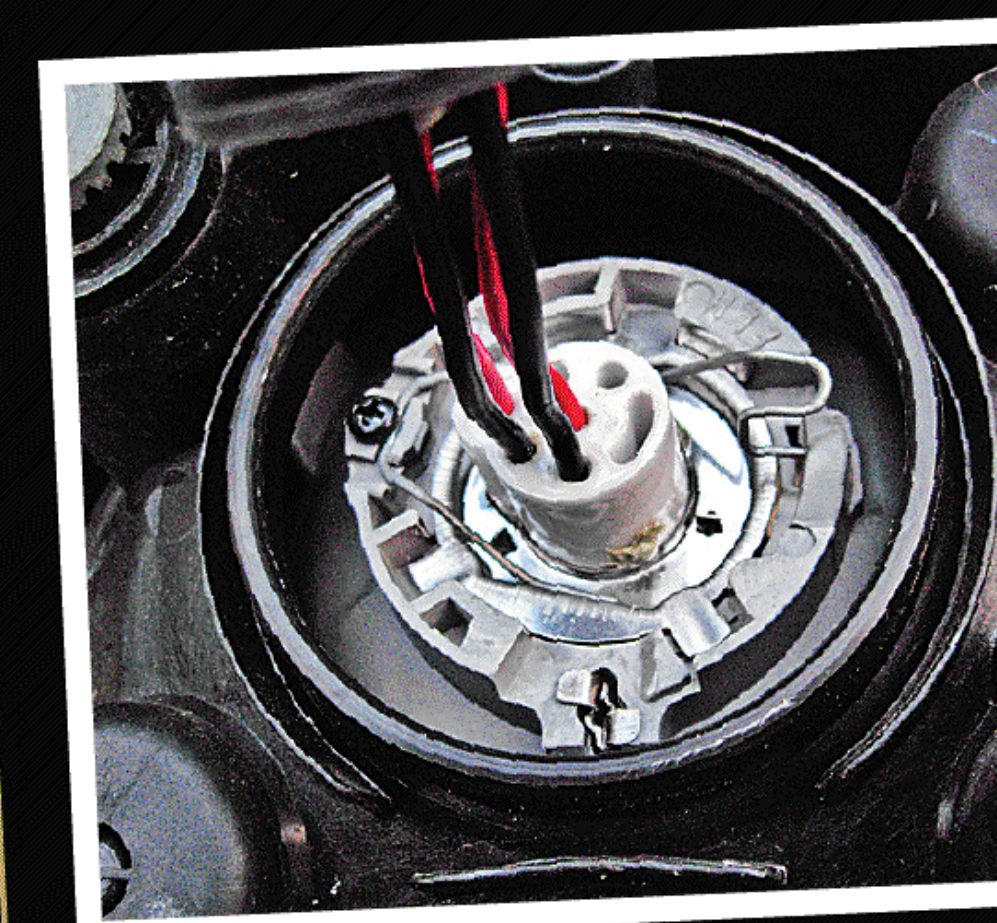
Personally I think that there is a better way of doing it, and I would discard the loom and relay block in favour of my own OEM+ wiring. With common supply bulb wiring, you may find that the full beam indicator on the instrument panel doesn't light after the HID system has been installed. If this is the case, the simplest solution is to add a constant-current drain to ground on the dip beam circuit (200mA should be sufficient), as this provides the negative path for the blue light.

Some H4 HID conversions can be a bit less effective in particular vehicles, for example, a magnetically-adjusted bulb in a Toyota MR2 Roadster. The dipped beam pattern is absolutely wonderful, but when the bulb moves to the full beam position, all the light moves up. Although you can see things at distance, there is no light on the road immediately in front of the car – it's like looking at the world through a letterbox.

Should your car have a winter pack fitted, that's the washer function sorted – unless you've a penchant for the smoothed look and it's all been taken off! It's not too hard to fit a headlight washer function, even for vehicles that were never supplied with one, but most people upgrading their headlights don't bother, in spite of the regulation. The point is that as xenon lights are brighter, any beam deflection caused by dirt on a lens causes more of a problem for on-coming traffic. Having a washer or wiper function helps alleviate this.

OEM HID headlights generally have motors in them to adjust the vertical beam aim. These are driven by an electronic module which is associated with deflection sensors mounted on the front and rear suspension, and calculates the correct rake. Be careful with these sensors if your car is lowered as they can be damaged by being used over a different range of suspension deflection. Many cars fitted with these sort of self-levelling headlights lower and raise the lights' aim when they are turned on, to find the end-stop and prove the function is working properly. There is another approach that is acceptable, and that is to have suspension that automatically levels the whole car. Something as simple as self-levelling rear shock absorbers will do the job, or you could fit air-ride with an active controller (like PVW's own Project 4Play) and set it to keep the car level.

Finally, the dip beam needs to stay on when using full beam. Many OEM H4 headlights are wired so that when the full beam filament is turned on, the dip beam is turned off, and this can lead to a lack of light immediately in front of the car with an HID conversion.



Two arcs, four wires – read the labels before connecting



The arc needs to be exactly where the halogen filament was mounted

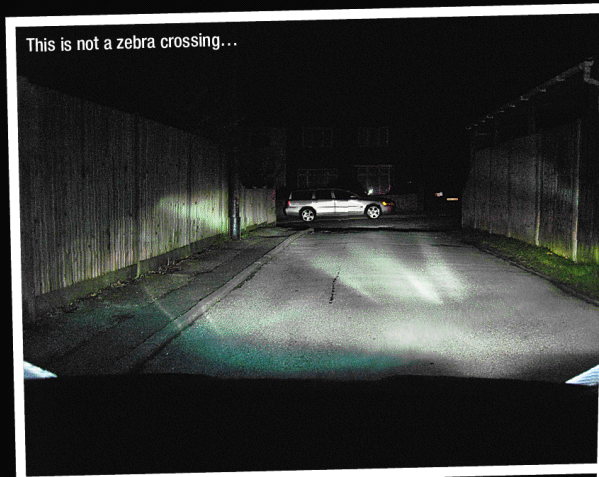
step 4 continued....

One alternative is to fit a kit with a dual arc bulb, and rewire the car so that the dip beam ballast stays on when full beam is selected. The same car has a different problem with

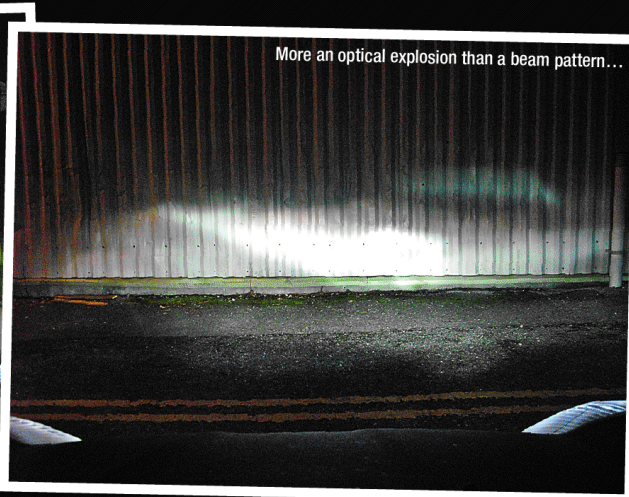
this type of bulb in that the arc for the dip function is not quite in the perfect place.

This leads to uneven dip beam light distribution on the road and a complete

disaster during the MoT test. If you look at the picture on the previous page of the dual arc bulb next to the halogen, it's clear just how far the arcs are from the filament locations.



Any type of bulb might work to your satisfaction in your own car, but you still have to consider whether it will get approval



when it's checked officially. Even the most basic tests show the limitations of this installation!

5

FITTING OEM XENON LIGHTING

In the end, I decided that the aftermarket HID-equipped headlights on the Audi were not as good as those on the S4. There were OEM xenon options available for the car, so the next step was to gather more parts together.

The starting point was to find a suitable set of headlights, because that determines the rest of the kit required. There are several descriptions for these lights, including xenon, bi-xenon, curve and adaptive lights. Xenon lights generally just have upgraded dip beam, with a standard halogen full beam bulb. Bi-xenon lights will have an upgraded full beam as well, although this often comes from the dip beam lens. The spare location on the headlight might be used for a daytime running light (DRL). Adaptive lights and curve lights are two names for the same thing – those fancy lights that point into a bend when you turn the steering wheel. It sounds like a bit of gimmick, but does help with unlit country lanes.

The lights I bagged turned out to have the full curve light function, although they had been modified to connect to a standard vehicle harness. An Audi B7 A4 might be fitted with halogen headlights, bi-xenon headlights or curve lights. Unfortunately, there are also two different headlight connectors and three different connection schedules, and the easy-install wiring modifications that the previous owner had made needed to be removed. In the end I had to dismantle the lights to trace and repair the internal wiring, and adapt the (incorrect) connector provided to suit the installation kit. You might not want to buy

new lights from a dealer, but nor do you want lights that someone else has been playing about with! Also, make sure that the lights come with the correct OEM bulbs and ballasts because these will be expensive if you have to buy them separately.

One of the eternal frustrations with my Audi is that there is no stub wiring for any option that has not been factory fitted, so I ordered a full retro-installation kit from Kufatec – there are two different kits depending on whether or not you need to control the curve light function. You don't need the Halogen/HID/Curve adaptor looms as well, and as Kufatec won't take back what you haven't used, be sure of what you need before ordering. The installation kit came with the correct OEM control module, suspension level sensors, a rather long wiring loom, and a few gaps in the installation instructions. It always takes longer than anticipated to fit a strange kit for the first time, and the sensors were quite a bit of aggravation. Remember that the loom has been designed for a left-hand drive car – it will be too long in some places and too short in others. A catering pack of patience is very useful, as is access to a well-equipped workshop and some (relatively) tame mechanics. You will also need a programming tool to set up the HID control module and change the coding in the central electronics (to recalibrate the bulb failure thresholds and set the DRL function) – VAGCom will do nicely. I'm not sure that I'd volunteer to do it all again, but the end result is rather impressive!

CONCLUSION

So, with the powers-that-be becoming less tolerant of aftermarket HID kits, are they worth the potential trouble of fitting them? They are a definite improvement over halogen bulbs for driving purposes, but if you only ever drive your car on the road the law says that you shouldn't fit them, and it looks as though they are going to become rather more insistent on the subject. Retro-fitting OEM xenon headlights is quite an undertaking, and isn't even an option for every car.

You could argue a case for fitting a kit for cosmetic reasons if your car is on a stand at a show, although perhaps a filament bulb with a whiter light would do a good enough job for a fraction of the money. When you're in the campsite the night before the show, it's obviously vital to be able to count the whiskers on a rabbit at 300 yards, and as the car is not on the road an after-market HID kit is not illegal. Just remember that the kits are as easy to disconnect as fit, and you should refit bulbs appropriate for the headlights for whenever the car is on the road.

Finally, many thanks to Mark McDonnell for asking all the questions that then led to all these experiments!