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Engine Conversions

FOR

DUMMIES®

Discover How To Convert Your Aircooled VW To Watercooled

A Reference for the Rest of Us!®

By VWKD

Introduction

So, you come this far – you decided that your air-cooled engine is no longer up to the job, it's let you down too many times, requires too much of your precious time to keep it reliable, or you're looking for more power and have reached the point where a pair of performance heads could buy you a complete 250bhp engine!

Whatever your motivation VWKD have put together this beginner's guide to answer a few of those questions and to distil all the information on our web site www.vwkd.com into a simple beginners guide. We have tried to keep it generic as specialist advice is available through the various sub-sections of the website.

Everyone wants something different from their engine and different people have different models of VW they wish to convert. Regardless, the basic principles of swapping and engine remain the same.

Choosing an engine

There are a few key considerations with an engine swap – most importantly you need to be realistic about your **ability** and the **money** you wish to spend and choose an engine that fits this profile. If you've never lifted a spanner before, and you're on a tight budget, then perhaps it's not best to be breaking new ground but better treading a familiar path where solutions are readily available. Be realistic!

You also need to think carefully and realistically about what you will use the car for, a 2.5 turbo-charged Subaru engine is not going to be economical in any car (although it may be more economical than your old air-cooled) and whilst it might do the right things on the strip or track you may not find this best for long trips on the motorway.

Remember Diesels are also an option so don't write these off, in fact on some earlier diesels simplicity will reward you with their simplicity. Don't get too hung up on brand loyalty – VW don't make 'the' best engines, they make good engines but you often have to pay more for them. There are many other options out there –so don't judge an engine by the car it came in!

Good donors come in all shapes and sizes..

Parts are also a consideration, if you want to keep things cheap, then you may want to choose a conventional and popular engine with a diverse range of applications. This will become particularly useful when you're looking for a flywheel with a different offset, a starter with a different length drive or even just for a cheap and reliable source of spares. A good example of this may be the Peugeot / Citroen 1.9 Diesel – available in many variations, turbo, normally aspirated, HDI, and in every model of Peugeot from a 306 to a small van, Citroens and even some Fiats!

There are other practical considerations, for example your engine choice should consider what adaptors are available and you may also need to think about physical size of the new engine – a v12 jag engine isn't going to fit in your beetle engine bay without a lot of work!!!!

Once you decided which engine is for you **do your research** – find out what a good price is and what a bad price is. There are often specialist forums for individual cars on the internet – so join up and start asking questions as you will find there are often variations on any single engine – some will make your life harder, some easier and some versions may be more costly than others. An example may be VW 20v Turbo….the version fitted to the TT is considered the most tuneable but is also the most expensive, whereas the more common Passat version delivers a little less performance but at a cheaper price. With many engines you may need other parts from the donor (often you need the engine loom, instruments, keys and ancillaries too) to make it run and these may not be available or may cost more than the engine – so find out what you need to make it run before you bid on eBay for a bare block!

Once you've chosen your engine and done all your research you'll need to buy one. There's not much I can say here except be careful – there are thousands of engines out there so don't get carried away.

To reduce the risk of buying an engine only fit to be a boat anchor, try and buy one in or at least see it in a running car. If you can afford the whole car then buy it - you will be able to make use of many other parts on the vehicle and weigh it in for scrap after – other bits you may also be able to sell on eBay. If you cannot buy the whole car you want to hear it running before you remove it. Buying an engine without knowing it runs will waste a lot of time later in the build. Don't be dazzled by warranties – many of these will not cover you putting it in a different vehicle and will probably have run out by the time you have fitted it in your car. Be careful – and make sure you get what you paid for! If possible try to get a lower mileage engine; a rebuilt engine will not be as good as a low mileage original one. Factor in if you want to keep the car for a long time as if you do then if you can foresee your engine will require a rebuild in your future it may work out cheaper to bite the bullet and get a better/more expensive one initially.

Adaptors and gearbox

Gearboxes are important features of your conversion and will determine how much pleasure you get from driving your converted vehicle –you might have 300bhp on tap or the potential to get 50 mpg but it's not much use when you're driving around at 6000rpm everywhere! Fortunately there is great inter-changeability between VW models (depending on how many modifications you may wish to be involved) and also some of the Porsche boxes may fit with some modification so often the answer can be found on internet forums.

In a road car you are aiming for tall gearing (more so in a low revving diesel) to assist with economy, strength and reliability. In a race car these considerations may be slightly different! The converters 'favourite' is generally considered to be the 091 or the 6 Rib box as fitted to later model 2.0 litre bay window campers – these have been fitted to beetles (with modifications) but simply bolt in to other bay window campers. T25s also had a version of the 091 gearbox but this came with a different shifter arrangement. Split screens can use beetle IRS boxes or, if none of the above are for you and you have a little more cash then gearbox specialists such as Bears or Cog Box can fit different ratios of your choice to your original box. A simpler and cheaper option may be to consider using larger wheels and tyres – as little as 1 inch gained in rolling diameter may produce some surprising results. Like all things how far you wish to take this depends on your budget. You do not have to change your gearbox but it will enable you to gain more from your conversion.

Larger wheels will give you lower gearing!

With most engine swaps, an engine to gearbox adaptor is required. Depending on the application these are available in many shapes, forms and quality. Most adaptors take the form of a machined plate that fits in between the VW bell housing and the new engine. These types of adaptors are available from companies such as DS Tuning, Kennedy Engineering, and Famous Phil's (there are others) and are generally suited to both beetle and van applications as they do not require the removal of the VW bell housing..

RJ Engineered Solutions (www.rjes.com) produce a bell housing adaptor – this is specific to Subaru engines on van gearboxes as only van gearboxes have removable bell housings. Essentially this adaptor replaces the VW bell housing with a hybrid. The advantage of this approach is the use of factory components such as the Subaru clutch and flywheel and gives a neater finish to the conversion.

RJES Bell Housing Mounted to VW Gearbox

If you are using a VW engine (a Golf GTI in a VW t25 for example) then it may be possible to raid the VW parts bin and use a 'factory adaptor'. The Diesel Type 25 was fitted with a bell housing which shares the same bolt pattern as many of the water-cooled VW range of engines. This bell housing bolts onto most van gearboxes and will provide you with a cheap alternative to an adaptor.

It may be that you are breaking new ground by fitting an obscure engine into your VW. In this instance assuming that you wish to use the VW gearbox, you will have little option but to make your own. This is not particularly hard but will take you time, a lot of research and ingenuity. You will also need access to a willing and appropriately tooled machinist.

If adaptors are not for you, or you have been fortunate enough to buy a complete car you may well find that your best option is to use the donor's gearbox as well – this is particularly relevant if you anticipate using an engine with a high output (which requires a strong box) or a diesel engine which requires taller gearing due to its lower revving. In these examples, building a VW box into the specification you require could be costly, so once you have added this to the cost of your adaptor and the fact you maybe using hybrid parts -the donor's gearbox may be very appealing. This is no simple task however, and you will not be able to mount a gearbox from a front engine car in a rear engine vehicle as this will result in 5 reverse gears and 1 forward gear.

To overcome this there are a few options. First you may be told you are able to 'flip the diff' in the gearbox. This is a term loosely banded about on internet forums which in reality cannot be easily done on many modern gearboxes due to the precision and small size of their castings and the way they are lubricated - check out your gearbox but do not expect to do this easily!

Your second option is to use the original donors gearbox in its original format….that may be transverse mounted (engine and gearbox mounted across the vehicle) or inline (engine in front of the gearbox). This is of course at odds with the traditional VW format but if you can live with a loss of rear seating (beetle) or slightly less load space (van) then you could end up with a very good engine and gearbox combination and better handling / weight distribution for very little money. This approach will require more fabrication and welding ability than bolting together adaptors but will give you a very practical and drivable vehicle especially if you take the opportunity to use the donor's suspension and brake components too!

Mounting the engine in the vehicle

Whichever adaptor option you have decided upon you will need to mount your donor engine into your VW and its not going to just bolt in.

There are a few kits available off the shelf which allow you to bolt it in – however, depending on your engine and vehicle it is most likely that an off the shelf kit does not exist due to the infinite variations and combinations made between models of vehicle and makes of engines. Most of the time, it will be up to the person converting the vehicle to make some sort of support.

Up to now you have mostly been buying things and making decisions…but now its time to get your hands dirty. Ideally for this part of the build you will be able to weld, but if you can't do not despair. There are a number of ways to go about this and without going into specifics of each engine and VW combination the following is just generic guidance.

Before you do anything take some approximate measurements of your new engine and the big space where it's going to live. In some applications you will immediately identify components which may foul on the firewall – if they are removable then think about how and if they can be moved elsewhere perhaps with a longer pipe, or if you need to make some additional space. Once you have a clear space and you're happy that your engine will go where it needs, then work can begin.

If you are able (for swing axle beetles for example this may be more difficult) then remove the gearbox and mate the engine with your adaptor and then position the whole assembly as one. If you do not wish to remove the box then mate the adaptor and engine 'in situ'. In beetles the box is fully supported so this bit is not relevant, only applies to additional strengthening. You will need to support the engine in situ using a jack, chocks of wood or whatever you can lay your hands on - the engine and box must be stable, and positioned centrally to the vehicle and the engine mountings must be accessible. Take a lot of measurements and be sure that nothing is going to move during fabrication of the engine support bar. Think about what engine mounts you want to use, either the stock VW ones or the ones that came on the new engine may be incorporated in the new mounting system, don't forget to allow for compression if supporting the engine elsewhere during mock-up.

Some VWs have existing engine mounting points on the body – you may or may not wish to use these. If you do not use them then ensure that any new mounting point is strengthened by welding a plate around the mounting hole. Once you have identified the location of your mounting points on the engine and also on the body then you can begin to make your support bar.

Depending on your fabrication skills you may decide to mock this up in wood and get it made by a local fabricator. If you're feeling more confident you will probably find its best to cut and tack weld a support together before either welding it yourself or having a fabricator weld it for you.

Whatever you decide the end result needs to be strong and corners should be braced where possible and any bolts should be appropriately sized. Diesel engines in particular are very heavy and produce a lot of vibration – so if in doubt over engineer it! Box section steel is cheap and useful for fabricating a support bar and also if you're not too hot with the welder you will struggle to blow a hole through it! Make precise and measured cuts and create a sensible support bar – think ahead about fouling on the exhaust system, drive-shafts, pipe-work or any other parts which won't be along until later in the build.

Cooling

Cooling is the difference between a successful conversion and a waste of a lot of time and money and it's where a lot of conversions go wrong. If you get it right you will be rewarded with a VW that drives like a modern car. If it's wrong you will be watching steam blow out the expansion tank and wishing you stuck with the air-cooled!

Not as impossible as you might think!!

Water cooling an engine is a simple principle – it varies slightly in each application but if you wish to make your own efficient system you need to understand how it works. Many ex- Air-cooled converters are not familiar with this system if you are one of them….do your research.

Water/coolant mix is used as the medium with which to transfer heat away from the engine. Once it is transferred away from the heat source by the water pump it is passed through a radiator where it is able to dump the heat and return to the engine for another round of heat collecting.

The system is regulated by a thermostat which opens or closes depending on the operating temperature of the engine. When cold the thermostat is closed to isolate the radiator and allow the engine to warm quicker – when it is warm the thermostat is open allowing the hot coolant to be cooled by passing through the radiator. Most cooling systems operate under pressure – by pressurising the system the coolant can reach a higher temperature before it boils allowing more heat to be transported to the radiator and lost – thus making it more efficient. Due to the requirement for the coolant to heat up and cool down, its volume will change so a space is required in the system – this is known as the expansion tank. The expansion tank also acts as a point to accumulate any air in the system and prevent air-locking of the main coolant loop, this can cause flow problems leading to overheating. The way in which each engine is set up (especially relating to its thermostat and expansion tank) is important and therefore you must understand how your engine's specific system has adjusted the general principles above.

The most important component in the cooling system is the radiator. The radiator is simply a dense core made of small bore pipes with many cooling fins which hot water can pass through. Air is passed through between the fins transferring the heat from the water to the air. A radiator loses its heat in a conventional car using a pressure differential from one side of the radiator to the other. High air pressure is created on the front side of the radiator and low pressure behind it. Air will naturally flow from high pressure to low pressure and therefore the high pressure air will pass into the low pressure area taking with it the heat transported to the radiator from the engine.

The air-cooled engine by contrast uses an engine driven fan to suck air in and redistribute the air over cooling fins on the engine and through an oil cooler – the fan is a critical difference as the air cooled engine DOES NOT need positive air pressure inlets to cool itself in the same way as water cooled engine. For this reason the vents found on vans and beetles are no more than air inlets they are **not** designed to channel air flow adequate to cool a radiator. The vents will not be sufficient to generate airflow through a radiator so if your thinking your radiator will be efficient in the back of your engine bay….you will be disappointed.

With the cooling system, efficiency is what you are trying to achieve….and this means fans only come on in traffic jams. Unless you can engineer a viscous coupled fan then do not rely on fans to cool the engine. It is not uncommon to find people and even companies that swear that they have a successful cooling system using a radiator in the back – the reality is this radiator has cooling fans which are on pretty much all the time. Radiator fans are not designed for this type of continuous use so it's only a matter of time before the motor burns out and you're left stranded with no natural air flow through your radiator and an overheating vehicle. A system reliant on electric cooling fans is NOT efficient. You will also find that the air flow of fans is no match for natural air flow at speed so the vehicle's top speed will normally be limited by the size of the fan.

To make an efficient system you need airflow – clean and uninterrupted ideally. If you can replicate the set up found in a conventional vehicle or the donor car then this will be the easiest way of making an efficient system – however – achieving this and retaining the 'air-cooled look' is where it usually goes wrong. Driven by aesthetics, radiators have ended up in all sorts of places….nowhere near any airflow.

In a beetle the radiator can be placed at the front with some cutting and shutting. There a numerous examples of this on www.vwkd.com in the radiator archive – some more discreet than others.

In a t25 VW did their bit by providing a factory water-cooled edition. In bays and splits however, the worst radiator set-ups are invariably found. It is difficult to mount a radiator at the front of either without making it obvious that you're using a water-cooled engine and so many choose to hide the radiator away from the airflow to retain looks!!!

The best results will be with a front mounted radiator – some have concealed them in spare wheel covers, others have used hidden vents or large intakes – and these will be the most efficient systems as they are using natural airflow to cool the radiator.

Radiator disguised as a spare wheel.

Louvers in front panel

Another popular choice is to mount the radiator flat between the chassis rails. This set up is becoming popular as it is easy and discreet and has had success even in hotter countries. It is perhaps not as efficient as front mounting but it is effective and proven.

Discreet 'belly' mounted radiator

Of course there are other considerations too – if you have an extremely low vehicle this may make cooling underneath less of a possibility as it will be less efficient and also at risk of damage. If you have a higher vehicle then you will be able to make your system more efficient by adding scoops and ducts to provide additional airflow. The worst choice is a rear mounted radiator – in a van the radiator cannot work without fans because it has low pressure on both sides. Whichever way you decide – AIRFLOW must be the first consideration, aesthetics should be secondary.

With the location of the radiator decided you will need to link it all up. There are many piping options out there and many choose to use copper due to the ease of use, availability and its ability to radiate heat (this may add to the efficiency of your cooling system) - despite its common use some converters will not use it with an alloy engine due to the effect one metal has on the other. There is a lot of information on the internet about this type of corrosion so research again is the key. Copper does have the advantage of being easily worked, easily available, easy to solder bespoke sections together and bleeds are easily available for bleeding awkward sections of the pipe work. It has been used in many conversions with no problems; possibly due to isolating it electrically form the engine, although some may argue that the electrical path is the coolant itself.

Other types of pipes are available – rubber, silicone, steel, stainless and are preferred by some. To assist with the flow of coolant, tight bends should be avoided where possible and all rubber to solid connections should have a rib to prevent hoses blowing off. High points should also be avoided, or if this is not possible, separate bleeds should be incorporated.

You will need an expansion tank - the way in which these are incorporated into the cooling system depends on your engine choice, however remember that one of the functions of this is to collect any air circulating in the system. Therefore it should be the highest point in the system and the higher the better!

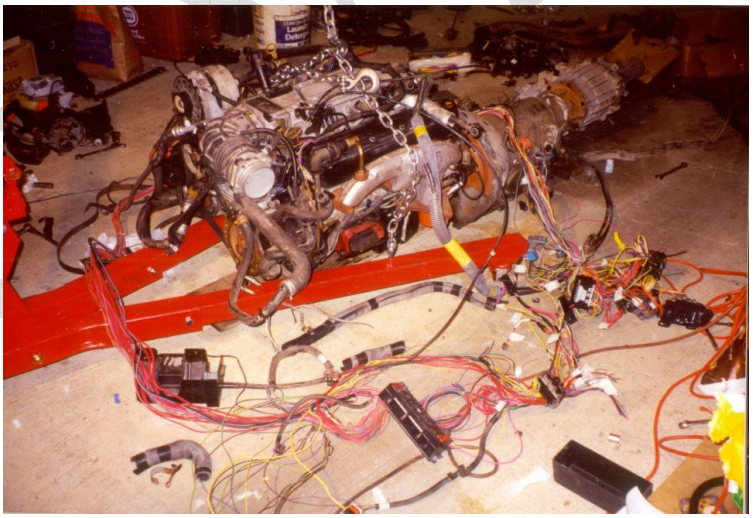
Heating is something you won't be used to in your air-cooled VW and converting to water-cooled means you can easily create an efficient and odourless heater! Again the heating system varies with each application but is always part of the warm up circuit of the cooling system to enable the heating to work as soon as the engine starts warming up.. The heater matrix is like a small radiator except when you blow air through it you duct the warm air into the car to keep you warm! A heater matrix or complete heater units are widely available in many shapes and sizes and are invariably cheap – you do not need to match the make of your engine so you may choose the cheapest, the smallest or the one you like the look of the most. Removing heaters from a donor vehicle can often be a challenge as they are usually buried behind a large plastic dashboard – in this case eBay may be the best way to buy as the hard work will already be done for you.

VW Polo heaters are a popular self-contained and compact unit.

Wiring and electrics

There's not much to say here as the degree to which your donor vehicle is linked to its engine and ECU varies hugely. Some cars simply require a couple of wires to get them running – others require extensive stripping of the loom, bypassing of immobilisers or even running of certain components (such as dash instruments or fly by wire throttles) to function. Depending on your expertise, budget and confidence you may decide to entrust this to an auto electrician, a specialist conversion company who have done this before or if you are interested in power and tuning then you may opt to ignore the factory fitted ECU and use an aftermarket set up.

Whichever option you choose you should always err on the side of caution and aim to remove the entire wiring loom complete with immobiliser, key, ignition barrel as a minimum from any donor and preferably without cutting it. As a general rule the more modern the car the more integrated the electrics are to the ECU and the running of the engine – so what might look like a meaningless sidelight earth now could mean hours wasted later! Again, research is the key and you might find other converters have already done the hard work for you. If you can read a wiring diagram and use a multi-meter and have some time to commit this may well be within your capabilities but be prepared for some fault finding later on!



Wiring can be complicated!

Some people choose to substitute their factory loom and ECU for an aftermarket kit. There are many variations on the theme out there of mixed quality with many different functions and varying potential for changing parameters. Most aftermarket ECUs will start at £500 and go up from there, don't forget to budget up to a day's worth of rolling road time which doesn't come cheap!

The most important to consider with an aftermarket ECU is your requirements and the compatibility with your engine – most of these will be re-programmable enabling you to get more from you engine by adjusting various parameters (in a similar way to setting your timing and mixture on the old air-cooled engine) so if you envisage future power modifications – perhaps higher boost pressures, increased fuelling or even the ability to switch between racing and road engine maps, then this might be the most cost effective solution as you will make your own loom up to suit the application and ECU rather than adapt the factory components.

If electronics are your thing you may wish to consider building your own ECU. Mega-squirt offer kits for numerous vehicles which enable you to put together your own ECU modify it in the future and all for a lot less than a decent off the shelf ECU. Whichever option you choose - if you intend to tune your own engine you should understand the principles of mapping and tuning before you launch down this road or you may end up relying on expensive rolling road sessions to get things working; or at worse you may cause more damage and cost more money than you intended.

Fuel

The major change in fuelling between your old air-cooled and conversion engine is most likely to be fuel injection. This system enables a more exact delivery and control of fuel into the combustion chamber by an ECU-controlled injector. The ECU will be processing information from all of the numerous engine sensors (temperature, crank, throttle position, Lambda etc), processing it and sending an appropriate signal to the injector telling it how long to stay open. Due to the improvement in fuel metering and the increase control over the fuel by 'injecting, it' you will see improvements in efficiency and performance.

Most engines have multipoint injection (a single injector per cylinder) however some smaller capacity cars use single point where the injector is mounted in the throttle body. In all cases fuel injection (diesel or petrol) will require you to run a fuel return – this returns the excess fuel to the fuel tank. The original VW tank does not have one of these fitted – however some of the Brazilian and US models of both beetles and vans came fuel injected – and therefore could provide you with a neat solution to providing a fuel return. If not, it is possible to tap into the tank breathers along with other solutions.

For petrol, you will need a fuel pump. A rotary style pump is probably best as it is much quieter – but pretty much any pump will do the job as long as it can deliver enough fuel. A good trawl on eBay or in the scrap yard will turn up a decent pump at a decent price as new ones can be costly. Another alternative is to try and utilise the pump from your donor vehicle. The advantage will be that it will already be correctly specified for the job. However, some vehicles such as Subaru's have an in-tank pump.

If you manage to transplant one of these into your VW tank you will also solve your fuel return and swirl pot requirements this may involve more work but will ultimately give you a very neat and upgradeable set up.

Subaru pump and tank internals grafted into a Bay fuel tank

In turbo or high performance applications the fuel system often uses a swirl pot. This acts as a small catch tank which ensures that you do not suffer from fuel starvation during hard driving or under hard acceleration as fuel is taken from the swirl pot first to supplement the existing supply. If you do not fit a swirl pot you may find that when your fuel tank is in its lower quarter and your cornering then you may experience mis-firing resulting from momentary fuel starvation. Retro – fitting one is easy - you can either use an external swirl pot from somewhere such as Demon Tweeks or if you are fitting an in-tank pump then you can fashion baffles to create a sump arrangement around your in-tank pump – a much cheaper and neater option.

For a diesel engine fuelling is much more simplistic. Fuel is sucked from the fuel tank by a large engine driven pump. It passes through a filtering system and then into the injection system. Traditionally diesel is injected in a similar way to petrol (i.e. in short bursts to each injector) but more recently Common Rail or High pressure injection systems (also known as HDI, JtD, TDCi etc) have been introduced and these use much more powerful (and expensive) pumps to deliver fuel at a higher pressure up to 30,000 psi! This atomises the fuel when injected allowing more efficient burning and thus saving of fuel. In conversion terms the fuel pump is part of the engine in either arrangement so it will only require a feed of fuel and a return. However some diesel vehicles, fuel pumps are linked with the immobilisation systems on the car (late model VWs for example) and some may also require an additional lift pump to transfer fuel from the fuel tank into the fuel lines.

Exhausts

The principles of exhaust design can be complex if you are looking at maximum performance. However for most converters this may not be the ultimate aim. The best guide you can use is by looking at the standard exhaust from your donor vehicle. Most of the time you will be able to use the donor's manifold, this is the most critical part of the system. This will give you a starting point from which to decide on diameter (never go smaller then original), number of silencers and also may even yield some useful parts. Do not worry that the system will not be as long the original – this is simply a function of the requirement to exhaust to the rear of a front engine vehicle.

As we are not talking performance exhausts here, then your design should really be suited to your application. An exhaust can be made in either stainless or mild steel and painted, ceramic coated or chromed depending on your budget and the purpose it has to serve. Consider that stainless may be more expensive initially but at least you will only have to do it once, not once every few years when the original has corroded! Tortuous routes should be avoided, as it will not only be difficult to make, it will also affect the efficiency of your system and may make working on your vehicle difficult. Avoid heat soak issues by routing the system away from your coolant pipes or other sensitive parts such as brake lines and try to make the system flexibly mounted by the use of a flexi – section and mounting on exhaust rubbers.

Even if performance is not your aim there is certainly scope for improving performance in most cases as fitting a new engine in and old vehicle negates the requirement to comply with the emissions restrictions (in the UK) therefore you can loose the catalytic converter. Do not forget that you will need to retain the Lambda sensor in your exhaust system and again you should try and place this in a position in the system similar to the factory design as they need to be heated up quickly in order to work properly – don't just put it in your tailpipe because its easy!!!!

If you want to start from scratch or use second hand parts – companies such as Jetex, Magnex, Custom Chrome supply a good range of bends and boxes separately that can be welded together to make custom systems.

Costs

Everyone always asks how much – and there isn't an answer. Costs range so much from engine to engine, component to component, vehicle to vehicle and most importantly relative to your own abilities that it is impossible to give anymore than ball park figures – you can always spend more on the newest, best, all singing all dancing parts, or you never know when a generous relative may donate their old Subaru as a donor or you stumble across a gem in the free-ads! Below is a very approximate list of typical main component costs….but, as with everything else – research is everything if you wish to save money or prevent wasting money. I have assumed that a donor car isn't purchased – this saves a lot of money and time chasing parts. Low end costs assume 2nd hand or you've managed to DIY – high end costs = new parts or relying on professionals.

Engine	£100 - 2000
Adaptor	£100-500
Materials: e.g.: steel, cutting discs etc	£100
Gearbox	£0-2000
Wiring	£50-500
Engine Support	£20-150
Fuel system parts	£25-200
Cooling parts	£50 – 500

Summary

You have probably noticed a recurring theme throughout this introduction to engine conversions and that is **RESEARCH**. The importance of doing your research before your conversion cannot be emphasised enough and this VWKD guide should just be the start. You should by now have a fair idea of what is involved with a conversion but this information is only a generic guide– don't let this be the last thing you read before buying that engine on E-bay!!! Go away and read through the postings on VWKD and ask lots of questions, join specialist sites specific to your engine choice and visit other sites and shows so you know what you're getting into. Too many conversions get started and never finished because costs, complications or simple avoidable factors (especially cooling design) have been underestimated.

If you do your research first then you should be able to go from complete novice to competent water-cooler in a short time and with minimal hassle. Although it may seem like it now– you probably are not going to be breaking new ground and somewhere someone has already solved your problem. What is more – it won't all be in vain - you will be rewarded with reliability, efficiency, power, long service periods and proper heating! The benefits of a modern vehicle with the style of an old VW.

We hope you have found this information useful and hope to see you and your project on www.vwkd.com soon.