Head Gasket Replacement 735 6 cyl

Intro

The issue of replacing a head gasket on a straight 6 cylinder model, including 5 series with the similar engines is normally a final straw for condemning these fine cars due to costs of repair.

If you are at all mildly mechanically minded with a basic tool set, calm, not in a rush, methodical, you can do it easily.

Overall cost will vary dependant on the condition of the cylinder head, your decisions to have advisable extra work done or parts replaced during the process.

Rough cost for this repair will be given as a guide but prices, items required will be different car to car and supplier to supplier.

On this car the symptoms were slightly awkward to diagnose unlike oil in water or vice versa.

This article gives information relating to the slightly harder coolant loss scenario but once you know your gaskets gone the repair procedure is the same.

It started when the car's temp would rise to nearly in the red and then fall back to normal and would remain that way until stopped and restarted again.

This was coupled with a loss of coolant about ¼ to ½ a litre a week dependant on how much the car was used.

It was an unsure diagnosis at that point and the advice to follow would be to check all other simple items first before getting a confirmation the gasket has definitely gone back to Germany!

What was actually happening with this engine was exhaust gas was seeping through No 6 fire ring into the cooling system, pressurising the system and creating an air lock which always manifested itself at the bleed whole by the thermostat.

The inlet side of the radiator was hot, outlet side and across the top to about halfway was absolutely cold, no coolant was circulating due to the air lock.

When the air lock was released, the loss of coolant could be measured and the whole issue started over again next time the car was used.

Please ensure you have at least thoroughly checked the cooling system for leaks at the water pump gasket, all hoses, radiator inlet connection, heater valve pipe connections et al before condemning a gasket due to coolant loss or air locks.

One very important hose to check is the very small bore line coming from the top of the radiator along the LHS wing back to the expansion tank.

This is the only way air can be passed back to the header removing a locked system in normal operation (not manually bleeding it) and if often becomes blocked with rubbish over the years including the actual whole inside the expansion tank where it goes into.

A sure fire way to confirm you have this issue, apart from constant air locks, losing coolant, a rock hard top radiator hose, radiator hot on the top one side, cold the other… is to get the coolant checked for exhaust gas with the chemical kits readily available or through your local mechanic, even BMW themselves.

The cost having a complete professional diagnosis will confirm what is wrong is well worth it if you're not sure.

It may show not to be a gasket but some other issue which could be lot cheaper to repair.

Don't always rush to a gasket failure through undetermined coolant loss. Oil in the water and the other way round are obviously a much clearer cut scenario.

There are a lot of other little jobs that can be done whilst the head is off and on this car advantage was taking to do nearly all of them as it was being kept and put back into daily service.

Read through first and check them out, decide whether you want to replace the smaller items along the way, nearly all of them are cheaper items so in general shouldn't be over looked.

Preparation advice would simply be to get everything as clean as possible before starting and keep cleaning along the way.

Normally you would not pressure wash the entire engine bay but on this car it was done. After all it wasn't going anywhere for a while, things would have plenty of time to dry out.

It would be advisable to have a Bentley manual around or a friend's to read through as well as gathering other sites comments, procedures to get a full picture of what's involved before you start, fore warned is fore armed.

For safety firstly disconnect the battery at the negative terminal behind the seat cover panel.

For ease of following, labels anything you take off or use a digital / phone camera so you clear where everything goes.

A lot of the hoses will probably have the original once only type crimp clamps, if you have the tool fine you can replace them with original items, otherwise use normal type jubilee clips.

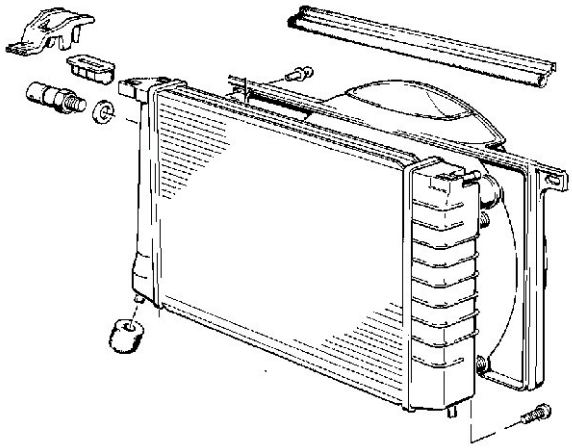
Procedure

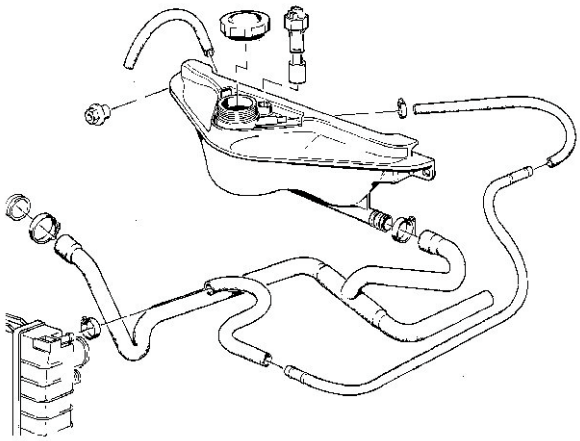
Pre Preparation before removing head

Drain the coolant from the system, if you know it to be good save for re-use otherwise take the opportunity and replace it. Only use BMW coolant it's not that much more expensive and take a look at the photo's of the old head on this car if you would like proof of poor quality / unchanged coolant damage.

Undo the small plug at the bottom left hand corner of the radiator, remove the expansion tank cap, when most of it stops you can take the bottom hose connector off at the right hand bottom corner and the main top inlet hose. Disconnect the thermostat hose. Disconnect the auxiliary fan switch wires. **Remove the viscous fan, radiator and shroud. Undo the cylinder head drain plug** (LHS of block underneath exhaust manifold by cyl 5/6)

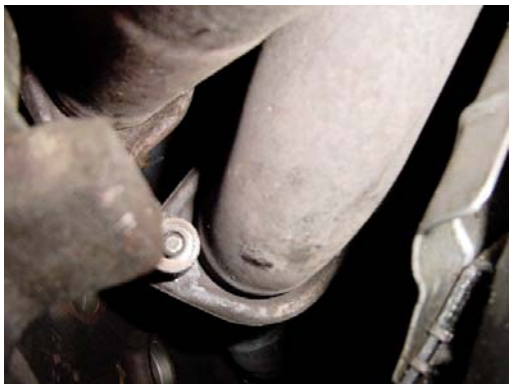
Disconnect the harness connector on the expansion tank, and the hoses, undo the retaining nuts underneath and **remove the expansion tank.**

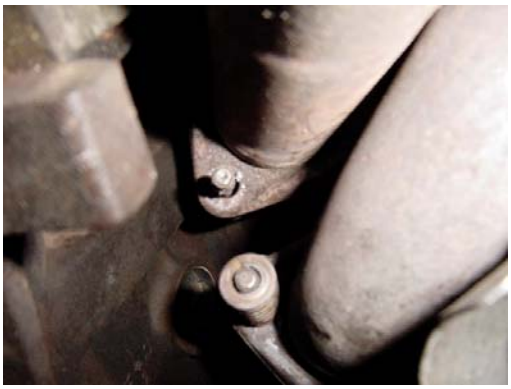


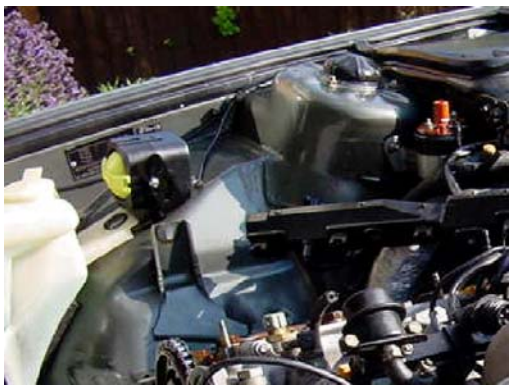


Remove the air cleaner housing by undoing the 10mm retaining nut and disconnecting the pipes either side, pull up out of the way, retain the rubber pieces that may fall out for re-fitment.

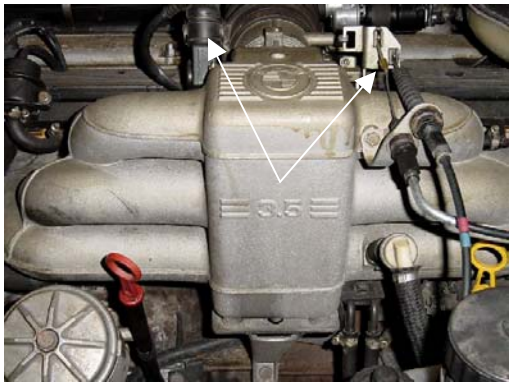
Remove the exhaust down pipe to manifold studs nuts (4) keep the springs, more info is available at “Prop shaft removal” On this car the front exhaust bracket underneath the car was removed allowing the exhaust to be pulled down a little and well clear of the exhaust manifolds on the cylinder head.

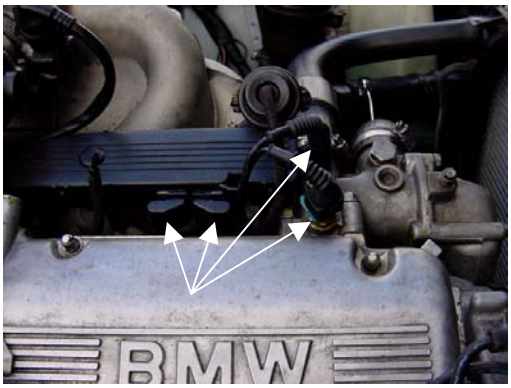


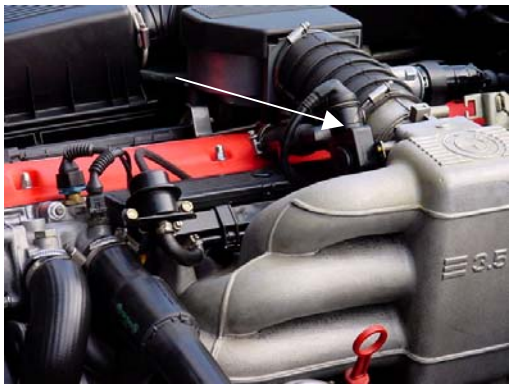




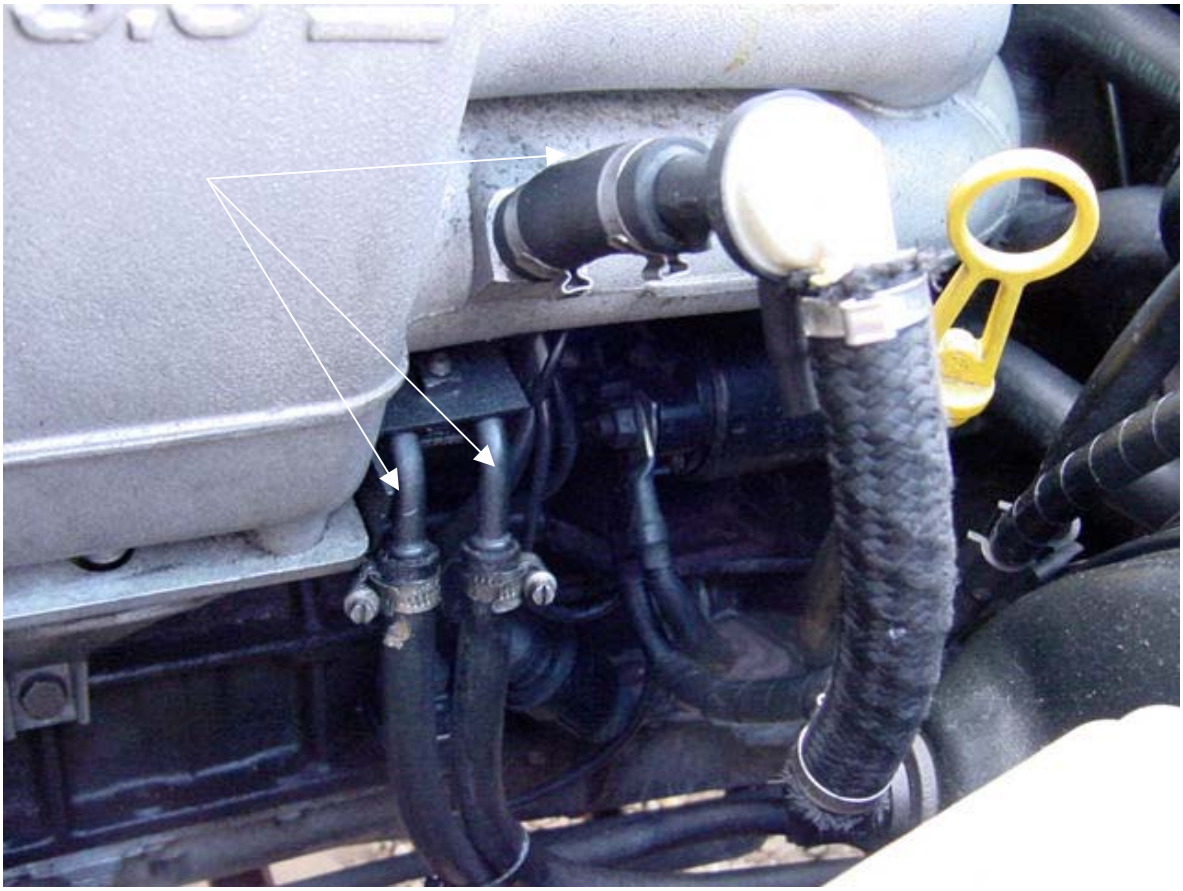
Detach the throttle cable at the butterfly housing and cruise control cable if fitted.
Detach the engine sensors, coolant temp, temp gauge, throttle, crank and cylinder ID







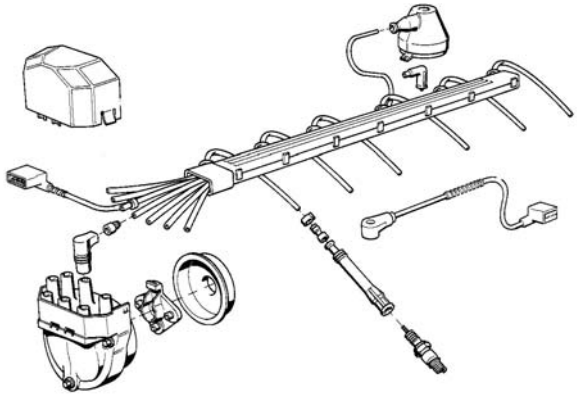
Disconnect the purge valve harness (near dipstick) connector, fuel lines and vac booster line, take care with the fuel lines to label them plus fuel under pressure may still be in the line.

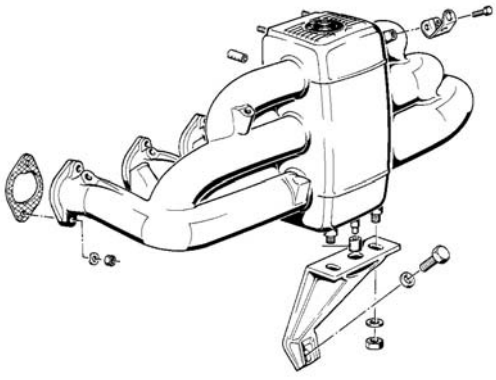


Remove the distributor cap, spark plug wires and rotor arm, the rotor adapter and shield cover. **Remove the support bracket** from underneath the inlet manifold.

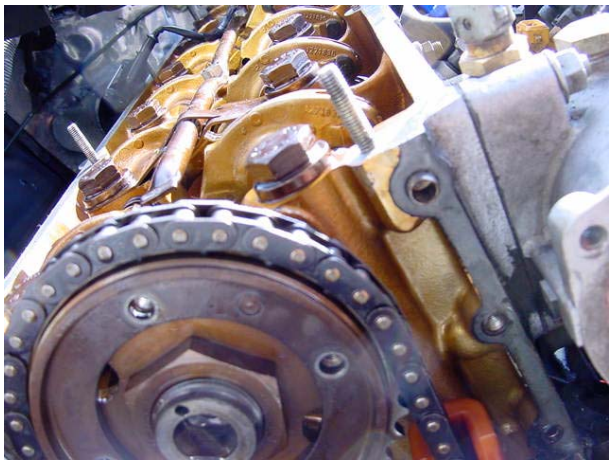
Disconnect the oil pressure switch connector at the left hand rear of the head, remove the main **engine harness from the mounting studs**, **pull off the injector harness connectors** and place the harness to the side.

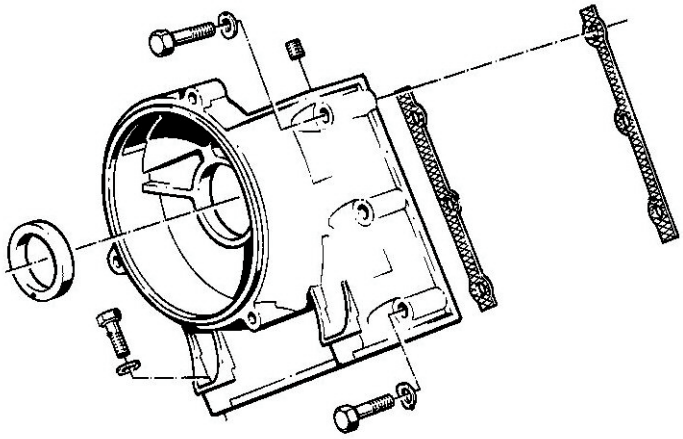
Remove the AFM by pulling the three clips underneath it. **Remove the rocker cover.**





Next remove the upper timing case cover, note that two of the eight bolts are longer by 5mm record where they came out of!



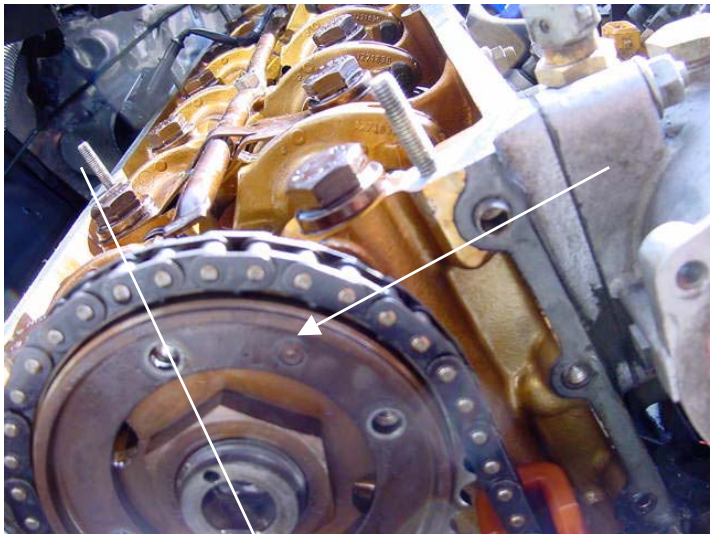


Cylinder Head removal

Set the engine to **Top dead Centre Position**. Rotate it via the crankshaft pulley nut. The markings will be shown as below and also on the front of the camshaft pulley the bolts holding it on will be straight up and down with the locating dowel hole in the bottom left hand corner.

It's important from this point on not to rotate the crankshaft during the repair in order to get the crankshaft /camshaft timing correct on re-fitment. This car's head was replaced with the engine in the Bottom Centre Position, it doesn't really matter as long as basically the timing positions are not moved during the repair.

This engine is in BDC, Top Dead centre would have the dowel hole in the bottom left corner. You can also mark the chain to pulley position in a couple of places to make utterly sure you have it right when going back together.

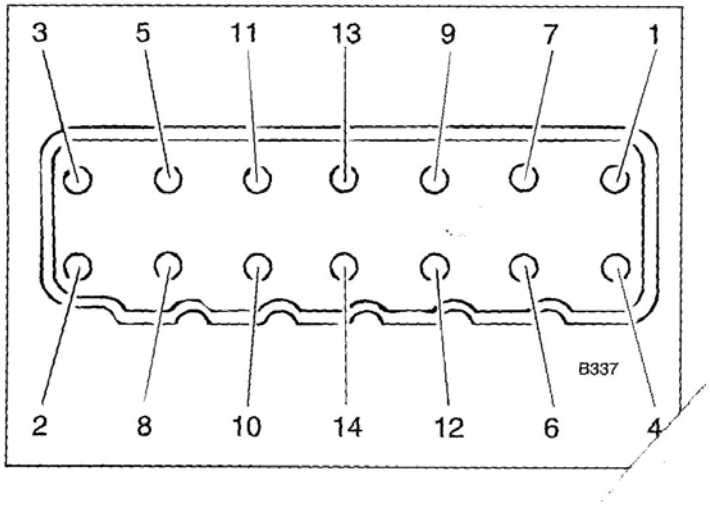


Remove the timing chain tension bolt, it's a long bolt with a tension spring behind it and some oil will come out.

Remove the camshaft pulley bolts and the pulley, tie the chain up out of the way, the top and bottom timing is now disconnected do not move the crankshaft or cam from this point. It is possible to re align everything just more work so if you don't have to disturbed it leave it. This is not possible if you're replacing a camshaft or follower etc…

Take a final look around the head for any wires or pipes still connected, identify any and remove. Here is the removal sequence for the head bolts, loosen evenly.

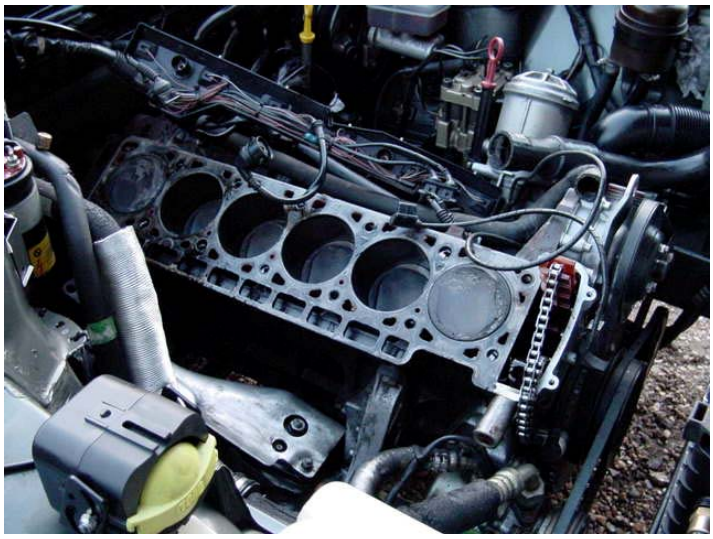
Rear Front

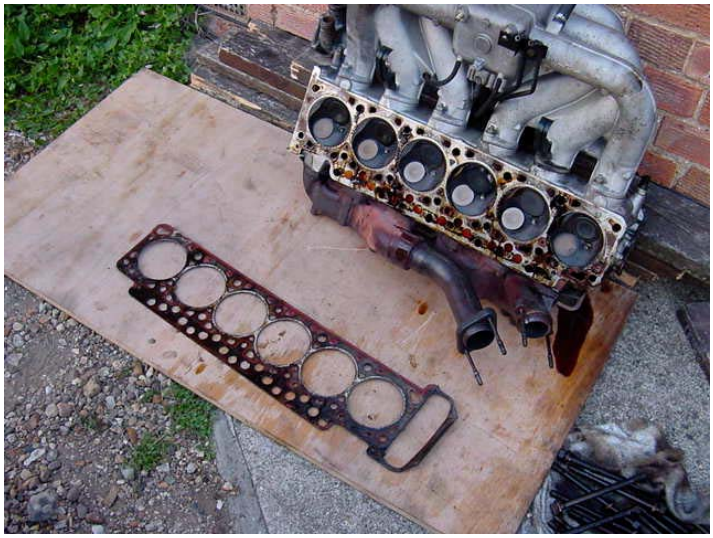


For the physical removal of the head take care as with the exhaust and inlet manifolds still on it's quite heavy, two assistants were used on this car, one to aid lifting, the other underneath the car to aid exhaust manifold clearance and to assist jogging the head up.

You can remove both the exhaust and inlet manifolds before removing the head if required, this way is more work though. If the head is stuck, tap it with a soft mallet or equivalent tool. Protect the wings of the car against any damage while removing.

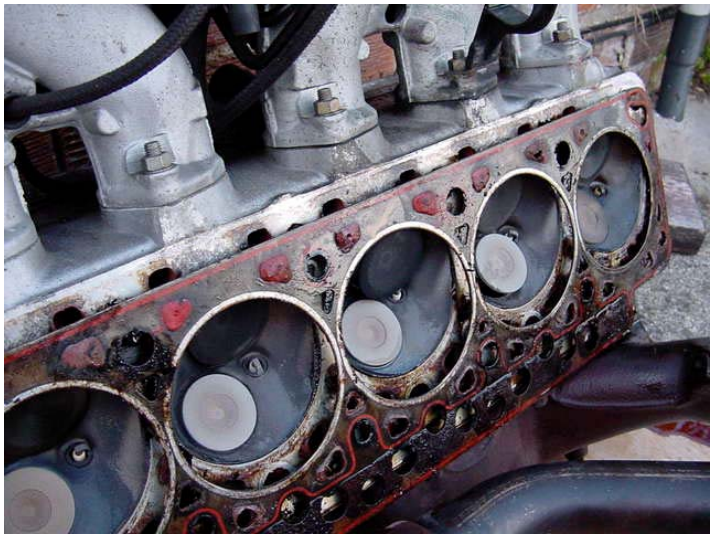
You should now be at the following point.





As you can see this head's waterways were almost blocked by previous "Block Sealer" products in attempts to cure this coolant loss, an advert never to use them and correct the real root problem properly.

What was encouraging for this car is the fact it was obviously burning correctly as seen by the colours and condition of the chambers.



This is the state of the fire ring on No6 cyl. At least the diagnosis for this engine was correct and the real issue was being repaired.

Now the clean up starts, there's no secret just your normal products and fine emery paper, soft scrapers as the aluminium is relatively soft. It's advisable to have the head checked for cracks, straightness, and pressure tests to ensure it's serviceable. That was the plan with this head although events took a turn for the worse when discovering the damage seen below.

The metal around the No6 cyl was literally crumbling away, the thought being poor quality coolant or lack of changes, more likely, with the amount of block sealer floating around.

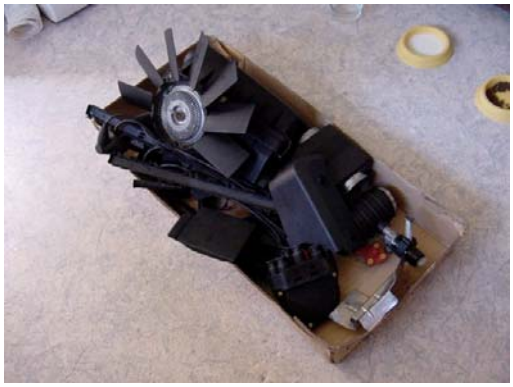
This head was condemned so a replacement was sought. Most factors will offer an exchange unit in various states with or without cam shaft etc…

Other options which are not as off the wall in relation to cost is to source a complete engine replacement although there's extra work involved. If you're not sure seek advice from a local BMW specialist, the many forums for 7 series, sites such as this for people's experiences and recommendations before you proceed.

For this car a decision to replace it with a reconditioned head was taken along with some performance modifications such as a larger angle camshaft and strengthened lifters etc… You can spend as little or as much as you like dependant on what you're doing with your car.

The original bill for the rebuild of this head was around £900 with the modifications. Exchange units vary anything from about £400-£800 depending on supplier / shipping. Skimming of the head and other checking work is not that expensive. One quote received was for about £100 to check this head and skim it if it were to be re-used.

Some of the following items that were replaced are not 100% necessary. On this car they were changed as part of preventative maintenance for the future as well as part of a “major” service. As a minimum you will need a new gasket and head bolts plus oil and a filter for a change after completion.

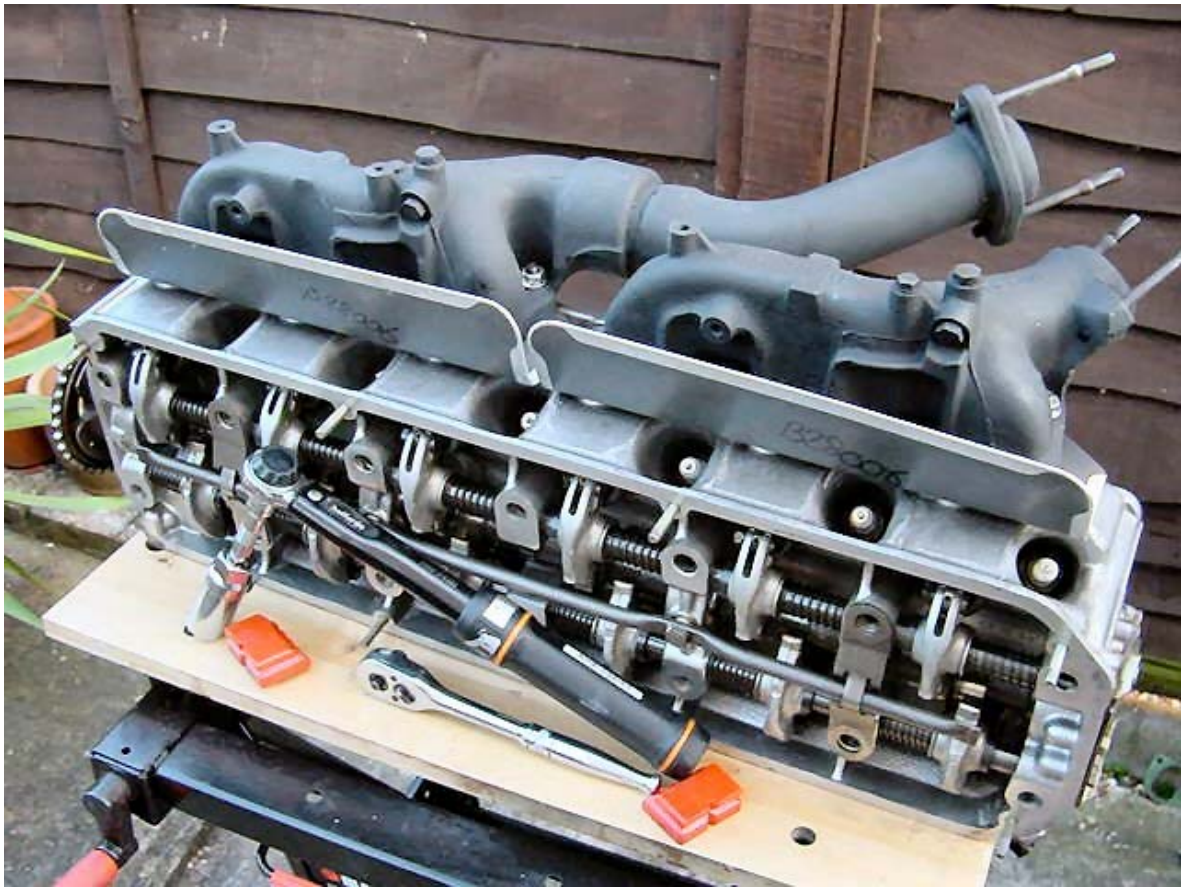


All the other ancillary parts were cleaned before anything else to check if they needed replacing and so not to hinder the rebuild if needed.

If you cylinder head has been machined then a BMW 0.3mm thicker gasket is available and should be used.

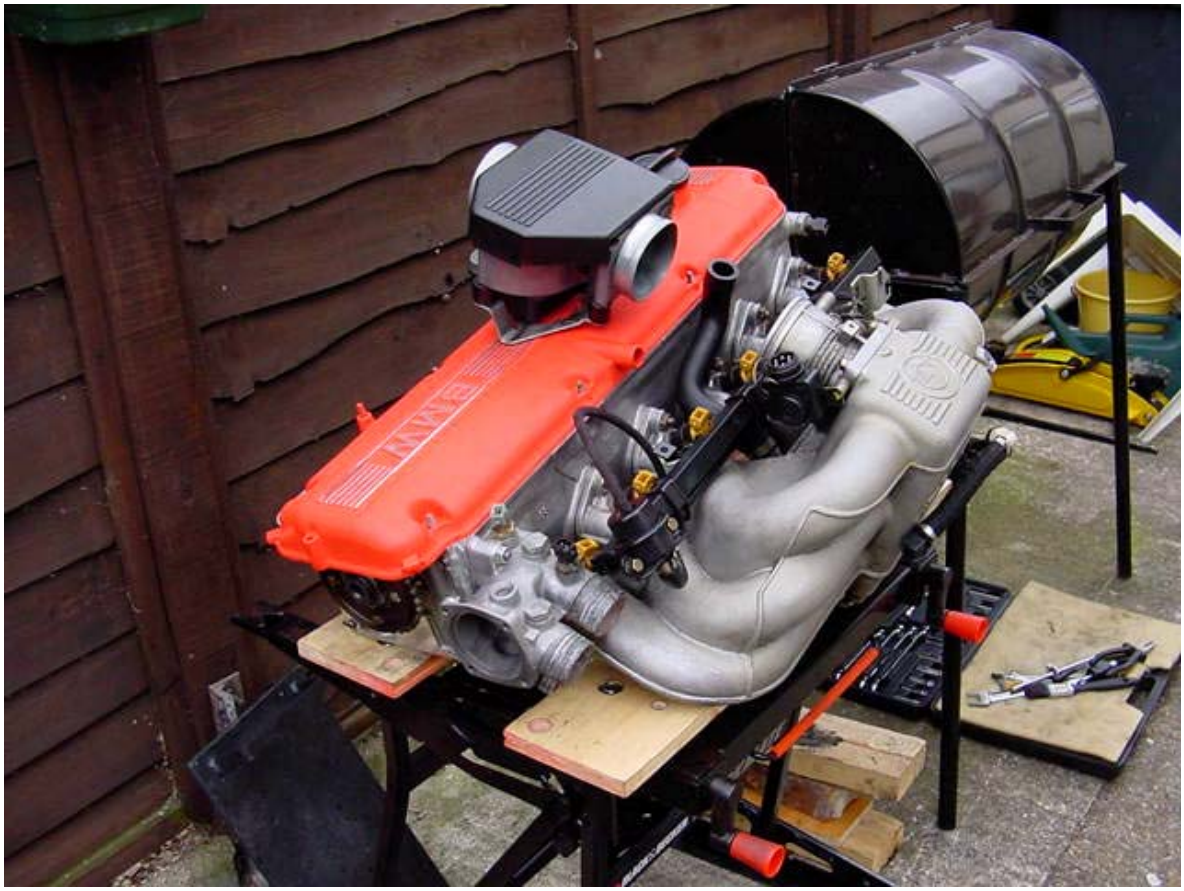
Both sets of studs inlet and exhaust in the head were removed and cleaned then refitted, you can place two nuts onto the stud and use the bottom one to remove them.

The spark plugs were changed for 36,000 mile units. Both exhaust manifold gaskets were replaced, exhaust manifolds cleaned. The injectors sent off for cleaning. All the nuts were replaced to the correct torque and copper grease or clear sealant applied.



The inlet manifold gaskets were replaced along with a clean of the manifold itself. The thermostat housing was removed, gasket replaced and the unit cleaned up.

Ready to refit.



On the block side all debris was cleaned off as best as possible. Very importantly the head bolt holes were cleaned thoroughly. A slot was cut down the thread of one of the old head bolts and was used as a cleaning tap for the threads in the holes. You will be surprised how much rubbish there is.

Carb cleaner and cotton buds plus a final blow out with an air compressor was used. You cannot have the holes with any oil in them as you will get a hydraulic lock effect and potentially crack the block.

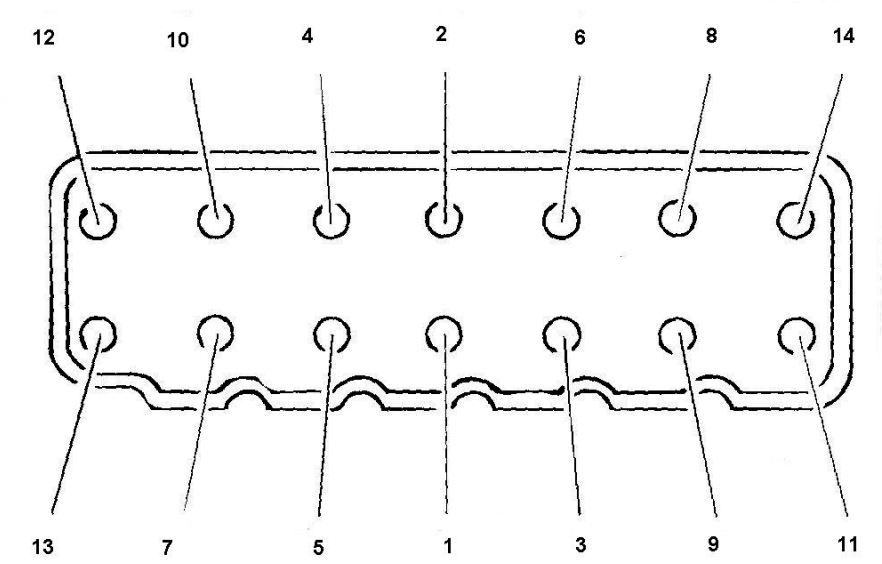
There are two small olive rings to assist locating the new gasket and block, these were replaced with new ones and also the old bolts (cleaned) were used as locating guides.

There is some discussion about replacing the head with the exhaust manifolds on which can be done. As the two assistants had disappeared by this time it couldn't be managed as such.

Lining up the exhaust studs into the down pipe couldn't be achieved so the exhaust manifolds were removed. It's relatively easy to fit them with the head on, only two of the nuts had to be done from underneath the car.

Head placed into position. A few old bolts were used to aid location. Both the olive dowels were replaced. Do not fit the chain as in the picture is should be done after tightening the head bolts down on the following section. The exhaust manifolds were re-fitted while there was still some movement allowed. The new head bolts were lightly lubricated.

Tightening sequence and method



The bolts are tightened in stages as follows

Stage 1 60 +- 2Nm = 42 lb ft +- 1lb ft Wait 20 minutes

Stage 2 Tighten further in sequence to 80 Nm +- 2 Nm = 58 lb ft +- 1ft lb

Stage 3 The engine should now be rebuilt as it should be run for 25 minutes, well up to normal operating temperature, then the rocker cover removed and the final angle tightening sequence of 35 deg completed using the appropriate bought or home made tool.

There are different thoughts about letting the engine cool down before doing this or trying to do it straightaway whilst still hot.

On this car the rebuilt engine was run for 30 mins, left about an hour as it was too hot to touch and work on properly then the rocker taken off and angle tightened.

On first start up the system pressurised again however on the further angle tightening everything settled down without leak or pressure present, probably down to the low 60 lb torque on stage 2 before angle tightening but it works fine overall.

With the head bolts tightened to stage 1 & 2 the timing pulley and chain should be re-fitted. All the chain slack must be on the tensioner side, if you marked the chain to pulley before removal you'll know it's in the right place. Tighten the pulley bolts.

Re-install the tensioner spring just leave it a little loose, pour a little engine oil down the side of the cover, push the tensioner in & out until you feel resistance. Oil should run past the end plug, then tighten it.

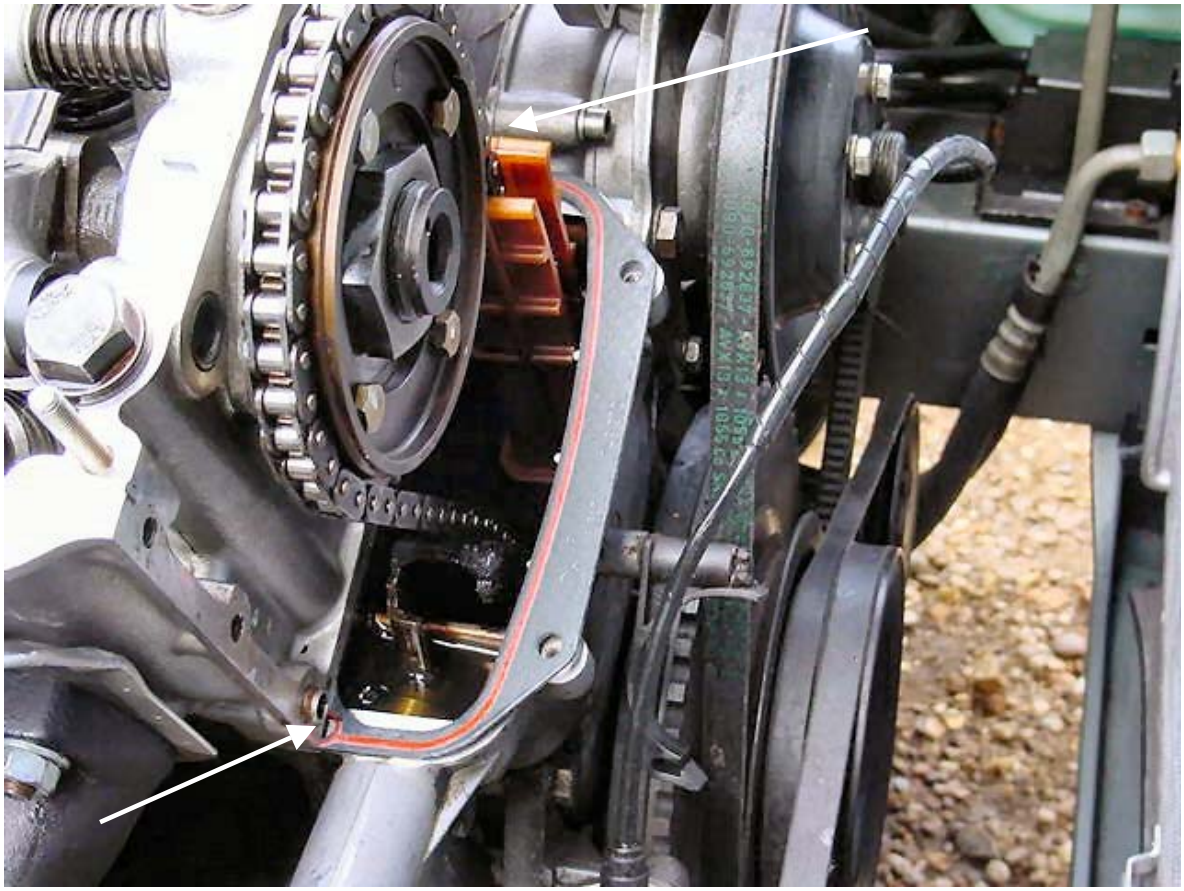
Very important turn the engine over by hand, use the crankshaft pulley bolt, **at least twice** and re-check all the timing marks, camshaft, crankshaft, chain marks, line up again.

Re-install all the other components removed. Adjust the valve clearances (settings in table), re-fill and bleed the cooling system.

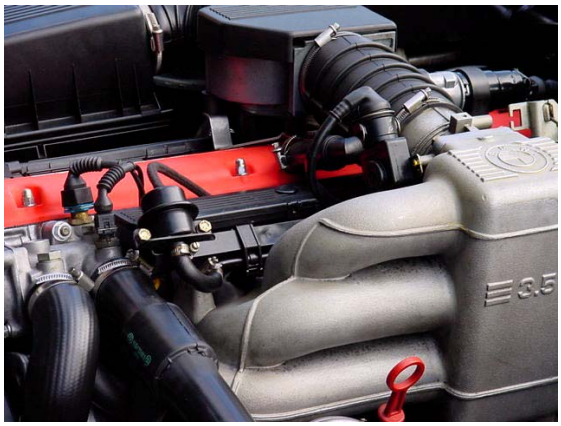
Normal advice is to change the engine oil and filter now although on this car the engine was run for about 100 miles before changing.

On the upper timing case cover make sure you apply a little sealant, Bentley suggests 3-Bond or equivalent on the lower corners where it meet the head gasket (photo) if not you will get an oil leak here.

New style Banjo bolts were also replaced as the old type have a habit of coming loose.



Job done!



This engine to date has now covered a further 48,000 miles without any cooling issues.

Torques

Cylinder head to block
Stage 1 60Nm 43 ft lb
Stage 2 80 Nm 58 ft lb
Stage 3 (after 25 min running 35 deg

Camshaft timing chain tensioner to cover 40 Nm 30 ft lb
Camshaft sprocket to flange 10 Nm 89 in lb
Rocker cover to cylinder head 10 Nm 89 in lb
Exhaust pipe to exhaust manifold Stage 1 tighten to 10 Nm 89 in lb then loosen 1 ½ turns.
Coolant drain plug to block 35 Nm 25 ft lb
Ignition rotor adapter to camshaft thread locking compound should be used 23 Nm 17 ft lb
Cooling fan to pump 40Nm 30 ft lb
Upper timing chain cover to cylinder head 10 Nm 89 in lb