Guidelines for Torquing Cylinder Heads

This subject crops up regularly, and has particular relevance when fitting a new gasket. The following applies principally to the UB engine of the Morris Eight and equally to the USHM engine (Series E), but can also be applied to other pre-war Morris engines, although of course the torque setting may vary. Minors, employing BSF head studs of smaller diameter than the Metric studs of the Eight, use a much lower torque setting.

There's nothing mysterious about torque settings, and you do not necessarily need an engine manufacturer's recommendation to establish the correct value. It's simply a factor of the diameter and pitch of thread, and the tensile strength of the bolt or stud. Your local friendly engineering supplier might be able to provide you with a torque setting chart, if you ask nicely; failing that, there are many such charts available from the internet.

The procedure outlined below has been arrived at via a long road littered with unsatisfactory results. Some may consider it too tiresome or too much trouble, but in my experience the modest additional effort of frequent re-torquing in the early stages is infinitely preferable to potential problems with leaks and gasket failure.

Without putting too fine a point on the matter, Eight engines are poorly designed in that the corners of the cylinder head are not adequately tensioned. Far better from an engineering perspective would have been a design with 17 studs instead of only 13, locating an extra stud at each corner. As it is, we have to make the best of a bad job by resorting to careful assembly and a meticulous re-tensioning regime.

Also bear in mind that the old iron these blocks were cast from is rough, grainy, and unstable compared with the finely alloyed materials used today. Furthermore, take a few moments to ponder how many heating/cooling cycles that old lump of cast iron has endured since it was

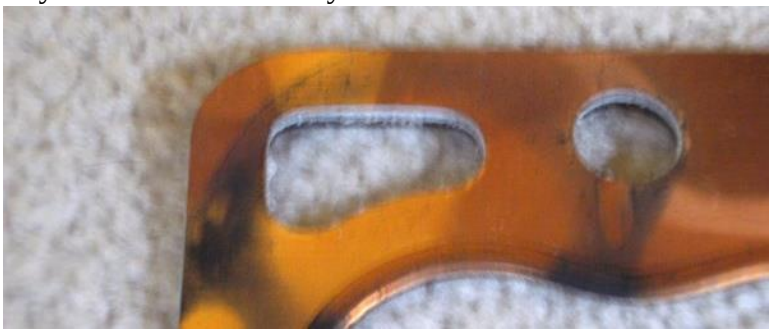
assembled into an engine at Morris Motors, around 80 years ago.

Cylinder Head Gaskets

Let's start with some notes on head gaskets.

Original equipment, Payen gaskets comprised a copper/asbestos/copper sandwich, and the asbestos layer was quite compressible - once correctly tensioned it would end up around 2/3 of its original thickness. In these supposedly more enlightened times asbestos has a nasty reputation, so a substitute material is used, which is less compressible. However, in my experience this has not changed the effectiveness of a well-made gasket, nor the procedure needed to get best service from it.

For some decades now gasket quality has been variable and something of a lottery. The best ones are those on which the copper is swaged over on all holes except the stud holes. Unfortunately there are many gaskets around that have only some of the coolant passage holes swaged, and these are less than ideal because it appears that even with a well-fitted and re-torqued head the coolant is able to leach through the asbestos substitute material to the outside of the gasket, resulting in an ugly stain down the outside of the block. Needless to say this is more likely to occur if anti-freeze is used.



Gasket on which some coolant holes are not swaged

Gasket with all coolant holes swaged

Should a gasket sealer be used?

In my view the answer is 'no'. Sealers on head gaskets are of dubious benefit, and leave a horrible mess to be cleaned up next time. Nonetheless the gasket should be otherwise treated to help it settle and form a seal. The old-fashioned way was to coat the gasket lightly with grease, but a more elegant method is to spray it with high-temperature aluminium paint (VHT, for example). The paint contains fine aluminium particles, which act to seal and cushion nicely. Spray a thick coat on both sides and allow to dry, followed by another thick coat before fitting to the engine. Runs are of no consequence. When next disturbed, any residue is easily washed off with thinners.

Studs

It should go without saying that the studs must be in good condition. Those stretched from repeated tightening or with damaged, dirty or corroded threads should be replaced. As already described, just consider how many heating/cooling cycles they've been subjected to since they were fitted. If in doubt, replace them. Studs

should be secured into the block using Loctite 243 (nut lock, medium strength, blue) which also serves to seal the threads.

The traditional rule of thumb for threads to be torqued is 'clean, lightly oiled', which is open to considerable interpretation, but essentially it means just the merest smear of ordinary engine oil. Never use slippery additive-type oils (e.g. Penrite) or anti-seize agents like Copaslip. In the absence of washers under the nuts, a slight smear of oil on the bearing face of each nut is probably acceptable. If the studs and nuts are new, they can be left dry.

Originally all studs were of the same length, but if buying or making new ones it's a good idea to have four that are 1/4" longer to compensate for the thickness of the dynamo cradle and horn/air silencer bracket.

The torque wrench/spanner debate

There's a school of thought that, because torque wrenches were not common in the motor trade before the war, tightening the head with an ordinary spanner is preferable to using a torque wrench. Personally I believe that argument is deeply flawed, and here's why:

1. Tensioning the head within the confines of the under-bonnet space requires a spanner to be used at a variety of different angles, making it virtually impossible to apply the same tension to all.
2. As the job progresses the mechanic gradually tires, making it even harder to judge the tension being applied. This is especially so if the task is repeated several times, as described below.
3. Once all the ancillaries are mounted on the motor access with a spanner for re-tightening is severely restricted, increasing the errors described in 1 and 2

above. Access with a socket and torque wrench is much easier.

4. Frankly I think it's a mistake to be too literal in applying 1935 logic and methods, which were written with newish motors in mind, to those same motors which are now around 80 years old and have been used and abused and re-engineered far beyond their intended life span. Neither does it make any sense to stick to crude old methods when, thanks to eight decades' accumulated development and experience, far better means are available.

There are some who suggest that the correct tool is a 9" ring spanner, or some other similarly arbitrary device (ring spanners were not common pre-war, either!). A moment's thought will reveal the folly of this. The force a fit 15-stone individual can apply to any given spanner will be considerably greater than that possible for a slightly-built chap with arthritic hands. The torque wrench eliminates the variables and ensures that all head studs bear an equal load. In my view those who've got away without using a torque wrench have been either lucky or exceptionally expert. I'm neither, so it makes sense to follow procedures that eliminate the element of chance.

Initial tensioning of the head

The most satisfactory procedure is to torque the head nuts in the sequence shown above, first to 35, then 40, and finally 45 ft.lb. Fill the cooling system and run the motor at fast idle until fully warm, perhaps 10-15 minutes unless you're in a hot climate. Immediately re-torque the hot engine; you'll be surprised how much further the nuts will go, usually at least 1/4 turn. Common sense tells us that, if an extra 1/4 turn on the nuts at this stage is possible but you *don't* follow this step, you'll be driving with a slack cylinder head. Not a good start in life for your expensive new gasket.

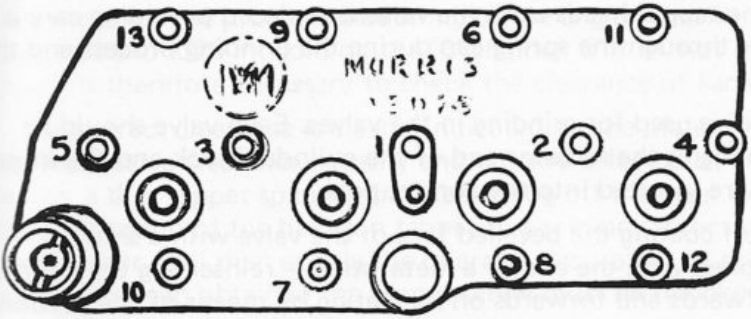
How frequently should the head be rechecked?

Further retightening should be done at short but progressively increasing intervals, starting at about 10 miles, then again at 50, 250, and 500 miles, and again at 800 miles, always with the engine hot. At each of these intervals it's important to back off each nut slightly before tightening, to break its friction—half a flat is sufficient. Once no further movement since the last time is apparent the job can be considered done.

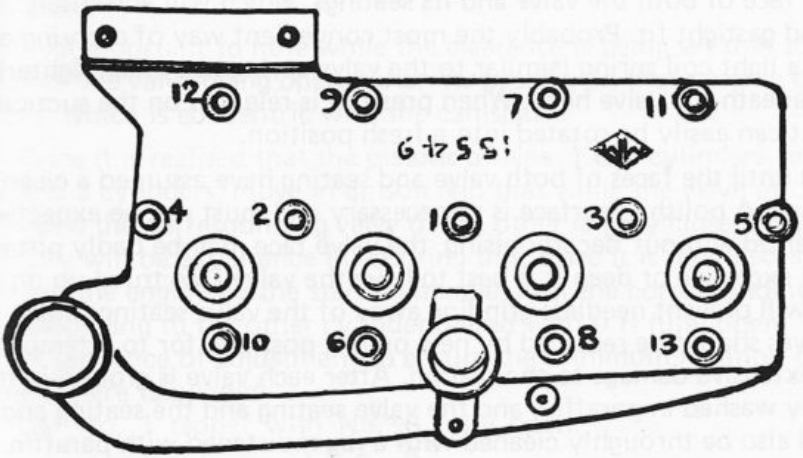
In my experience you can't re-torque too often in the early stages. It may be a chore, but will pay dividends in the long run, long after the bother of it is forgotten.

To access all the head nuts the dynamo base bolts must be slackened, and its adjustment slot machine screw and fan belt removed so that it can be swung outwards; and (on Pre-Series and early Series 1 cars) the horn removed from its bracket. In the early stages the horn can be simply left off, instead strapping it to the oil can bracket, cushioned by a rag, to save repeated removal and refitting. Similarly, on Eights the coil might be removed and temporarily rigged for easier access to no. 4 stud.

MORRIS '8'



MORRIS 'E' & 'Z'



The sequence in which the cylinder head stud nuts should be tightened.