

## Tech Article 1

### Troubleshooting your XK Engine

So I'm sitting at a stoplight and some punk in a jacked up pick-up truck pulls up next to me, leans out his window, and says "Hey, Grandpa, what's that thing got in it?" I look him right in the eye and say "4.2 litre, dual overhead cam HEMI". And I proceed to leave him in my dust! Won't the younger generation ever learn not to mess with me??

"Harvey, wake up." (It's my wife Kelli calling out to me from our dual Barcaloungers). "Your favorite program on the History Channel has been over for an hour and you've been napping. Why don't you go upstairs to bed?"

Damn, woke me up from a most excellent dream! But truth be known, your XK engine is in fact an overhead cam Hemi. All that Hemi means is that your combustion chamber is shaped like a hemisphere and that's exactly what the XK engine has. So be proud and let your powerful cat loose whenever you can. But you say it hasn't been running right lately? Or not running at all! And you're not looking forward to the 4 figure bill it's going to take at the local "Jag-you-are specialist" to get things right. Well, listen up because you can do some troubleshooting yourself and take control of your situation. Or at least you can deal with your chosen mechanic from a position of knowledge.

I took possession of a new E-Type a few months back. Here's what I learned on the way to a better running car. First, a method is required. Certain things need to be checked first or you may just be spinning your wheels, so to speak. The general order is to address air, spark, and then fuel. Let's break this down a little further.

First let's talk about air. Your engine is basically a big 6 cylinder air pump. The intake valves open as the piston is moving downward and draws in a full charge of air and fuel. The intake valves close and the piston moves up and compresses the air/fuel mixture. The amount of compression is expressed as a ratio. For my 4.2 litre XKE engine its 8 to 1. As the piston nears the top of its travel (top dead center or TDC) the spark ignites the compressed charge. The resulting increase in pressure drives the piston downward on its power stroke. As it reaches the bottom of its travel, the exhaust valves open. The next time the piston comes up, the combustion gases are forced out through the exhaust valve and the exhaust system. At that point, everything starts over again. This is the basic 4 stroke cycle. So your first chore is to assess the health of this cycle. For this you need a compression gauge (see tool list, below). Get your engine warmed up. Turn it off and remove all your spark plugs with a 13/16" deep socket. You might want to temporarily number your spark plug leads for later re-assembly. Screw the compression gauge into the 1st plug hole. I like to pull the center spark plug wire from my distributor and lay it against the block so as to absorb the resulting spark. Place the gauge so you can see it from the driver's seat, push the accelerator to the floor, and crank the engine. About 5 seconds should do it but you want to watch your compression gauge until it stops further upward movement. Hop out and write down the pressure number. Repeat for all 6 cylinders. A healthy engine should indicate 140 psi to 170 psi. What's most important is that all the numbers are about the same, say within 10 psi of each other. If you have a major problem, one or more cylinders will show a dramatically lower number. If this is the case, utter your favorite swear words and clutch your wallet because it isn't going to be cheap to get it fixed! You've experienced a major failure such as a blown head gasket, defective valve, or my favorite, a piston with a hole in it. They make nice conversation pieces for your desk or coffee table. Look, it could be worse. I once had a broken Porsche crankshaft on my desk at work as a conversation piece!

If you like, a leak down tester will give you a little more info. These are a little more

difficult to use than a compression tester as they require a source of compressed air and also require that each piston be brought to TDC (top dead center) in order to make the check. I did it and it wasn't overly difficult. Follow the directions that come with the tool. Or ask your mechanic to perform this test. The leak down test can isolate whether the problem is valves, head gasket, or rings/piston.

So let's assume that your compression numbers weren't terribly bad but suspiciously low. Believe it or not but you really need to check your cam shaft timing next! The cams are a big part of proper air delivery. Because if the valves are not opening and closing at the correct times with respect to the movement of the pistons, engine performance will definitely suffer.

Gee, camshafts. Now you're really looking around for something simpler to tackle. Like brain surgery! Come on, it's not that bad. I'll come over and give you a hand. You're actually going to have a week to think about this because you need to order a \$10 cam aligning tool from Terry's or one of the other usuals. It's a little piece of metal that serves as a template to tell you when your cams are set in the proper position. What you can do while you wait is check the TDC timing mark on your crankshaft. For the early XKE engines the stationary timing mark is at the very bottom of the crank shaft. I understand that for later engines it is up on the sides, at the 10:30 or 2:30 position, depending on how you look at it. It's a flat piece of metal that extends out over the crankshaft pulley. On the pulley, you need to identify the timing marks. On mine, 0 degrees and 10 degrees are marked, with 1 degree tick marks in between. You can use a 1 5/16" wrench or socket to turn the engine manually so that the marks become visible. Clean the marks off. A little dab of white paint (Liquid Paper works nicely) on the 0 degree mark will help it show up later.

Now you need to turn the engine until the #1 cylinder is at its TDC position. There is a precise way and a rough way to check this. First, a bit of trivia. Since many of the Jaguar engineers were refugees from the shrinking aircraft industry after WWII, there are many quaint aspects of the aircraft business surrounding these cars. One is that the #1 cylinder, normally at the front of an engine designed by automotive engineers, is at the rear of an engine designed by aircraft engineers. Closest to the bulkhead or some such thing. Whatever, pull the plug on the #1 cylinder, that being the one nearest the passenger compartment. Turn the engine with your wrench while you use your third hand to hold a finger over the spark plug hole. If you are on the compression stroke, you will feel a little whoosh of compressed air under your thumb as the piston comes up. Once you are on the compression stroke, look down into the spark plug hole with a light and stop when the top of the piston comes into view. The precise method is to get a dial gauge with magnetic base (see tool list) and use it down the hole to determine when the piston is as high as it will go. This will take several try's back and forth turning the crank to get it at its penultimate point. An alternate tool is available that screws into the spark plug hole. It's also listed in the tool list. The crude method is to put a rod of some sort down the hole and just use your calibrated eyeball to determine when the piston is at its highest point. Either way, stop when you think you have the piston at its highest point. Hop down under the car and check the zero degree mark on your crankshaft against the stationary pointer. In some cases, you may have to adjust the stationary pointer a little bit to get it lined up correctly. Regardless, you will see that the zero mark should line up with the flat side of the pointer, not the rounded side. Now you'll know what to look for when you are checking timing. And if you find that the pointer is substantially out of position, you may have just discovered why the ignition timing may be out of spec!

If you haven't figured out by now, only men shaped like Gumby can get under an E-Type unless it is raised up somewhat. I made ramps out of 2x6 lumber to drive the car up onto. Two thicknesses of wood (3") makes a big difference. Another advantage is that the hood can open fully without striking the bumper on the floor.

Gee, is that Jerry I see over there gesturing that I've used up my allotted space for this month! I've got to stop for now. Next time we'll check those cams.

Disclaimer - Automotive work can be dangerous if proper safety procedures are not followed. In homage to our litigious society, I must state that I cannot be held responsible for any real or perceived mis-information that may be contained in this article. A good shop manual is mandatory before you attempt any work. Read the safety section of your manual. If you have any questions, contact me at [hdferris@earthlink.net](mailto:hdferris@earthlink.net) so we can hopefully get questions worked out before a problem is created.

#### Specialty Tool List

Compression Gauge- get the kind with the hose.  
See Summit Racing Equipment P/N SUM-900009  
Leak down tester- Summit P/N SUM-900010  
Cam aligning tool- Terry's Jaguar Parts P/N C3993  
Dial Gauge with magnetic base- Summit P/N SUM-900016-1  
Top dead center tool- Summit P/N CCA-4795  
First aid kit- priceless!



Tech Article 2

#### Troubleshooting your XK Engine - Checking Cam Timing

I'm anxiously awaiting the final decision of the judges at Pebble Beach. After all the work I've put into the restoration of my E-Type, could this be the penultimate moment? "And the winner of this year's Pebble Beach Concours D'Elegance is Harvey Ferris and his magnificent Jaguar E-Type ..." "Harvey, wake up."

(It's my wife Kelli calling out to me as I nap in my hammock) "It's time to come in and shower before dinner." Damn, woke me up from a most excellent dream!

Now's a good time to continue with our troubleshooting guide for the XK engine. My specific example is the 4.2 litre 6 cylinder engine in my 1967 E-Type. But the concept I am going to discuss this month,

Cam Timing, can be applied to other engines too.

Last time, we checked the compression in the cylinders, in order to establish if major problems were in evidence.

Hopefully, you didn't come up with any serious issues.

Last time we also discussed identification of the timing marks on your crankshaft pulley and the static timing guide on the front of the engine.

We also discussed the procedure for placing your #1 cylinder at top dead center.

It turns out that to check the cam timing, the #6 cylinder must be placed at top dead center.

The procedure is the same, except you will be working on the cylinder closest to the front of the engine (#6) instead of the one at the rear (#1).

Here is the procedure required to determine if your cams are set to open and close the valves at the correct time. First you will need to remove the two cam covers.

This will require a 1/2" socket to loosen the dome head nuts around the perimeter of the covers.

Depending on various factors, the covers may be stuck the first time you try to take them off.

You can use a rubber mallet or a hammer tapping against an intermediate block of wood to help break the seal, tapping laterally around the sides of the covers.

Once the covers are off, the intake and the exhaust camshafts will be visible.

You can now see that each cam has 6 eccentric lobes spaced along the length of the cam.

Each cam lobe rotates against a circular "bucket".

Although you can't see it, under each bucket is the end of a valve stem.

As the cam lobe rotates, it alternately pushes the bucket down (in the E-Type the maximum movement down is 3/8") and then releases it back up to its relaxed position as the lobe passes.

Each time this happens, the valve underneath is opened and closed.

Each lobe has a different orientation such the valves are opened in a precise sequential fashion, over and over again.

You will need a 1 5/16" socket or wrench, placed on the nut at the end of the crankshaft pulley, to rotate the engine.

Make sure the tranny is in neutral. For extra safety, you might want to disconnect the ground wire at the battery or the 12V lead at the ignition coil.

Go ahead and practice rotating the engine by hand. You are going to get good at it real soon!

Go ahead and use the instructions from our last article to rotate the engine until the timing marks are lined up at 0 degrees on the crankshaft pulley, corresponding to top dead center.

Furthermore, establish that you are at TDC for cylinder #6.

You can do this several ways.

The workshop manual simply suggests that you pull the distributor cap off and make sure the rotor is pointing roughly towards the position of the #6 spark plug wire.

All you are trying to establish here is that you are at TDC for #6, not #1.

If you are in the correct position, you will see a "notch" on the end of the camshaft adjacent to the timing chain drive gear.

As you approach TDC, the notch will be roughly at a right angle (90E) to the gasket surface of the camshaft cover.

If you are on #1 cylinder, the notch will not be visible at all, as it will be on the bottom side out of sight.

There are notches on both in the intake and the exhaust cams. Both will have a similar alignment.

Assuming that you ordered your cam alignment tool as suggested in our last article, you are ready to go.

The alignment tool is pretty much self explanatory when you have it in your hand.

Starting on the intake (carburetor) side camshaft, use your 1 5/16" socket to carefully rotate the engine forward until the tool just aligns with the notch on the cam.

If you overshoot, rotate the engine backwards 2 or 3 pulls and the approach again in a forward direction so the slack in the timing chain is positioned correctly.  
Looking at the front of the XK engine, normal forward rotation is clockwise.

Now go back and look at your timing marks on the crankshaft.  
With perfect camshaft alignment, the 0E mark on the crankshaft pulley will exactly line up with the static pointer.  
Perfect is a lofty goal sometimes and yours may be 2 or 3 degrees to one side or the other. When I baselined my engine, I found the intake to be at 10E and the exhaust at 15E! Not acceptable!

Check the intake cam timing several times if you wish, to be sure you have the process down correctly.  
Write down the numbers you are seeing.  
By the way, the numbers etched on the crankshaft pulley go from zero in 1E increments up to 10E.  
These numbers represent degrees before top dead center.  
It's possible you will fall on the other side of zero, in which case you will have to estimate your value, which should be reported as degrees after top dead center.  
The above process should be repeated the same way for the exhaust side camshaft.

When you are done, you hopefully will be close to zero, plus or minus a few degrees.  
A little bit of deviation should not result in marked degradation of engine performance.  
I would think that values greater than 5E would be grounds for resetting the cam timing.  
Unfortunately, this is a job that is best left to your mechanic or, if you feel up to it, the Bentley manual describes the procedure in great detail.  
I was able to do it on my engine but there was definitely a learning curve.  
If there was an interest in the club, this activity would warrant a hands-on technical session, lubricated with frosty beverages!

So there you have the cam timing check in a nutshell. Next time we will talk about checking the valve clearances between the cam lobes and the cam.

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A good shop manual is mandatory before you attempt any work.  
Read the safety section of your manual.  
If you have any questions, contact me at [hdferris@earthlink.net](mailto:hdferris@earthlink.net) so we can hopefully get questions worked out before a problem is created.  
Previous Technical Articles will be posted at my website [www.newhillgarage.com](http://www.newhillgarage.com)

#### Specialty Tool List

Cam aligning tool- Terry's Jaguar Parts P/N C3993  
1 5/16" socket with ratchet or 1 5/16" wrench (I bought a complete 3/4" drive socket set at Agri-Supply at an amazing price. Also check out Harbor Freight.)  
Note that a fire extinguisher is not required for this job but is always good to have around!