Worn camshaft

wisdom & woe from the workshop

This month we will be looking at camshafts and how to select the correct camshaft for your application. Most TVR applications utilise relatively high performance camshafts, so the longevity of these components is often compromised. This means that most TVR engines will require camshaft replacement at some point in their lifetime...

Many TVR engines (e.g. Rover V8 and Cologne or Essex V6) have a single camshaft located in the centre of the engine block, with both intake and exhaust lobes on the same camshaft. This type of set-up translates the motion of the cam lobes to the intake and exhaust valves via followers, pushrods and rocker arms. Other TVR engines (e.g. Speed Six) have two separate camshafts located in the top of the cylinder head, with the intake lobes on one camshaft and the exhaust lobes on the other camshaft. This type of set-up translates the motion of the cam lobes to the intake and exhaust valves via solid finger followers.

When selecting a non-standard camshaft for your application you first need to ensure that you have the ability to modify the fuel quantity and ignition timing, particularly at full load and preferably throughout the entire load/rpm range. If the camshaft is not significantly different from the original specification, then a slight adjustment of the fuel pressure and ignition advance at peak torque may be sufficient. If the camshaft is significantly different from the original then you may require some significant work in terms of fuel and ignition adjustments, to ensure that you get the most out of your chosen camshaft (e.g. aftermarket engine management, larger fuel injectors, modified advance curves, etc).

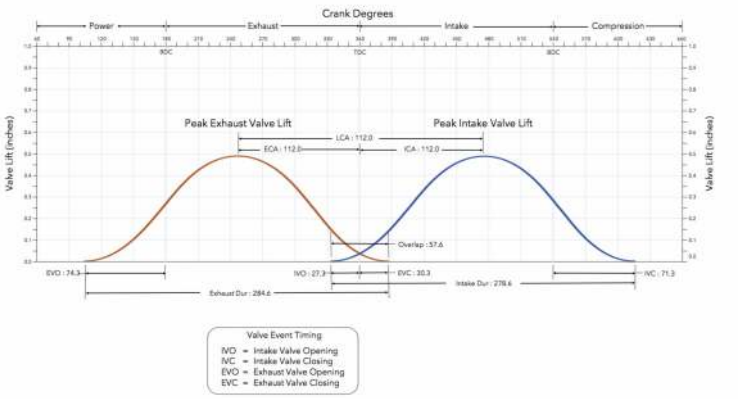
In many cases we often rely on the opinion of fellow TVR owners when it comes to camshaft selection. The downside of this approach is that your fellow TVR owner will most likely have been replacing a worn out camshaft, so practically any camshaft will have given a significant improvement! This does not mean that their chosen camshaft was the best choice for their application.

There are two main parameters to look at when selecting a different camshaft for your application - valve lift and valve event timing.

Rover V8

Speed Six

Cologne V6

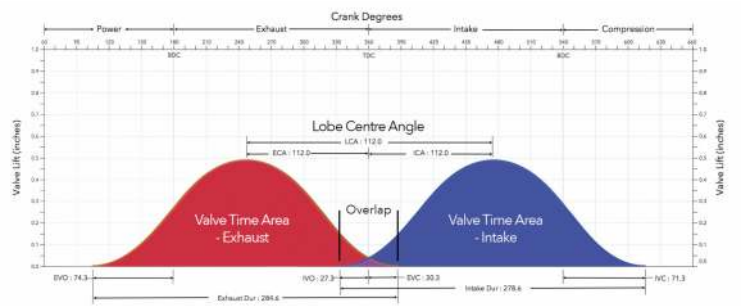


Valve lift is the amount that the intake or exhaust valve is opened off the valve seat - on a pushrod engine (e.g. Rover V8 or Ford V6) this corresponds to the camshaft lobe lift multiplied by the rocker ratio. For example - a Rover V8 fitted with a Kent TVR51 camshaft and standard 1.6:1 ratio rocker arms will have 6.75mm of lift at the camshaft lobe, which equates to 10.8mm of lift at the valve (6.75 x 1.6 = 10.8).

The maximum amount of valve lift that can be used with a particular engine depends on the existing engine specification. More valve lift means less piston to valve clearance and less valve spring retainer to valve guide clearance, so these clearances need to be carefully checked when fitting a camshaft that has more lift than usual. Increased valve lift also compromises the rocker arm (or finger follower) geometry and increases the load on the valve-train. Valve-train components such as the valve-springs, retainers and rocker arms may need to be upgraded to reliably cope with the increased valve lift, particularly if the rpm limit is also going to be raised as a result.

Roller rockers and/or double valve springs -

Valve lift is always a compromise - more valve lift will generally provide more power and torque but will also adversely affect camshaft and valve-train longevity and reliability. The increased performance is not only from the increased valve time area window, but also from the increase in effective overlap. This increase in effective overlap will produce more top end horse-power but at the detriment of idle quality and low rpm manners. This is because at lower engine speeds this increase in effective overlap essentially behaves like an air leak between the intake and exhaust valves on each cylinder. This reduces the intake manifold vacuum and low rpm performance, giving a less stable idle.



Valve event timing is specifically when the intake and exhaust valves are opened and closed, measured in terms of 2 revolutions of crankshaft rotation (720). The timing of these valve events is critical.

When comparing different camshafts we tend to try and simplify the valve event timing by looking at it in terms of intake and exhaust duration, but two camshafts can have similar duration values whilst having quite different characteristics. This is because trying to compare the valve event timing solely in terms of duration is far too simplistic. Lobe centre angle (LCA) is another way of comparing different camshafts, this is the angle between the centrelines of the intake and exhaust camshaft lobes on the same cylinder. On an engine fitted with two independent intake and exhaust camshafts (e.g. Speed Six engine), this angle can be changed when setting up the camshaft timing relative to the crankshaft. On a single camshaft V6 or V8 this angle is incorporated into the original camshaft design. Some camshaft designers will widen the LCA in an attempt to broaden the power band on a particular camshaft design, but other very well respected engine builders (e.g. David Vizard) argue that there is a specific LCA that is optimum for a given engine specification.

Overlap is another way of simplifying the valve event timing numbers to allow us to compare different camshafts. This is slightly easier as the amount of overlap does give us a good idea of idle quality versus peak performance. In reality, even using overlap is still slightly simplistic, although it is the most straightforward way of comparing the valve event timing of different camshafts if you do not have access to engine simulation software, a cylinder head flow-bench and a dyno.

Overlap	Idle Ignition Timing	Idle Speed
15 - 40°	6 - 8° BTDC	600 - 750 rpm
40 - 55°	8 - 12° BTDC	750 - 900 rpm
55 - 75°	12 - 16° BTDC	900 - 1050 rpm
75 - 100°	16 - 20° BTDC	1050 - 1300 rpm

This table is purely to illustrate the effect of overlap on the engine's idle behaviour and requirements. It is worth noting here that this table above is a generalisation based on relatively standard specifications - without aftermarket cylinder heads with much larger valves, very large bores or particularly high compression ratios.

So far the information in this article tells you what a good engine builder looks for when selecting a camshaft for a particular application, as well as the effect of the main camshaft parameters. It is useful to have this level of understanding but in most cases you might just wish for a basic camshaft recommendation for a particular application. Here we will now focus solely on the Rover V8 - partly because this is probably the most common engine fitted to TVRs, but also because we happen to specialise in the Rover V8 engine.

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We have fitted different camshafts to Speed Six engines (including custom camshafts), Ford V6 engines (Cologne & Essex) and other engines in TVRs (including Chevy V8 engines) but we now need to try and simplify a fairly complex subject into a basic recommendation for a particular application. Even with this one engine we have to make it clear that we do not have a 'one size fits all' recommendation. Engine components such as the cylinder heads, intake manifolds and exhaust manifolds have such a considerable effect on the behaviour of an engine that it would not be correct to recommend a particular camshaft for a range of Rover V8 engines with different specifications.

Below are a few examples of particular camshafts that work well with Rover V8 engines of a particular specification. Note that some camshaft suppliers may also be able to supply very good camshafts, but we have not included them here because they do not provide important details such as lift and valve event timing, which does not allow us to make an accurate assessment of their camshafts for a particular application. We have a lot of experience of the Kent range of camshafts, so they do feature predominantly here:

Piper 270i

- for relatively standard 'fast road' 3.5-litre Rover V8s. Stable idle, good driveability but with limited top end horsepower. This camshaft has an intake and exhaust valve lift of 10.67mm with an LCA (lobe centre angle) of 108° and 56° of overlap.

Kent TVR51

- original specification camshaft for many 4-litre Rover V8s fitted in TVRs. Despite being slated for various design decisions throughout the years TVR did design some very good camshafts for the Rover V8 engine. The Kent TVR51 camshaft is a superb all-rounder for a standard TVR-spec 4-litre Rover V8, as fitted to the Chimaera 400. This camshaft gives a stable 900-1000rpm idle with a broad spread of power. This camshaft has an intake and exhaust valve lift of 10.8mm with an LCA of 112° and 51° of overlap.

Kent H218

- good 'muscle' camshaft for a 4-litre Rover V8. The idle is less stable than with the TVR51. It has very good mid-range torque but with limited top end horsepower. This camshaft has an intake and exhaust valve lift of 11.4mm and 11.8mm respectively. With an LCA of 112° and 57° of overlap.

Kent H214

- excellent camshaft for a TVR-spec 4.6-litre Rover V8 as fitted to a Chimaera 450. This camshaft gives a stable 900-1000rpm idle with a broad spread of power. This camshaft has an intake and exhaust valve lift of 11.9mm and 12.44mm respectively. With an LCA of 110° and 71° of overlap.

Kent TVR885

- original specification camshaft for many 5-litre Rover V8s fitted in TVRs. This camshaft gives a relatively stable 1000rpm idle with a fairly broad spread of power. This camshaft has an intake and exhaust valve lift of 11.6mm and 12.3mm respectively. With a wide LCA of 116° and 60° of overlap.

Again we need to reiterate that these recommendations are for particular engine specifications. Modifications to cylinder heads, compression ratio, intake system and exhaust system will all have a significant effect on an engine's optimum camshaft requirements.

We hope that you found this article interesting and useful. If you have any particular questions that you would like us to answer, or technical articles you would like us to write, then either write to Sprint magazine or contact us at enquiries@lloydspecialistdevelopments.co.uk

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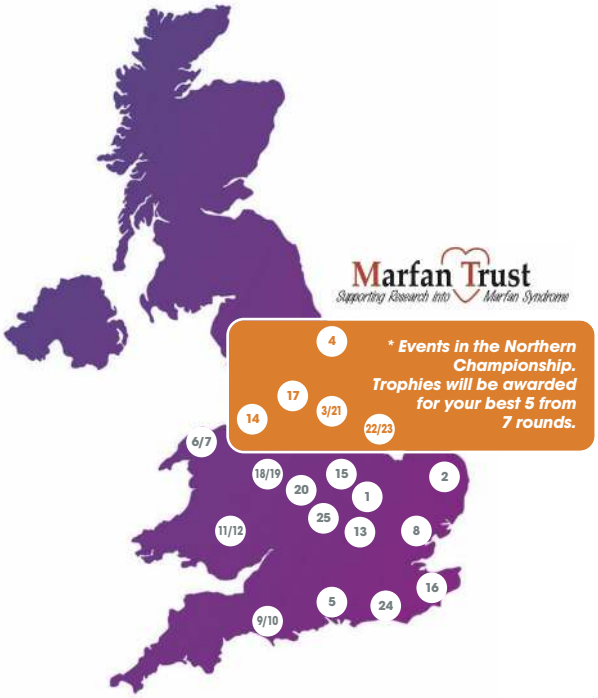
tvrcc speed championship 2017



1	Rockingham	Sunday	26-Mar
2	Hethel	Sunday	02-Apr
3	Harewood*	Sunday	09-Apr
4	Croft*	Monday	17-Apr
5	Gurston	Saturday	22-Apr
6	Ty Croes	Saturday	29-Apr
7	Ty Croes	Saturday	30-Apr
8	Debden	Sunday	07-May
9	Wiscombe	Saturday	13-May
10	Wiscombe	Saturday	14-May
11	Epynt	Saturday	10-Jun
12	Epynt	Sunday	11-Jun
13	Stowe	Sunday	18-Jun
14	Aintree*	Saturday	24-Jun
15	Curborough	Sunday	02-Jul
16	Lydden	Saturday	15-Jul
17	3 Sisters*	Sunday	30-Jul
18	Loton Park	Saturday	05-Aug
19	Loton Park	Sunday	06-Aug
20	ShelsleyWalsh	Saturday	12-Aug
21	Harewood*	Sunday	27-Aug
22	Blyton*	Saturday	02-Sep
23	Blyton*	Saturday	03-Sep
24	Goodwood	Saturday	23-Sep
25	Prescott	Saturday	30-Sep