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2 LITRE SPORTS SEDANS

Setting up camshafts – Lee & Bob Uhlhorn

The aim of the process is to ensure the camshaft(s) achieve the correct valve opening and closing points for your engine.

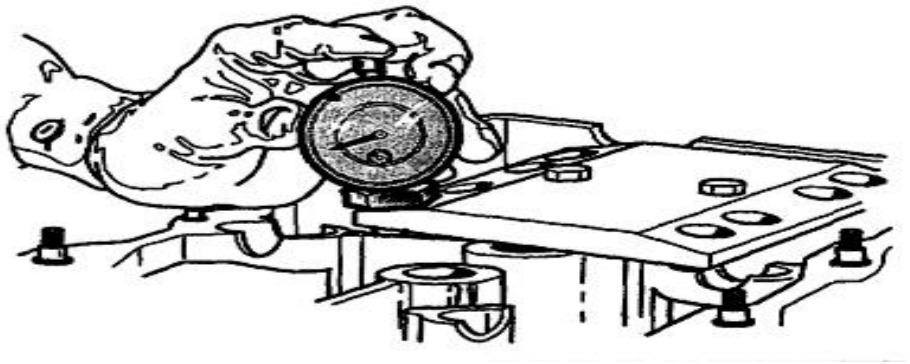
All camshafts are made via a "master" and either ground (some are CNC machined) and thus are carefully made. Several factors can cause the camshaft to crankshaft phasing to be different to what the manufacturer intended; for example:

1. Incorrect alignment "marks" on Cam or crank gears;
2. Keyways not machined correctly;
3. On SOHC & DOHC engines, milling the head or the block will retard the cam(s).
4. On rocker arm style valve-trains, valve tip length (and hence valve seat cutting depth, and length of valve) , rocker geometry, camshaft base circle size, these ALL effect timing
5. Lobe Separation – on DOHC type engines – you can vary this to drastically change engine response.
6. Changing valve timing events (IVO-IVC, EVO – EVC) to change the torque response.

Hence we need to measure when the valves open/close relative to crankshaft position!

There are several preliminary measurements and clearance checks that have to be done:

1. Valve to valve clearance;
2. Valve to piston (radially and vertically);
3. Retainer to stem seal;
4. Valve to bore clearance
5. Cam to head casting;
6. Spring seat to retainer
7. With the forked rocker on an SR, the valve clearance needs to be checked on both sides of the rocker pad



This is a factory Nissan tool to measure valve tip height!

The “starting point” is to install your cam on factory marks using the engine manufacturer's procedure. With the SR20 – there are several checks that should be done to ensure reliability:

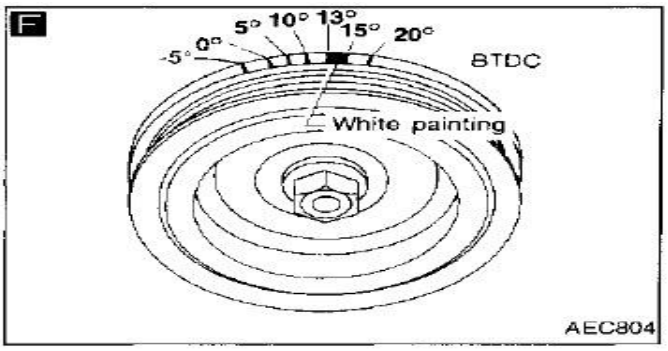
1. With the forked rocker on an SR, the valve clearance needs to be checked on both sides of the rocker pad.
2. Checking the cam wipe on the rocker pad (this can be an issue with the SR & the L series) – bearing blue and check the wipe pattern.
3. With a big cam you sometimes have to make a compromise & have the closing ramp wipe off the end of the pad.
4. The rocker to valve tip contact need to be checked.
5. Valve springs – you need to know how much seat pressure, and how much spring pressure “over the nose” so that cam motion can be controlled by the spring.
6. With a rocker arm – the relative height of the pivot to the valve tip, determines the net valve lift, and also the valve lift curve (shape / acceleration). See Vizard “Pinto SOHC” and Racer Walsh L Series articles.
7. The radius on the rocker can be used to greatly change the lift curve!
8. “Rocker stoppers” can be used to prevent the pivot from dislocating from the lash adjuster – really only required for very high rpm use.
9. Adjustable cam pullies will make your life easier – in getting the timing chain to “fit” properly, and not have slack between the gears …

EQUIPMENT REQUIRED to properly degree your camshaft

1. “DTI” with enough travel to suit camshaft max lift (say 0.500”)
2. Degree wheel
3. Pointers that can be bolted solidly to block

STEP 1 - Finding True Top Dead Centre (TDC)

Rotate the crankshaft until you get No 1 piston close to TDC, then adjust your pointer to the “0” TDC position on the degree wheel.



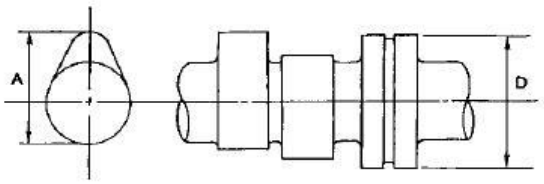
You can either use “the positive stop” method, or the “minimise DTI” method to establish “true TDC” as follows:
Rotate the crankshaft to around 15 degrees on your degree wheel (note reading exactly), then screw in the piston stop until it contacts the piston, rotate the engine in the “opposite direction of rotation” until the piston comes back up and touches the piston stop.
Note what degree the pointer is on – then add these two numbers together then divide by 2. This “number” is therefore from either of your stop points is true TDC. Zero your pointer/wheel at “0”. It is useful to accurately mark a fixed slot on the crankshaft pulley to a fixed reference on the block/front cover.

The alternative method is to “rock” the piston across TDC, while watching the DTI carefully, as it moves upwards, stops, then reverses, the approximate centre point can be found. Always DOUBLE CHECK measurements!!

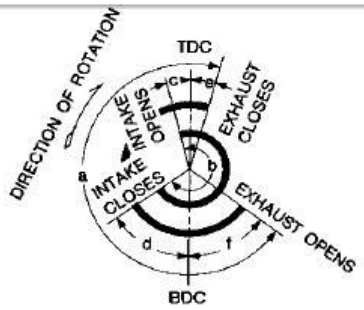
SR20 forums

What does the Cam Card Mean?

All camshaft manufacturers will provide a card with the camshaft(s), which typically has the following information:



SEM568A



EM120

Unit: mm (in)

		Standard	Limit
Cam height (A)	Intake	42.415 - 42.605 (1.6699 - 1.6774)	—
	Exhaust	42.415 - 42.605 (1.6699 - 1.6774)	—
Wear limit of cam height		—	0.2 (0.008)
Camshaft journal to bearing clearance		0.045 - 0.090 (0.0018 - 0.0035)	0.12 (0.0047)
Inner diameter of camshaft bearing	#1 to #6 journals	28.000 - 28.025 (1.1024 - 1.1033)	—
Outer diameter of camshaft journal (D)	#1 to #6 journals	27.935 - 27.955 (1.0998 - 1.1006)	—
Camshaft runout*		Less than 0.02 (0.0008)	0.04 (0.0016)
Camshaft end play		0.070 - 0.148 (0.0028 - 0.0058)	0.2 (0.008)
Valve timing (Degree on crankshaft)	a	232	—
	b	232	—
	c	–1	—
	d	53	—
	e	4	—
	f	48	—

* Total indicator reading

The Cam Card should include:

- The opening and closing timing points
- The amount of lift at the lifter or at the valve (depending on engine type) at which the timing should be checked.
- Cam lift (and ASSUMED rocker ratio)
- Net valve lift,
- Valve lash (tappet clearance)**.**

This enables you to install the camshafts as per the cam grinder's specs.

Engine: NISSAN SR20DE(T) - S13 & S14/S15

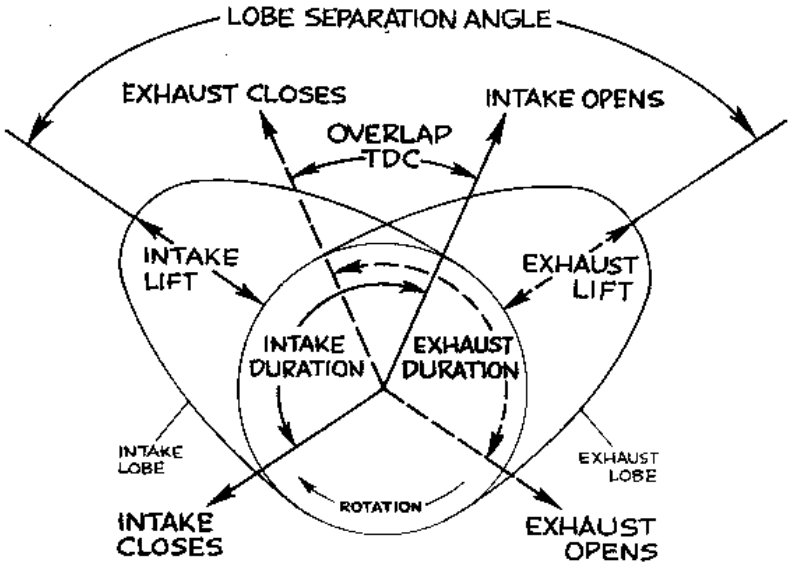
Advertised	Duration:	272°	272°	Duration	@	.050"	at	the	lobe:	
224°	224°	Duration	@	.050"	at	the	valve:	234°	234°	Valve Lift
(inches):		.494"	.494"	Valve	Lift	(mm):		12.55	12.55	Valve
Lash	(inches):	.000"	.000"							

Timing Graph
IVO 9 BTDC
IVC 53ABDC
EVO 53 BBDC
EVC 1 ATDC

The “numbers” can be viewed more simply as:

9 + 53 + 180 = total inlet duration (242 deg)
53 + 1 + 180 = total exhaust duration (234 deg)

The centreline is defined as the “maximum opening point” for both inlet and exhaust. In the above example:
(53+180-9)/2 = 112deg (inlet)
(53+180-1)/2 = 116 deg (exh)



Mounting the Dial Gauge

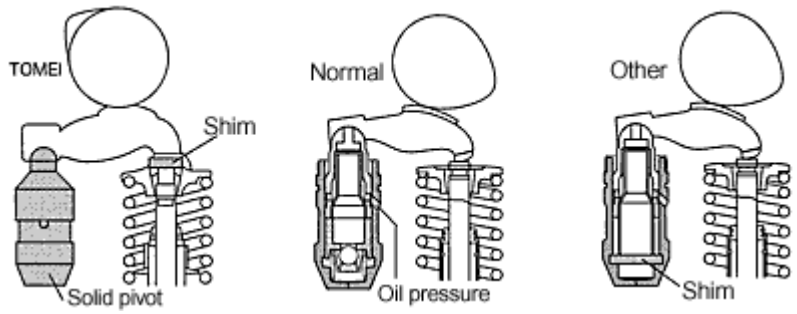
- Mount the dial gauge to something solid, (often requires a long extension to reach down beside the cam lobe, or cam bucket (bucket OHC engine)).
- The DTI plunger MUST be on the same axis as the lifter being measured (geometrical errors).
- Zero the DTI with the cam on the base circle.
- Check that the DTI moves freely (up and over full lift and back to the zero position) by rotating the camshaft (head off block).

Mount the degree wheel

- Mount the wheel on the front pulley – bluetac is quick and cheap – make very sure it can "move".
- Make a pointer with a ground point – bolt this solidly to the front cover.
- Bend so that you can read the wheel to better than 1 degree.

Lifter Setup

Hydraulic lifters SHOULD NEVER be used when dialling in cams (they can compress, creating false readings).
For OHC engines with hydraulic cam buckets (Nissan SR20 etc.) or for OHC engines with rocker arms and hydraulic lifters (Mitsubishi 4G63, Nissan SR20), you will need to make a solid lifter that gives 0.1mm valve clearance (typical) when the cam is on the base circle. This can be done by replacing the "plunger" in the hydraulic lifter, with a piece of turned silver steel.



Three "different" Methods

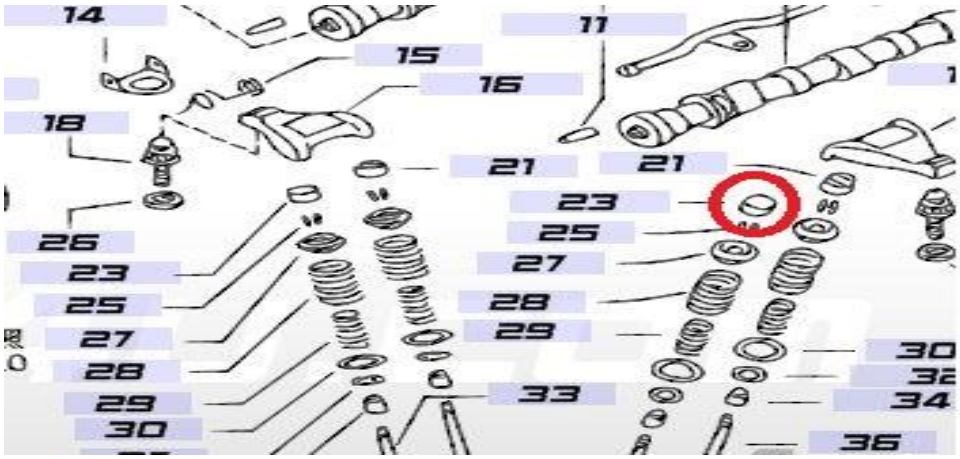
There are 3 basic ways in which the camshaft phasing cam be measured:

1. Lobe centre method – install the cam at the MOP, and place the crank at that angular position – the issue with this method is most camshafts have "dwell" at maximum lift, and it is easy to misplace the MOP point.
2. Lift at TDC method – most cam makers will supply the lift at TDC on both the inlet and exh sides. Simply use a DTI to put the cam in position that has the required lift on both sides of the engine. This method is quite accurate - PROVIDED THAT THE LASH IS EXACTLY as per the manufacturers specs. A small error in lash (say 1 thou) can easily result in timing being out 4-6 degrees!
3. Open and close points at 50thou lift. This is the most accurate method, as the cam is on the "flank" and a very small change in crank position is easily noticed. It is tolerant of lash errors, it is however, the most time consuming method!

Single and Double Over Head Cam Engines

1. For mechanical lifter OHC - all readings are taken with the valve lash set to the proper clearance as specified by the cam card.
2. For hydraulic lifter OHC engine, a mechanical lifter must be used for checking (with clearance set to what the cam maker specifies).
3. Then turn the engine in the direction of rotation until you reach 1.25mm valve lift on the DTI, record the figure on the degree wheel. NBB – some cam grinders use “40 thou, some use 50 thou”).
4. Rotate in proper direction counting up to full valve lift - record the full valve lift angle.
5. Continue to rotate in proper direction, counting down from full lift until you are 1.25mm away from fully closed, record the degree wheel figure.

http://www.precisionshims.com.au/products/lap

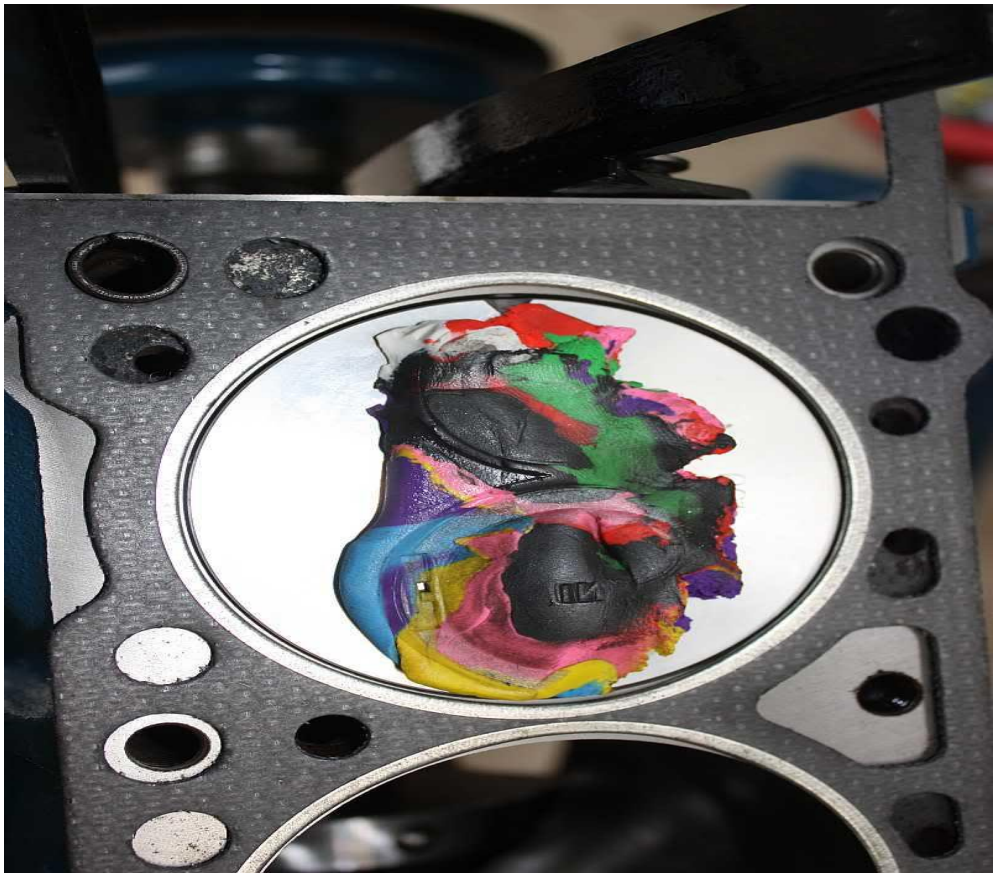


Now you get to “adjust” the camshaft – so that they match the figures on your spec card.

NOTES:

The camshaft manufacturer will NOT KNOW the exact specification of your engine package – so the timing numbers will be close, but may not be absolutely optimal. The ONLY WAY to check this takes time on a repeatable dyno.

Take the extra time to measure piston to valve clearances, so that you have the ability to change cam timing – without having to remove the pistons to make the cut-outs deeper! A “safe” minimum is around 120thou on inlet, 100 thou on exhaust. A bit more is advisable in most cases.
Some manufacturers quote duration at 1.0mm – read the cam card carefully!



L20B – plasticine check – performance forums.

Slit plasticine with knife, measure thickness with Vernier.

NOTES – Part two:

Race cams for SR20 are likely to be around

240 to 260 degrees @ 50”

11 – 13mm+ valve lift

105 – 106 LCA