Product Knowledge Document
Camshafts
Classification,
Configuration and Working

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History of Camshaft Development

- In the 1950s, cams were commonly called 1/2-race, 3/4-race, and full-race. The problem with that terminology is that it was often subjective—one person's 1/2-race cam could be another's 3/4-race, and so on.
- During the 1970s, camshaft companies were using a spec called "advertised duration." This was a step forward, but the companies still used different measurement standards, so one company's "292" could be smaller than another company's "288."
- By the 1980s and 90s, most companies were publishing "duration at .050 in. lift" numbers. Customers could use seat, .050 in. and .200 in. numbers to compare lobe intensity.

All these previous methods gave us these generally accepted truths:

- Wider lobe separation (less overlap) makes for a better idle than narrow lobe separation (more overlap).
- Advancing the cam makes more low end torque. Retarding results is more on the top end.
- Longer duration cams make more power up top, but suffer from a rough idle, and lack low-end.
- Nitrous and blower cams have wider lobe-separation numbers.

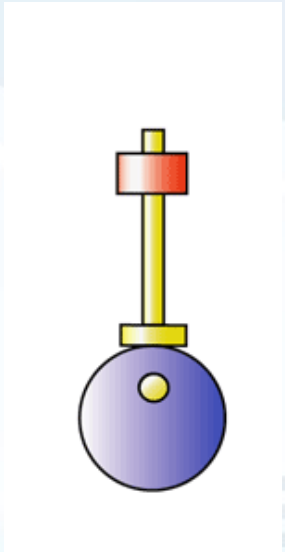
Unfortunately, this led to generalities like "Always install a cam 4 degrees advanced" and "Never run less than 110 degrees of lobe separation on the street."

INTRODUCTION

A camshaft is a rod in an engine that works to change circular motion Into motion up and down or from side to side. A camshaft Determines how and when the engine valves open..

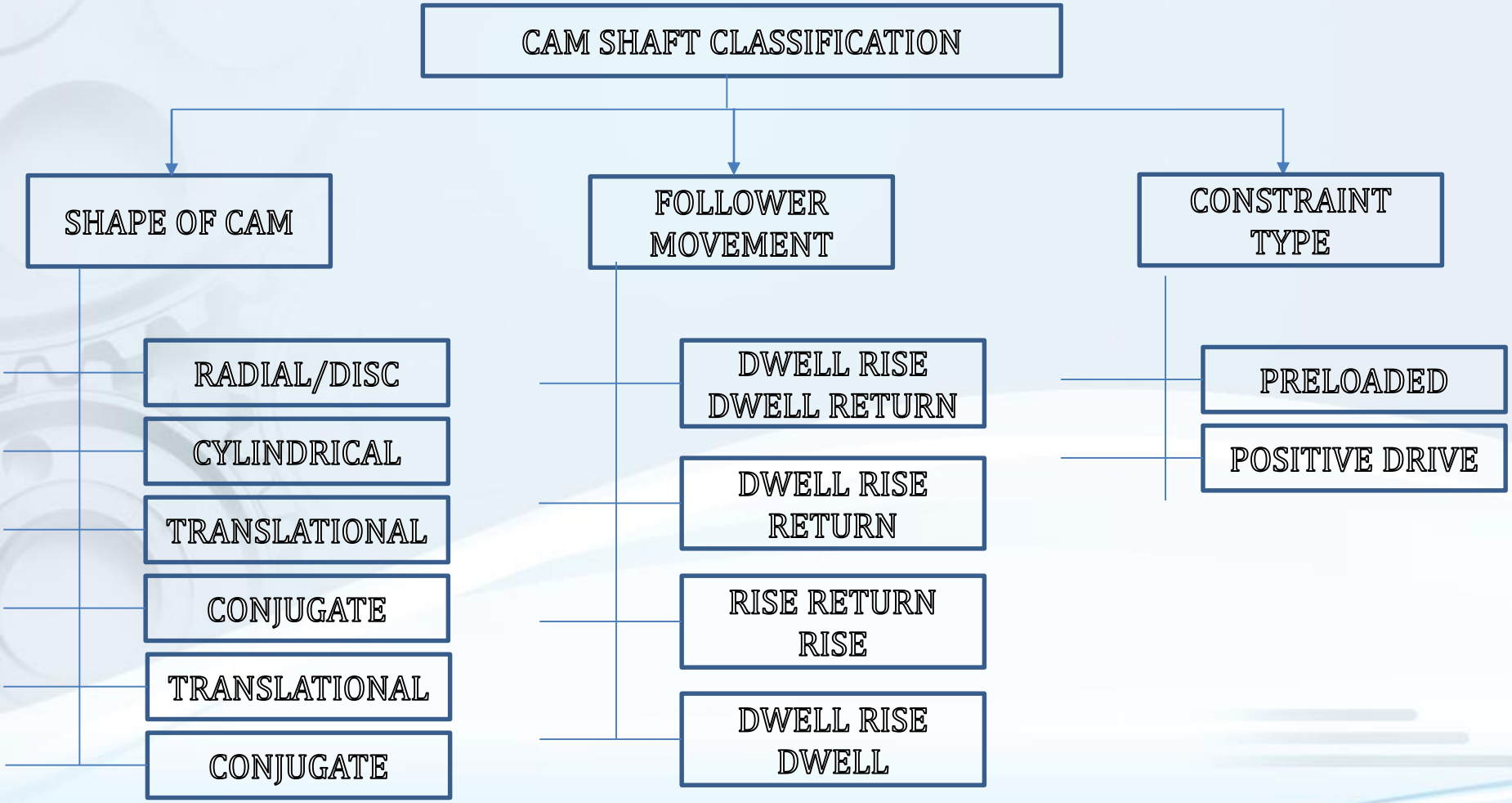
A camshaft is a shaft with one or more cams attached to it, especially one that operates the valves in an Internal combustion engine. As the camshaft rotates, the cams push against the followers to open the valves.

In an internal combustion engine with pistons, the camshaft is used to operate poppet valves. It consists of a Cylindrical rod running the length of the cylinder bank with a number of oblong lobes protruding from it, one for each valve.



CAM SHAFT – TYPES

CAM SHAFT CLASSIFICATION



CAM SHAFT – BUILDING BLOCKS

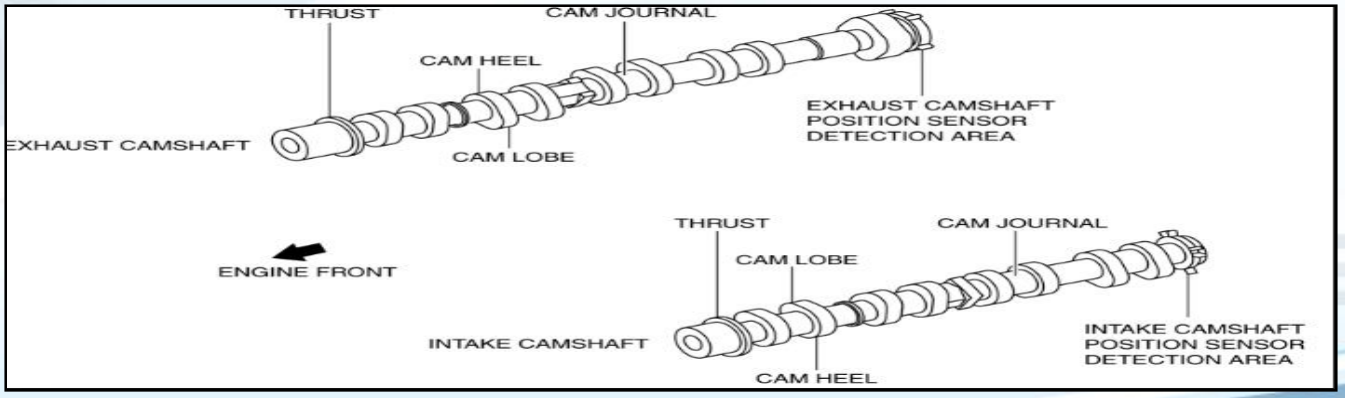
BUILDING BLOCKS OF A CAM SHAFT

Main Journal:- The power created by the camshaft comes from constant rotation. The main journals keep the camshaft in place as it spins around in the engine bay.

Lobes :- While the camshaft spins, the lobes work in time with the motion of the piston. They open and close the intake and exhaust valves, and the pace in which they open and close the valves reflects on the vehicle's engine performance. The cam lobes change speeds when an engine changes speeds..

Ends:- The front end of the cam secures the vehicle's timing belt and keeps it in time with the crankshaft. The rear end of the cam turns the distributor of the engine with a special gear. This part keeps the ignition timing in tune with the rest of the engine.

Bearings:- Cam bearings are added parts used in conjunction with the main journals. The bearings help prevent the camshaft from damaging the engine block in the case of a malfunction in the engine. The bearings keep the camshaft in seamless rotation.

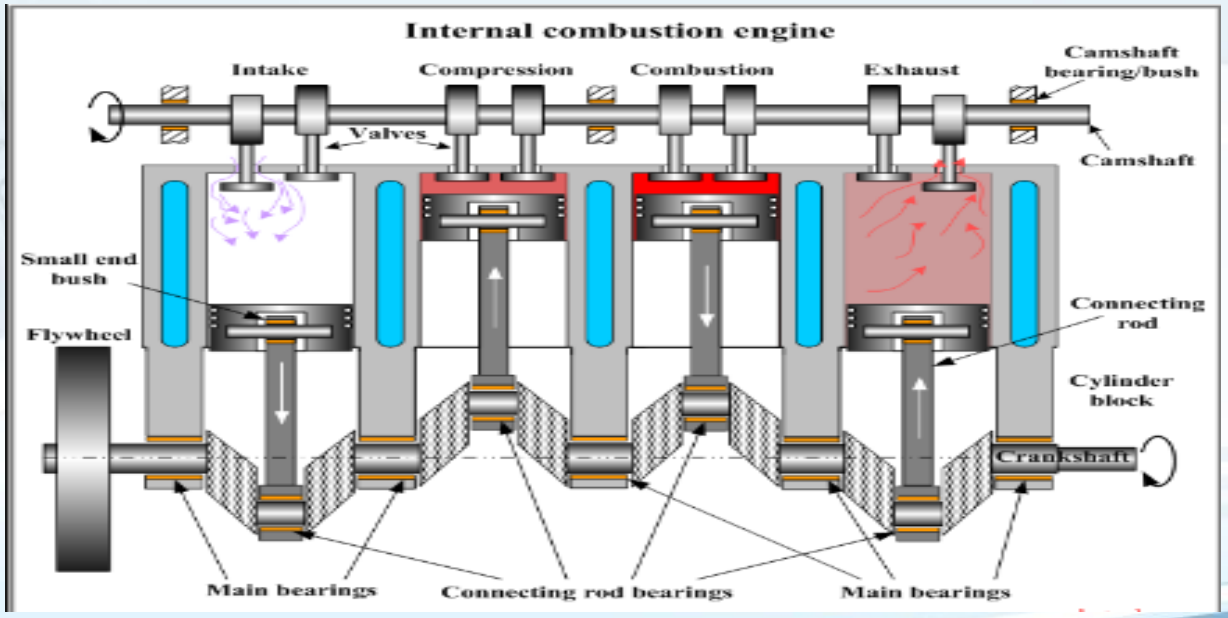


CAM SHAFT WORKING PRINCIPLE

Working Principle of Cam Shaft - Camshaft Basics

The key parts of any camshaft are the lobes. As the camshaft spins, the lobes open and close the intake and exhaust valves in time with the motion of the piston. It turns out that there is a direct relationship between the shape of the cam lobes and the way the engine performs in different speed ranges.

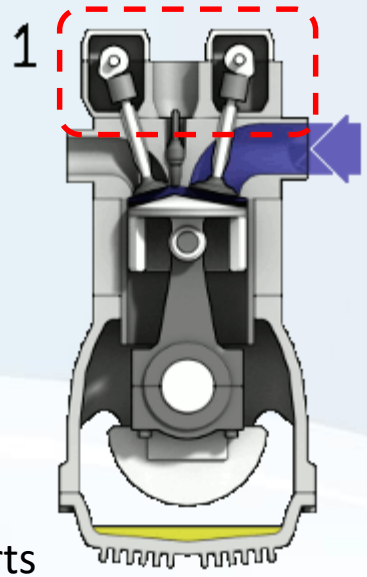
Just as the piston starts moving downward in the intake stroke (called top dead center, or TDC), the intake valve would open. The intake valve would close right as the piston bottoms out. The exhaust valve would open right as the piston bottoms out (called bottom dead center, or BDC) at the end of the combustion stroke, and would close as the piston completes the exhaust stroke.



Working Principle of Cam Shaft

A camshaft is a rod which rotates and slides against a piece of machinery in order to turn rotational motion into linear motion. These moving pieces of the shaft are the cams. The linear distance moved is called the 'throw' .

A camshaft on an internal combustion heat engine is a device that controls both the input of fuel and the expulsion of exhaust fumes. It consists of several radial cams, each displacing intake or exhaust valves. This camshaft is connected to the crankshaft via belt, chain or gears. This ensures consistent timing of the valves in relation to the motion of the piston.



The function of a camshaft is dependent on how a valve works and the function of the cam itself. A valve on a cylinder head consists of two basic parts, a stem and a head .

The head plugs the nozzle that allows fuel intake or exhaust flow and requires linear motion. A cam, in its simplest definition, is a mechanical link that converts rotational motion into linear motion, or vice versa. The cams on a camshaft achieve this displacement by the rotation of a radial pattern, and a follower which moves perpendicular to the rotational axis. The cam pattern on a camshaft is non-circular with a single lobe. The follower matches the displacement of the cam as it rotates. This displacement is then translated to the stem of the valve, allowing head to rise as the lobes of the cam pass trough the follower.

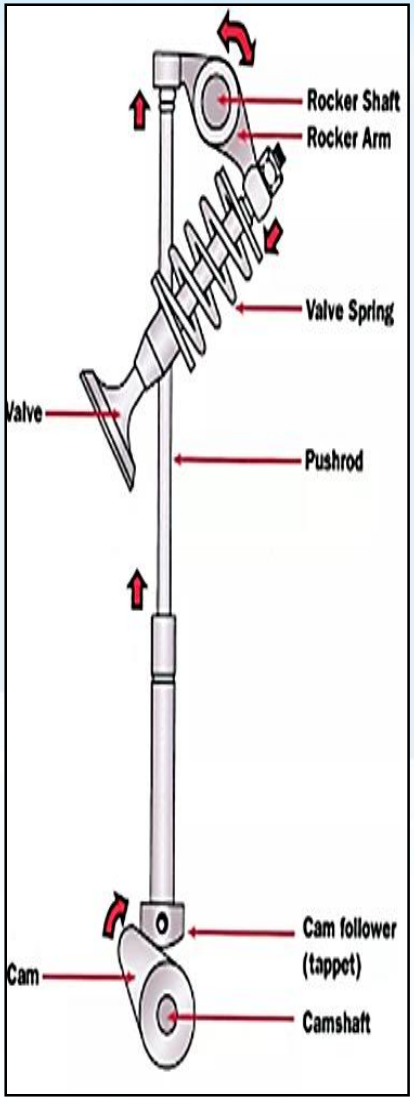
Working Principle of Cam Shaft

Since an automotive engine has several pistons like the piston , a single cam is insufficient for all of these pistons. An entire rod covered with cams must be used. This is called as the camshaft.

Note that the precise placement of the cams along the shaft allow for precise timing of the relative valves opening and closing. This precise timing is needed since a car engine is firing at thousands of RPM. Insuring the timing is proper in a car engine is one of the simpler ways to save money and energy.

When the intake valve opens and the piston starts its intake stroke, the air/fuel mixture in the intake runner starts to accelerate into the cylinder. By the time the piston reaches the bottom of its intake stroke, the air/fuel is moving at a pretty High speed.

If we were to slam the intake valve shut, all of that air/fuel would come to a stop and not enter the cylinder. By leaving the intake valve open a little longer, the momentum of the fast-moving air/fuel continues to force air/fuel into the Cylinder as the piston starts its compression stroke.



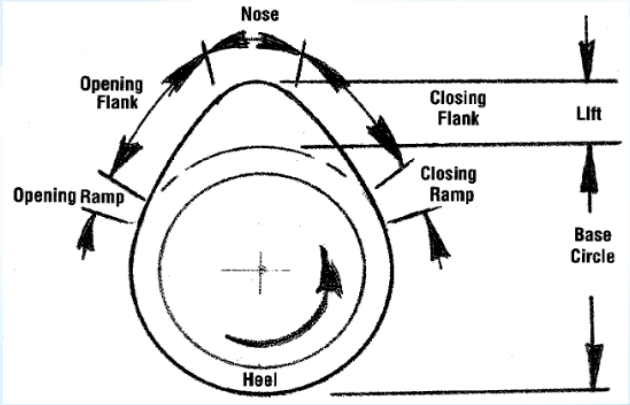
So the faster the engine goes, the faster the air/fuel moves, and the longer we want the intake valve to stay open. We also want the valve to open wider at higher speeds -- this parameter, called valve lift, is governed by the cam lobe profile.

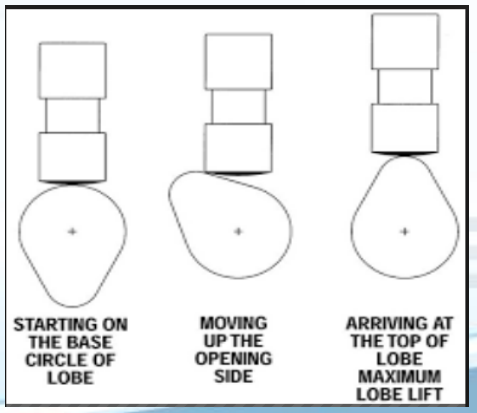
Camshaft Configurations - Single Overhead Cam

This arrangement denotes an engine with one cam per head. So if it is an inline 4-cylinder or inline 6-cylinder engine, it will have one cam; if it is a V-6 or V-8, it will have two cams (one for each head).

The cam actuates rocker arms that press down on the valves, opening them. Springs return the valves to their closed position. These springs have to be very strong because at high engine speeds, the valves are pushed down very quickly, and it is the springs that keep the valves in contact with the rocker arms. If the springs were not strong enough, the valves might come away from the rocker arms and snap back. This is an undesirable situation that would result in extra wear on the cams and rocker arms.

On single and double overhead cam engines, the cams are driven by the crankshaft, via either a belt or chain called the timing belt or timing chain. These belts and chains need to be replaced or adjusted at regular intervals. If a timing belt breaks, the cam will stop spinning and the piston could hit the open valves.





Camshaft Configurations

Double Overhead Cam

A double overhead cam engine has two cams per head. So inline engines have two cams, and V engines have four. Usually, double overhead cams are used on engines with four or more valves per cylinder -- a single camshaft simply cannot fit enough cam lobes to actuate all of those valves.

The main reason to use double overhead cams is to allow for more intake and exhaust valves. More valves means that intake and exhaust gases can flow more freely because there are more openings for them to flow through. This increases the power of the engine.

Camshaft Configurations

Pushrod Engines

Like SOHC and DOHC engines, the valves in a pushrod engine are located in the head, above the cylinder. The key difference is that the camshaft on a pushrod engine is inside the engine block, rather than in the head.

The cam actuates long rods that go up through the block and into the head to move the rockers. These long rods add mass to the system, which increases the load on the valve springs. This can limit the speed of pushrod engines.

The camshaft in a pushrod engine is often driven by gears or a short chain. Gear-drives are generally less prone to breakage than belt drives, which are often found in overhead cam engines. A big thing in designing camshaft systems is varying the timing of each valve

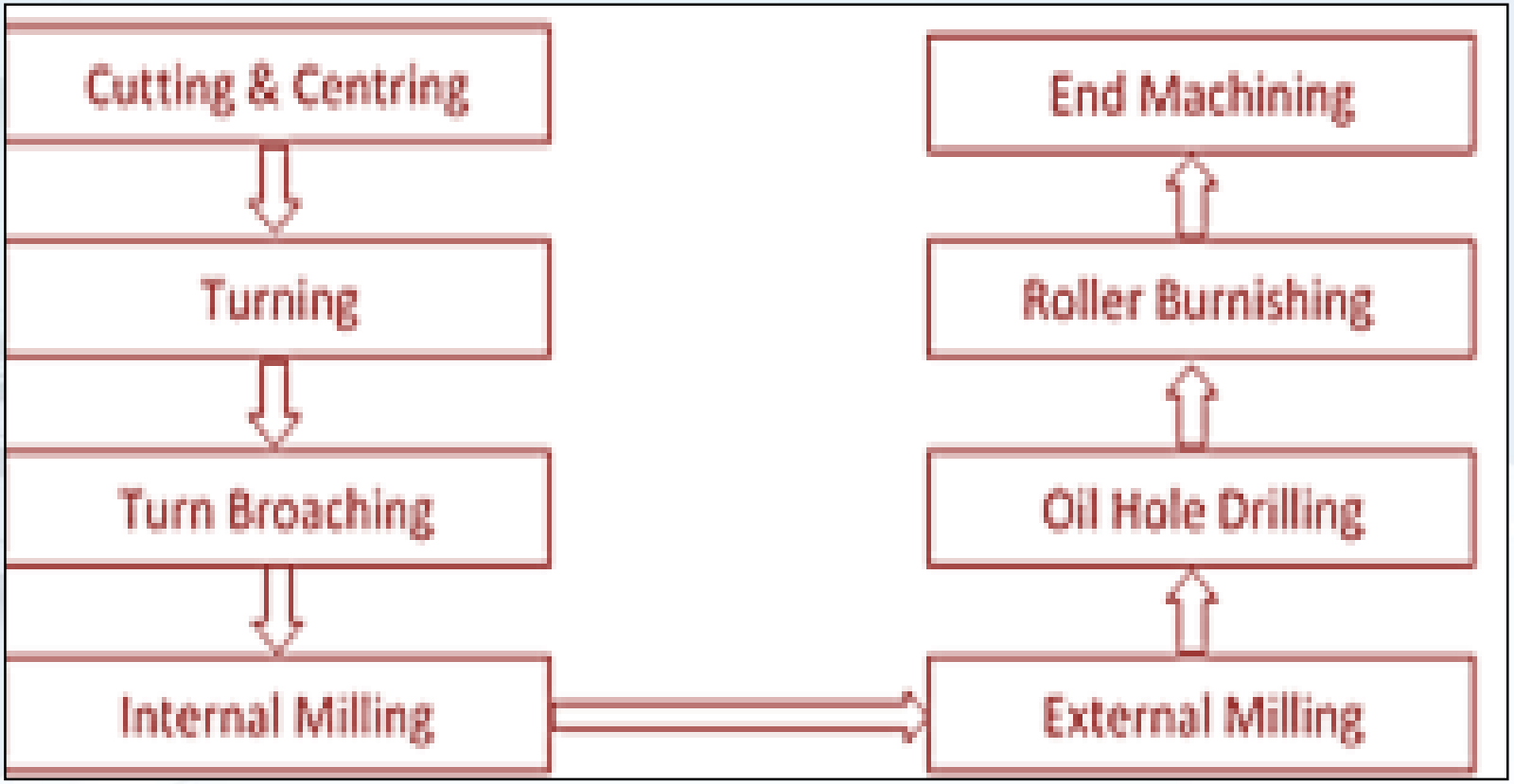
Variable Valve Timings

There are a couple of novel ways by which carmakers vary the valve timing, called VTEC.

VTEC (Variable Valve Timing and Lift Electronic Control) is an electronic and mechanical system in some engines that allows the engine to have multiple camshafts. VTEC engines have an extra intake cam with its own rocker, which follows this cam. The profile on this cam keeps the intake valve open longer than the other cam profile. At low engine speeds, this rocker is not connected to any valves. At high engine speeds, a piston locks the extra rocker to the two rockers that control the two intake valves.

Some cars use a device that can advance the valve timing. This does not keep the valves open longer; instead, it opens them later and closes them later. This is done by rotating the camshaft ahead a few degrees. If the intake valves normally open at 10 degrees before top dead center (TDC) and close at 190 degrees after TDC, the total duration is 200 degrees. The opening and closing times can be shifted using a mechanism that rotates the cam ahead a little as it spins. So the valve might open at 10 degrees after TDC and close at 210 degrees after TDC. Closing the valve 20 degrees later is good, but it would be better to be able to increase the duration that the intake valve is open.

Manufacturing Flow of Camshaft



THANK YOU

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Are there any Questions?