Camshaft and Valve Train Condition

A valve will operate only as well as its actuating parts. This includes the timing gears, chain or belt, sprockets, camshaft, lifters, pushrods, and rocker arm assemblies. For good valve life, each of these must be checked and replaced if worn or damaged.
When making an inspection, each valve train component should be carefully checked. Use the following guidelines when inspecting the components.

1.Individually mounted rocker arm assemblies:
- Check for loose mounting stud and nut or bolt.
- Check for plugged oil feed in the rocker arm.

2.Pushrods: Check for bent pushrods.

3.Valve spring assembly-with or without damper spring: Check for broken or damaged parts.

4.Retainer and keepers-both two-piece and one piece: Check for proper seating of keeper in the stem grooves and in the retainer.

5.Overhead cam follower arm and lash adjuster assemblies
- Check for broken or severely damaged parts.
- Check for a soft lash adjuster (adjusting shim) by using hand pressure on the rocker arm while it is on the base circle of the camshaft.

6.Camshaft
- Check for plugged oil feed.
- Check for correct cam lift.
- Check for broken or severely worn areas.

7.Check the timing belt, sprockets, and related components.

Camshaft
After the camshaft has been cleaned and a visual inspection has been made, check each lobe for scoring, scuffing, fractured surface, pitting, and signs of abnormal wear. Premature lobe and lifter wear is generally caused by metal-to-metal contact between the cam lobe and lifter bottom due to inadequate lubrication. The nose will be worn from the cam lobes, and the lifter

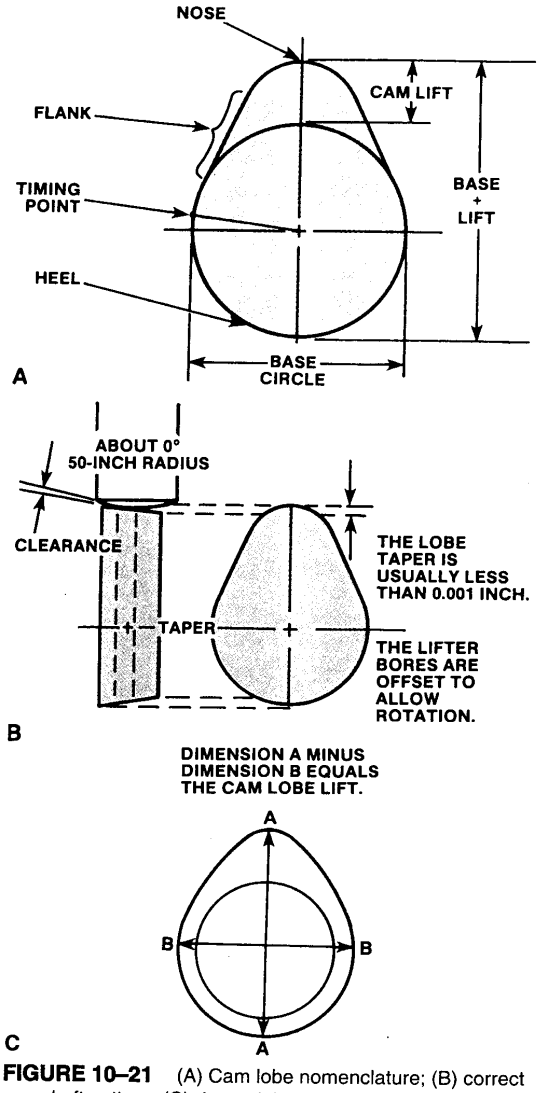

FIGURE 10–21 (A) Cam lobe nomenclature; (B) correct camshaft pattern; (C) determining cam lobe lift.

bottoms will be worn to a concave shape, or may be worn completely away. This type of failure usually begins within the first few minutes of operation. It is the result of insufficient lubrication or use of an oil that does not meet the engine manufacturer's requirements for viscosity and API service grade.

There are several methods of measuring cam lobes for wear, but the two most popular are the dial indicator and outside micrometer.

The dial indicator test for worn cam lobes should be conducted with the camshaft in the engine. Check the lift of each cam lobe (Figure 10-21) in consecutive order and make a note of the readings. Be sure the pushrod is in the valve lifter socket. Install the dial indicator so the cup-shaped adapter fits into the end of the pushrod and is in the same plane as the pushrod movement. Connect a remote starter switch into the starting circuit. With the ignition switch off, bump the crankshaft over until the lifter is on the base circle of the camshaft lobe. At this point, the pushrod will be in its lowest position. Put the dial indicator at zero. Continue to rotate the crankshaft slowly until the pushrod is in its fully raised position (highest indicator reading). Compare the total lift recorded on the indicator with specifications. If the lift on the lobe is below the specified service limits, the camshaft and lifters operating on the worn lobe(s) must be replaced. Any lifter showing pitting or having its contact face worn flat or concave must also be replaced. To be safe, most manufacturers recommend all lifters be replaced when the camshaft is replaced.

To compare the cam lobe height with an outside micrometer, the camshaft must be removed from the engine. Place the micrometer in position to measure from the heel to the nose of the lobe and again 90 degrees from the original measurement. Record the measurement for each intake and exhaust lobe. Any variation in heights indicates wear. Also, check the measurements taken against the manufacturer's cam lobe heights.

Measure each camshaft journal in several places with a micrometer to determine if it is worn excessively. If any journal is 0.001 inch or more below the manufacturer's prescribed specifications, it should be replaced.

The camshaft should also be checked for straightness with a dial indicator. Place the camshaft on Vblocks. Position the dial indicator on the center bearing journal and slowly rotate the camshaft. If the dial indicator shows runout (a 0.002-inch deviation), the camshaft is not straight. A bent camshaft must be replaced.

Valve Lifters

All engines that have mechanical lifters use some method of adjustment to bring valve lash (clearance) back into specification. There are four basic methods for lash adjustment: rocker arm with adjustable pivots, adjustable pushrods, rocker arm with adjustable screws, and adjustable cam follower (using some type of adjustable screw or replaceable shim).

Of these four adjustment types, the first two methods are typically associated with OHV engines. The other two adjustment procedures-rocker arms with adjustment screws and adjustable cam followers-are commonly found on OHC designs.

When inspecting mechanical lifters, carefully check their bottoms and pushrod sockets. Heat, scoring, or pitting makes their replacement necessary.

Technically, the normal wear of the valve lifters is referred to as adhesive or galling wear. This is a result of two solid surfaces (camshaft lobe and lifter face) that are in rubbing contact. The two surfaces tend to weld together. This process is considered normal wear between the cam lobe and

lifter. Fortunately, proper lubrication retards this process. However, excessive loading will negate the beneficial effects of the lubricant and accelerate the wear process. Examples of excessive loading would be incorrectly matched valve springs (too much spring pressure), old lifters on a new camshaft, or new lifters on an old camshaft.

If a camshaft and lifters are going to be reused, the lifters must remain with their respective lobes. Worn valve lifters and improper camshaft installation are common causes of camshaft/lifter failure. Figure 10-24 shows the ideal contact between the crowned lifter bottom and the tapered cam lobe.

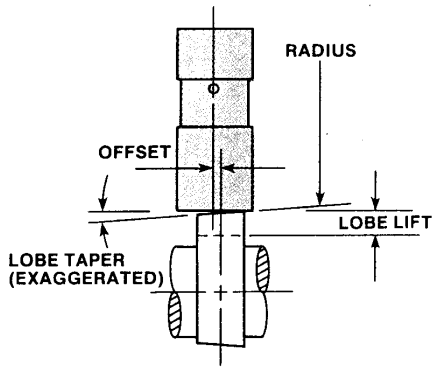

FIGURE 10–24 Ideal contact between the crowned lifter bottom and the tapered cam lobe.

The normal wear path is off center with no edge contact between the lifter and the lobe. The taper on the cam lobe and the spherical radius of the lifter bottom are specifically designed to result in an offset contact pattern causing the lifter to rotate. The spinning lifter reduces the sliding friction and also equalizes the load around the lifter bottom.

Interference occurs primarily in engines originally equipped with a separate cam sprocket spacer (used to control end clearance). Lifter damage develops when a replacement sprocket with a built-in spacer is installed without removing the original spacer. This forces the camshaft rearward, allowing the lobes to strike adjacent lifters, chipping the edges of both. Interference will also develop if sprocket bolts are not tightened properly or if the cam sprocket/engine block thrust surfaces are worn excessively.

Edge wear on cam lobes occurs when used lifters are installed with a new camshaft. The bottoms of used lifters are often flat or slightly concave due to previous wear. As a consequence, the lifters will contact the lobe along a narrow band at the lobe's edge. This tends to create high contact forces and rapid wear results.