CAMSHAFT INSTALLATION

There are many ways in which a camshaft may be phased; however, the following procedure is the method which we use and have found to be the most accurate.

PART 1 - Determination of T.D.C. (Top Dead Center)

1. Place dial indicator (minimum $\frac{1}{4}$" travel) on top of piston. On some engines this may be done without removing the head by inserting the indicator through the spark plug hole. Be sure the indicator is rigidly mounted.

2. Affix a 360° protractor (degree wheel) on the crank shaft with a pointer. Place the pointer as close to "0" (T.D.C.) as you can by watching the indicator.

3. Rotate the engine (in a clockwise direction when facing the front of the engine) until the dial indicator reads exactly .030" before T.D.C. Stop. Take reading from the degree wheel. Write it down. Reverse rotation (counter clockwise) of the crank and rotate until the piston comes up again and the dial indicator reads .030" exactly. Stop. Take reading from the degree wheel. This reading should be the same number of degrees away from "0" (T.D.C.) as the first reading, only on the other side of "0". If it is not, move the pointer half the number of degrees in the direction of the minimum degree reading.

   Note: The .030" selected above was for explanation purposes only. Any measurement of .015" or greater is acceptable.

   EXAMPLE - With the degree wheel, pointer, and dial indicator in position, turn the engine over (clockwise) until .025" is read on the indicator. If you go past you must start again. Do not back up, go all the way around. Read the degree wheel. Say 8°. Reverse rotation and rotate until the indicator reads .025" again. Read the degree wheel. Say 350°. Move the pointer on the degree wheel 1° to read 351°. Repeat. At .025" the degree wheel should now read 9° and 351°. Now the pointer is reading 0° at T.D.C. Note: The reason for reversing direction to obtain the second degree reading is to take out any clearance in the con-rod bearings.

PART 11 - Timing the Camshaft

1. With the camshaft in place, insert a tappet for the intake valve of the No. 1 cylinder.

2. Place the dial indicator on the tappet with the cam at maximum lift.

3. Take a look at the timing card received from the manufacturer. It should have the following information.

Example

Intake Open (I.O.)	30° BTDC
Intake Close (I.C.)	74° ABDC
Exhaust Open (E.O.)	74° BBDC
Exhaust Close (E.C.)	30° ATDC

The duration of the cam is Total Number of the degrees the valve is open.

Example: Using the figures above

30°	When the intake valve starts to open
180°	The number of degrees between T.D.C. and B.D.C. (Bottom Dead Center)
74°	The number of degrees after B.D.C. at which the valves close
284°	TOTAL - Duration

The centerline or point of maximum lift is always half ($\frac{1}{2}$) the duration. In the above case, 142° after the valve starts to open. This means that the centerline of the camshaft, or point of maximum lift, will occur at a point 142° less 30° equals 112° after T.D.C. on your degree wheel. Think about this. It is fundamental to understanding what we do from here on.

4. Turn the engine over (clockwise) until the indicator reads .025" before reaching maximum lift. Stop. Read the degree wheel, write down the number of degrees. Continue rotating the engine in the same direction (clockwise) past maximum lift until .025" is read again on the indicator. Stop. Read the degree wheel. Write it down. Add the two degree wheel readings together and divide by two. The answer is the point where the centerline is.
   Note: The .025" was used for illustration only. Any measurement above .015" is good enough.

   EXAMPLE - Using the numbers from the timing card above - starting from T.D.C. rotate the engine (clockwise) until the indicator reads .020". The degree wheel reads $101\frac{1}{2}$°. Continue to rotate the engine in the same direction until the indicator reaches .020" again. The degree wheel reads 125°. Add $101\frac{1}{2}$° plus 125°. Answer - $226\frac{1}{2}$°. Divide by two. Answer - $113\frac{1}{4}$°. Thus we must advance the cam $1\frac{1}{4}$° in order to have the centerline at 112°. Offset keys, eccentric bushings, and other devices are available for this purpose. Insert the proper device so that the centerline of the cam is moved forward (advanced) in the direction of its rotation. Repeat above. Now we should read $100\frac{1}{4}$° at .020" from maximum lift on the indicator; and 123 3/4 at .020" after maximum lift on the indicator. Add $100\frac{1}{4}$° plus 123 3/4°. Answer - 224°. Divide by two. Answer - 112°. The cam is now installed correctly.

5. An optional method may be used when the valve mechanism for No. 1 cylinder is in place. On a push rod overhead valve engine, place the indicator on top of the valve stem or retainer. On an L-head engine, place the indicator on top of the valve head. This method will give a slight variation from the method outlined in No. 4 - this should not exceed $1\frac{1}{2}^{o}$. The difference in reading is caused by the back lash in the chain being taken out by the spring force reversing directions on the lobe of the cam. Method No. 4 is preferred.