CRANE Cams®

Installation Instructions

Tune-A-Cam Kit

For "Big Twin" Harley-Davidson®

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DEGREEING IN YOUR CAM

The purpose of degreeing a cam is to insure that the cam is phased correctly with the crankshaft per the cam manufacturer's specifications. Some factors that may cause improper phasing are: Cam or crank gears incorrectly marked; keyways out of position on gears; or keyway in the crankshaft mis-indexed. It is the exception, rather than the rule, that a cam may be out of phase, but this factor should be known in order to be able to establish a baseline, or a point of tune. This kit will aid you in a complete engine reassembly or for just a check of the camshaft timing when the camshaft is replaced with the engine in the motorcycle. Refer to your service manual for any engine specifications or instructions necessary for proper assembly of your engine.

EQUIPMENT IN YOUR KIT

Included in your Tune-A-Cam-Kit:

1. An accurate degree wheel for the crankshaft
2. A pointer to be firmly attached to the engine to indicate points on the degree wheel.
3. A dial indicator to accurately measure cam lift, end play and valve travel.
4. Top dead center stop bolt.
5. Checking springs to replace valve springs for checking valve clearances.
6. Checking plug to replace stock hydraulic lifter plunger during dial indicator checks.

ENGINE IN CHASSIS METHOD

This is a quick check method to degree in your camshaft when the engine is in the chassis, and the primary drive side of crankshaft is not accessible for a degree wheel. The method uses a measurement taken at the lifter with the dial indicator. The measurement is from the heel of the cam to a point partially up the ramp (FIG. 1) when the crankshaft is at Top Dead Center (TDC). TDC can be found when the TDC mark

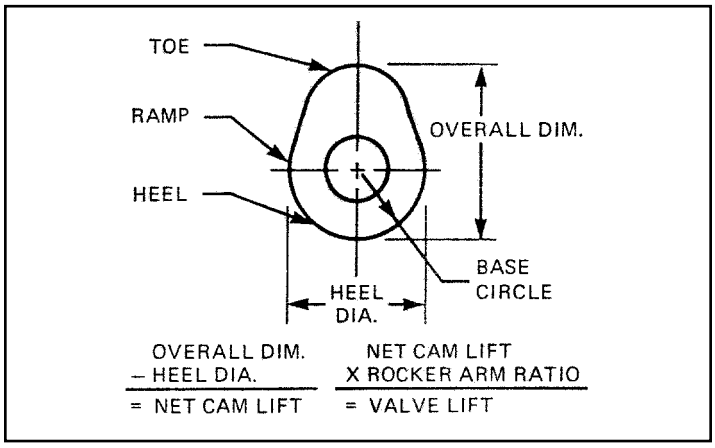

Fig. 1

is visible in the center of the inspection hole on the left side of crankcase (**BE CAREFUL!** The marks on the flywheel have changed over the model years). This method will only be as accurate as the mark and the keyed gears.

For this method the motorcycle should be on a secure stand with rear wheel off the ground and the engine in high gear. Start with the intake lifter. Use the plug provided to replace the hydraulic lifter plunger for taking measurements (Fig. 2). By moving the rear wheel, therefore rotating the engine, set your indicator on

Fig. 2

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zero (0) when the lifter is riding on the heel of the cam (the lowest reading). Rotate your crankshaft forward until the indicator starts to move. Now watch for the TDC mark on the flywheel. When the mark is centered in the hole, read the dial indicator and write down the amount of travel. Turn the crankshaft back to where the lifter is on the heel again to double check your zero measurement. Compare with the figure on the specification card.

Now check the exhaust lifter. The difference in exhaust measurement is that once you establish your "0" on the heel, you rotate the crankshaft backwards. When the indicator starts to move, watch for the TDC mark on the flywheel. When it is centered in the hole, take your reading. Double check it and compare with the specification card. Readings of +.005" or -.005" of the specification card will not have an adverse affect on tuning.

ENGINE OUT OF CHASSIS METHOD

The piston moves very little in relation to crankshaft rotation when it is near TDC, so it is practically impossible to find exact TDC with a dial indicator by rocking the crankshaft back and forth. The positive-stop method is the answer. Install the degree wheel so it can be read from the right side of the engine (Fig. 3).

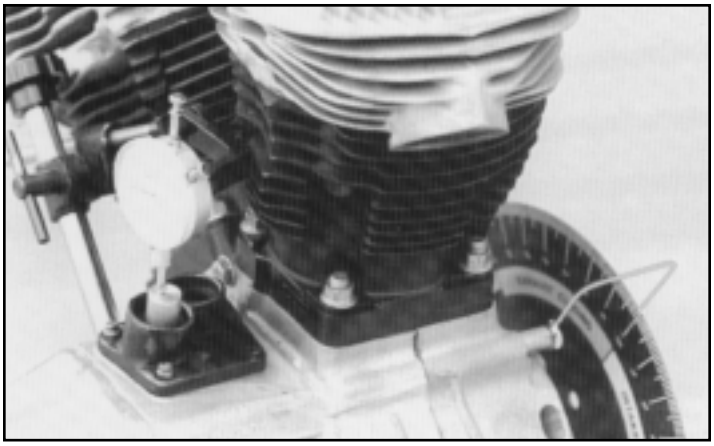

Fig. 3

Rotate the crankshaft to get the front cylinder piston in approximate TDC position by looking through the spark plug hole. Next, adjust the degree wheel to TDC position in relation to the pointer. This is just a rough approximation, but it can save errors later. It is essential at this point that you have some means of rotating the crank that will not interfere with the degree wheel. No matter how tight it is, there is a definite chance of slight misalignment while forcing the crank around.

After the degree wheel has been set approximately, and a means for turning the crank provided, you're ready to install and set the piston stop. This requires turning the crankshaft to lower the piston enough in the cylinder by moving the crankshaft 15-20 degrees. Screw in the piston stop until it touches the piston (Fig. 4). Gently turn the engine in the same direction until

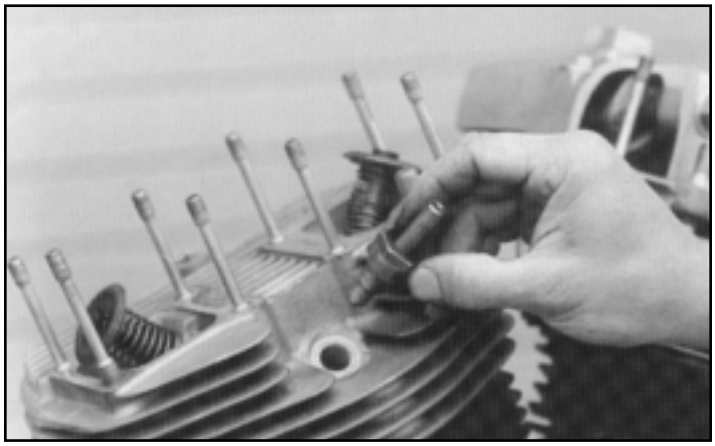

Fig. 4

the piston comes back up and touches the piston stop. Make a note of what degree the pointer is on. Rotate the engine in the opposite direction until the piston comes back up and touches the piston stop again. Make a note of what degree the pointer is on. Add these two numbers together then divide by two. Example: Let's say that the stop points are 16° in one direction and 20° in the opposite direction. The total would be 36 degrees. Divided in half would be 18 degrees. Therefore, 18 degrees from either of your stop points is true Top Dead Center. Move the pointer to align with the 18 degree mark on the degree wheel, without moving the engine or degree wheel so the piston is still against the stop. Now turn the engine in the opposite direction until the piston comes back up and touches the stop. The pointer should be aligned with the 18 degree mark on the other side of the TDC mark. If this is correct, you have found positive top dead center. It is best to repeat this to make sure that nothing has moved.

If you didn't get the same results both times, per our example, you will need to repeat the procedure until you get the same amount of degrees on both sides of TDC. Remove your piston stop and you are ready to properly degree your cam.

It is important that the dial indicator's plunger be aligned as closely as possible with the lifter being measured. The lifter plug should be installed in the lifter. Any substantial angle between the axis of the plunger and the lifter will introduce geometrical errors in the lift reading (Fig. 5).

When the degree wheel and its pointer are accurately set, and the dial indicator is solidly in place, rotate the crankshaft until the cam's base circle is under the lifter for the cam lobe being measured. Set the dial indica-

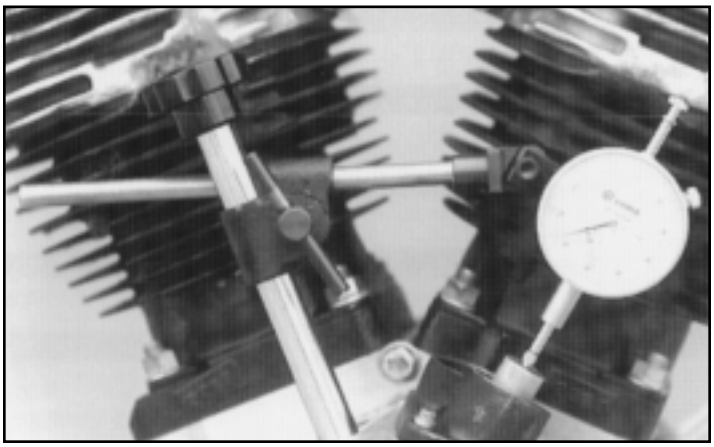

Fig. 5

tor to zero at this point. Be sure the dial indicator is pre-loaded about .100" to insure that it will not run out of travel while on the base circle. Rotate the crankshaft to lift and lower the tappet several times to verify that the dial always returns to zero when the lifter is on the base circle. If it doesn't return to zero, there are several possible causes: (1) the dial indicator may not be mounted rigidly; (2) the lifter may not be contacting the base circle solidly; (3) the lifter could be sticking slightly in its bore. Find the trouble and correct it before proceeding.

It may be necessary to apply slight finger pressure against the lifter when rotating the engine to insure its return to the base circle.

CHECKING BASE CIRCLE RUNOUT

This is a good time to check for runout of the cam's base circle. This is out-of roundness, or wobble, during rotation. If the cam lobe is concentric with the camshaft bearing journals there shouldn't be any appreciable runout. We try to hold base circle runout to less than .001" for optimum cam performance and ease of setting lash. If the runout on your cam measures to more than .002" we would suggest returning it to the manufacturer.

If there is measurable base circle runout on your cam, adjust the dial indicator so the runout is divided equally on both sides of zero. This will give the minimum error for checking the cam's timing.

CAM SPECIFICATION CARD

All the information you need for checking the timing accuracy and phasing of a camshaft is provided on the specification card that you receive with your cam. This will include the opening and closing timing points and the amount of lift (at the lifter) at which the timing should be checked.

There are two popular methods of checking cam phasing: (1) Using the opening and closing figures at tappet lift off the base circle of the cam; (2) Using the intake centerline method.

When checking with either method, always turn the engine in the normal direction of rotation because of possible slack in the timing gear drive.

Using the opening and closing at cam lift, obtained from the information on your cam specification card, turn the engine in the normal direction of rotation. Watch the dial indicator move up .053" from the base circle, then stop rotating the engine. Record the degree number the pointer is on. Then continue to rotate the engine in the same direction. Watching the dial indicator, it will change direction at maximum lobe lift. Record the cam lobe lift. Continue to rotate the engine in the same direction until you reach .053" before returning to the base circle. Record this degree number. Continue on to zero lift and verify that the dial indicator has returned to zero. The opening and closing figures should be within +1 or -1 degree of the card figures.

If you have any type of problem, contact your cam manufacturer for more information.

If the intake centerline method is going to be used, you must first understand the difference between intake and exhaust certerline and lobe centerline (which should be more understandably stated as lobe separation). Lobe centerline (or separation) is the distance in cam degrees between the maximum lift point (centerline) of the intake lobe and the maximum lift point (centerline) of the exhaust lobe. This separation is ground in the cam and can't be changed unless the cam is reground. Intake and exhaust centerline relates to the phasing of the cam to the crankshaft.

To locate the intake or exhaust centerline you must find the maximum lift of that lobe. Similar to finding TDC you must use an arbitrary figure, this time in thousandths of an inch instead of degrees, say .050". With the dial indicator on the intake lifter, rotate the engine in the normal direction until you reach maximum lift. This is where the dial indicator changes direction. At this point set the dial indicator at zero. Back the engine up until the dial indicator reads .100". Turn the engine back in the normal direction of rotation until the dial indicator reads .050". At this point record the degree number the pointer is on. Continue to rotate in the normal direction of rotation until the dial indicator goes past zero to .050" on the other side of maximum lift. Record the degree number the pointer is on. Add the two degree numbers together and divide by two.

That number will be the location of the maximum lift of the intake lobe in relation to the crankshaft. As you can see, this method does not tell you anything about the cam, or how well it is made.

If the cam card you are using does not state what the intake centerline is, don't assume any number on the specification card is the intake centerline. In most cases the lobe separation (lobe centerline) is not the same as the intake centerline.

Another point about the intake centerline method is that most cams today are of a non-symmetrical design, which means that the opening side of the lobe is not a mirror image of the closing side. Therefore, the "as measured" centerline will not be correct.

Once the cam is phased with the crank, per the manufacturer specs, then a baseline can be established. From that baseline of performance you can dial the cam exactly to your combination. The cam can be advanced or retarded from the card specs up to 4 degrees. Advancing the cam will move the power band down in the RPM range. Whatever you gain in bottom end power you will lose on the top. Retarding the cam will move the power band up in the RPM range. If 4 degrees is not enough, a different camshaft profile would be needed.

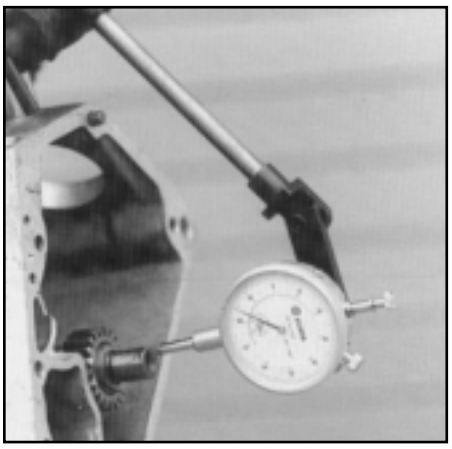

Fig. 6

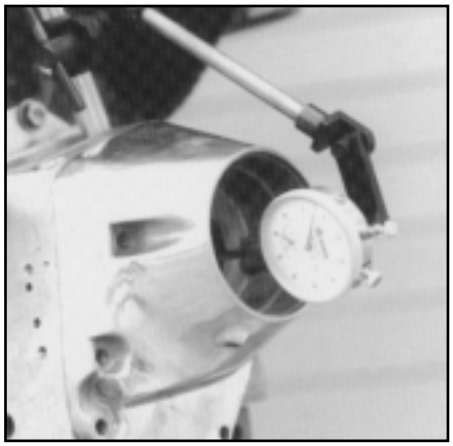

Fig. 7

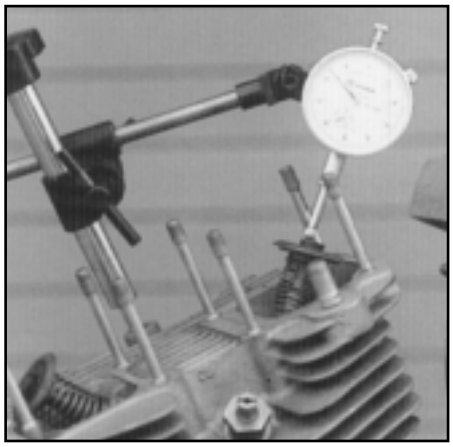

Fig. 8

CHECKING CRANKSHAFT END PLAY

Crankshaft end play is the maximum movement from side to side as pressure is applied to the ends of the crankshaft. Crankshaft end play should be checked at the time of assembly (Fig. 6).

CHECKING CAMSHAFT END PLAY

When your engine is reassembled or a camshaft is replaced, the camshaft end play must be checked (Fig. 7).

CHECKING VALVE COLLAR TO GUIDE TRAVEL

A Tune-A-Cam Kit will check the distance a valve will travel from the fully closed position to the point the collar touches the valve guide. Set the dial indicator assembly up as shown in Fig. 8 with the kit's checking springs installed in place of valve springs. Set the dial indicator hand to zero and record the reading. Push the valve down (fully open position) and record that reading. Subtract the open reading from the closed reading and the difference will be the maximum possible valve travel. It is always best to allow .050" clearance from the collar to the guide at maximum lift to eliminate the possibility of contact during actual operation.