



FEULING

CAMCHEST INSTALLATION INSTRUCTIONS FOR TWIN CAM ENGINES

'07-'17 (INC. '06 DYNA)
CHAIN & GEAR DRIVE



'99-'06 (EXC. '06 DYNA)
CONVERSION CAMS, HYDRAULIC TENSIONERS

PART #'S: 1005, 1006, 1008, 1009, 1011, 1012, 1014, 1015, 1016, 1017, 1018, 1019, 1020, 1022, 1303, 1304, 7030, 7060, 7062, 7074, 7075, 7084, 7087, 7088, 7205, 7205P, 7206, 7206P, 7208, 7208P, 7209, 7209P, 7211, 7211P, 7211ST, 7212, 7212P, 7212ST, 7215, 7215P, 7215ST, 7217, 7217P, 7217ST, 7220, 7220P, 7221, 7221P, 7222, 7222P, 7222ST, 7223, 7223P, 7223ST, 7224, 7224P, 7225, 7225P, 7225ST, 7231, 7231P, 7233, 7233P, 7235, 7235P, 7235ST, 7237, 7237P, 7237ST, 7320, 7320P, 7322, 7322P, 7324, 7324P, 8015, 8033, 8080, 8083

FEULING OE+ CAMPLATE (PART #8033) can be used with factory HD® oil pump or any Twin Cam® oil pump using the '07-'17 bolt pattern.
FEULING HIGHFLOW CAMPLATE (PART #8015) requires a **FEULING HP+ OIL PUMP (PART #7060)** or **RACE SERIES OIL PUMP (PART #7062)**, use the provided allen head oil pump bolts or see optional FEULING x ARP bolt kit (Part #8020).

FEULING RECOMMENDS THE FOLLOWING INSTALLATION PROCEDURES FOR ALL OILING SYSTEM COMBINATIONS ON TWIN CAM® ENGINES.

IMPORTANT NOTICE:

This installation should be done by an experienced mechanic who has access to a factory service manual and all required tools.

CAUTION:

Incorrect installation can cause engine damage not covered under warranty. Failure to install components correctly can cause engine seizure, which may result in serious injury to motorcycle, operator, passenger, and/or others. Removal of the rocker arms and or pushrods with the valve-train loaded can damage rocker arms, pushrods, bushings and or camplate. Always rotate engine to TDC of compression stroke on the servicing cylinder.

VALVESPRING/CAMSHAFT NOTES:

***1999-2004** Twin Cam cylinder heads with stock valve springs can accommodate the Feuling Reaper 525 camshaft as a bolt in but may require minor case clearance for intake lobes. The Feuling Reaper 543, 574, 594, & 630 camshafts require high lift valve springs when used with factory '99-'04 cylinder heads. See Feuling Beehive Spring Kits (Part #1120, 1122, 1100, & 1200).

***2005-2017** Twin Cam cylinder heads will accommodate Feuling Reaper 525, 543, & 574 camshaft grinds as bolt ins but may require minor case clearance for intake lobes. Feuling Reaper 594 & 630 will require high lift valve springs when used with factory cylinder heads. See Feuling Beehive Spring Kits (Part #1121, 1123, 1105, 1205).

INSTRUCTIONS:

1. Refer to the proper factory service manual for your model and year of engine, for removal of exhaust, cam cover, camchest and oil tank.
2. If using 1 piece pushrods which is highly recommend by FEULING - see FEULING #4072 or 4073 for full travel lifters. Remove fuel tank, exhaust, rocker box top covers, breathers and rocker arms to access the pushrods.
3. Inspect pinion shaft for burrs, use fine grit wet sand paper to clean and assure smoothness of shaft.
4. Measure flywheel pinion shaft runout, crank, bearing play & end play. Excessive pinion shaft runout and or end play will cause damage and or failure and voids manufacturer's warranty. **Feuling recommends crankshaft runout and bearing play combination at or below 0.003"** but our warranty does cover up to 0.005". Measure crank bearing play by lifting up on the tip of the pinion shaft with dial indicator in place and adding that amount to the runout for your total.

Ideal end play is 0.003"-0.004", Pinion shaft OD to camplate bore ID has a recommended clearance of 0.0005" – 0.0035".

CRANKSHAFT
RUNOUT
MEASURING
TOOL
(PART #9015)



Crank runout under 0.005"
Ideal is under 0.003".
Including bearing play.
End play 0.003" – 0.004"
Pinion shaft OD to camplate bore ID 0.0005" – 0.0035"



Measure crank bearing play by lifting up on the tip of the pinion shaft with dial indicator in place.



A dial indicator can be attached to the case to check runout if needed.

5. Feuling highly recommends dropping the oil tank & performing a deep clean & flush on the oiling system to remove any & all debris. This is required for our 2 year warranty policy – (visit www.FeulingParts.com/warranty for more info).

NOTE: ANY DEBRIS IN THE OIL TANK WILL RUN DIRECTLY THROUGH THE BRAND NEW OIL PUMP & CAMPLATE.

See oil pan gaskets (Dyna: Part #2100 & Touring: Part #2101).

6. Feuling recommends replaing the inner cam bearings with a full complement style needle bearing.

'99-'06 (Excludes '06 Dyna) use Part #2076, '07-'17 (Includes '06 Dyna) use Part #2077.



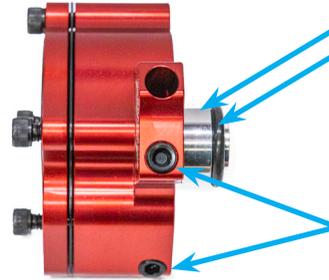
INNER CAM BEARINGS (PART #2076 & 2077)

Install new inner cam bearings using the proper tools & press lube.



7. Wash, clean & inspect the new FEULING components. Verify oil pump & camplate have all external plugs & pressure relief valve, spring & roll pin are installed into camplate.

Camplates #8015 & 8033 have 12 black Allen head plugs installed around the profile, plugging the cross drillings.



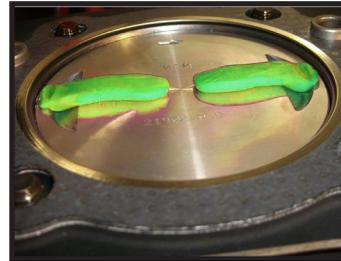
Oil Pumps #7030, 7060 & 7062
Verify subseal standoff is installed into back of oil pump.
Verify oil pump has 3 allen head plugs in the scavenge housing.

8. When installing a new set of cams, inspect camshaft for rotating clearance in engine case. Verify camshaft intake lobes clear crank bearing boss. If installing a high lift camshaft verify piston to valve clearance. High lift camshafts will also require new valve springs. See Feuling Beehive spring kits.

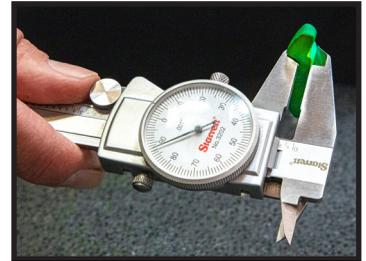
TECH TIP: Piston to valve clearance should not be less than the pre-load set on the hydraulic lifter.



Verify camshaft lobe rotating clearance to engine case.



On high lift camshafts measure valve to piston clearance.



Measure thickness of clay after cycling engine.

9. CAMPLATE BOSS PLUG: Examine the cam compartment for the boss on the left side of the engine case.

A.) DYNA & TOURING ('A' Engines): If the boss is not present ('99-'00) the plug included with your camplate MUST be installed, if the boss is present it is not required to install camplate plug as the boss is a 'dead' hole, however, Feuling recommends installing the provided plug in all "A" engines to help prevent any potential oil leak at the boss.

B.) SOFTAIL ('B' Engines): The boss passage is used to feed oil to the crankshaft counter balancers. The camplate plug should NEVER be installed when used with a "B" engine, unless the crankshaft balancers have been removed.

When installing the 1/16" pipe plug into the camplate use Loctite and torque to 55-60 in-lbs. (NOTE: Use of the O-ring at the boss is still required even if the plug is installed).

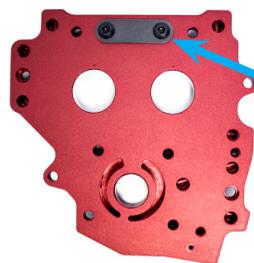
BOSS: If this boss is not present, the 1/16" plug must be installed into camplate.



If installing the 1/16" boss plug, apply Loctite & torque to 55-60 in/lbs.



10. (GEAR DRIVE ONLY) Camplates #8015 & #8033 can be used with chain or gear drive cams. If you are running gear drive cams you will need to install block off plates to block the oiling holes for the hydraulic tensioners. Install block off plates using Loctite 263 (Red) & torque fasteners to 120 in/lbs. Block off plates can be purchased separately, see FEULING #8016.



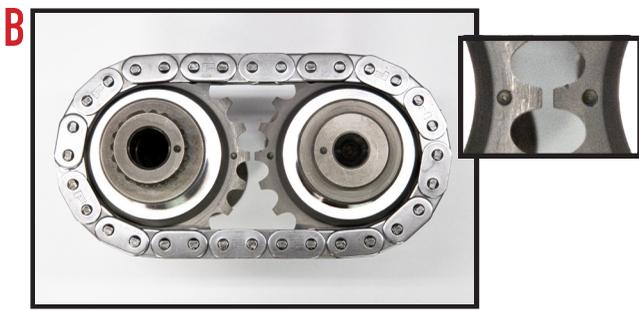
Install block off plates using red Loctite & torque fasteners to 120 in/lbs.



11. Install cams into camplate.

CHAIN DRIVE INSTALL

- Apply engine assembly lube to the cam journals and rear thrust surface of the camplate.
- Apply lube to the front journals of the cams and install the inner chain on the camshafts verifying the timing marks on the cams are aligned.
- Leading with the rear cam, slide cams into the camplate evenly to prevent binding. In some cases the cams should be rotated slightly to aid installation.
- Once cams are installed install the 0.100" thick washer on the front cam along with the retaining clip. Rotate cams by hand to verify they rotate freely.



Install chain on the cams & verify that the timing marks are aligned.



Install cams into camplate. Lead with rear cam.



Install front cam .100" thick thrust washer & retaining clip. Install clip with sharp ID edge outward.

GEAR DRIVE INSTALL

- A) Cam gears are not included with FEULING REAPER cams. (See Drag Specialties Part #0925-0152).
- B) Install cam keys into camshafts then press the inner cam gears onto the camshafts using proper press tools & lube.
- C) Apply engine assembly lube to the cam journals & the front & rear thrust surface of the camplate.
- D) Slide the front cam into the camplate & install the 0.100" thrust washer & retaining ring
- E) Slide the rear cam into the camplate verifying that the timing marks are properly aligned.
- F) Rotate the cams by hand to verify that they rotate freely.
- G) Skip to step 13.

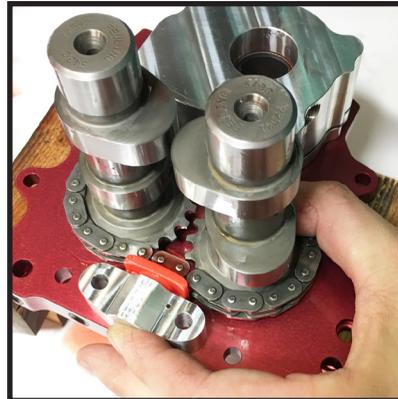
* WHEN INSTALLING GEAR DRIVE CAMSHAFTS THE MAX ALLOWED RUNOUT IS 0.003" *



12. Lube inner tensioner pad, chain and inner bore of tensioner housing. Install inner hydraulic tensioner squarely. Torque tensioner fasteners to 120 in/lbs. using a small amount of moly lube on the under head flange of the bolts and Loctite 263 (Red) on the threads. **Note:** Do not install 1 bolt then rotate the tensioner housing into place as this can cock the pad and create premature wear or failure.



Lube inner tensioner pad, chain, & inner bore of tensioner housing.



Install tensioner pads & housings squarely.



Make sure tensioner pad is square to the chain & the pad moves up & down.

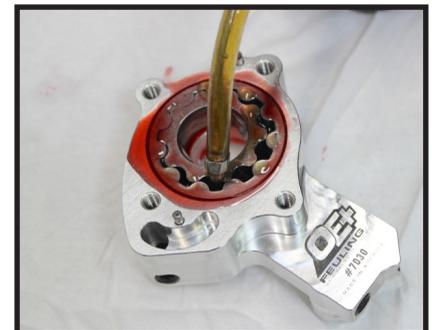
13. Apply engine assembly lube to oil pump gears, oil pump housing, camplate oil pump mating surface and pinion shaft bore. Assemble oil pump verifying that all O-rings (HP+/RS oil pumps only) are in place, and prime oil pump using an oil can and clean motor oil.



Apply assembly lube to the inside of the pump housings.



Lubricate the inner & outer gears of the oil pump.



Prime the oil pump with clean fresh oil before attaching to the camplate.

14. Using moly lube on the threads and under head flange of the oil pump fasteners install the oil pump to the cam support plate finger tight, align the pump gears so the flats are horizontal, and install the O-ring on the back of the oil pump with lubricant. **DO NOT USE LOCTITE ON OIL PUMP FASTENERS.**



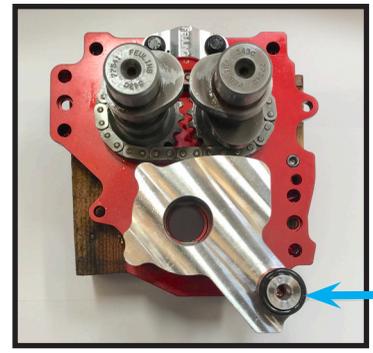
Install oil pump to the camplate finger tight. Note: use moly lube or engine oil on the fasteners.



Align the oil pump gear flats horizontally to aid installation onto the crankshaft.

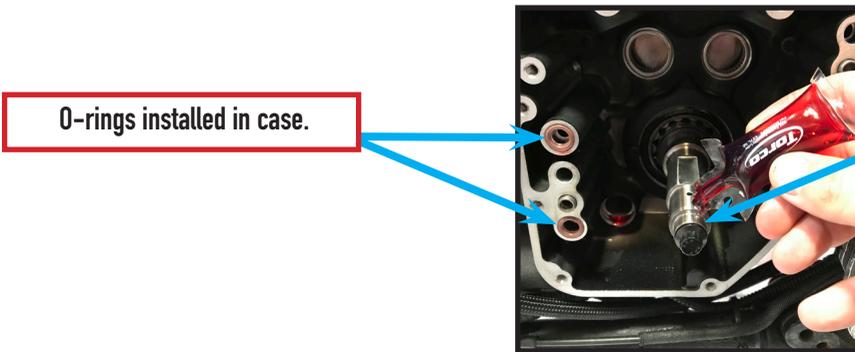


PART #9017
FEUING PART #9017 CAN BE HELPFUL WHEN ALIGNING GEARS



Install O-ring on the back of the pump before installing assembly in the cam compartment

15. Prep cam compartment for oiling system install by installing the O-rings on the left side of the compartment, lubing the pinion shaft and inner cam bearings. Install pinion sprocket bolt into the pinion shaft and rotate the engine until the flats are horizontal to match the oil pump gears.

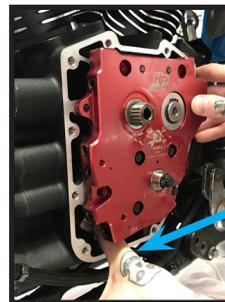


O-rings installed in case.

Rotate crankshaft until flats are horizontal.

TECH TIP: The pinion shaft sprocket bolt can be installed into the pinion shaft during engine assembly and used to easily rotate the engine.

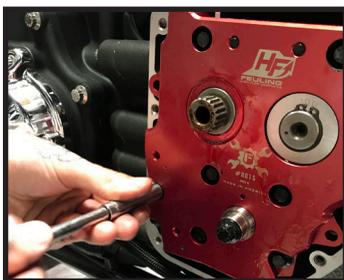
16. Install Camplate and oil pump into cam chest as an assembly. As the assembly slides onto the crankshaft, press inward on the lower section of the oil pump and the camplate at the same time. Note: you should feel positive engagement from the oil pump subseal O-ring.



Using your thumb to press pump inward can aid in installation.

17. TIGHTEN AND TORQUE CAMPLATE BOLTS FIRST, THEN OIL PUMP BOLTS SECOND.

A.) CAMPLATE: Apply moly lube to the under head flange and threads of the camplate fasteners, install finger tight. The engine should be rolled over 4-5 times to center the camplate. Alternately tighten the camplate bolts to **10 in/lbs** and then rotate the engine several times again. Using the same alternating sequence final torque camplate bolts to **90-120 in/lbs**.



Install camplate bolts finger tight. Use moly lube or engine oil on the under head flange & threads.



Rotate the engine 4-5 times to align the camplate then tighten camplate bolts to **10 in/lbs**.



Rotate the engine several more times and final torque to **90-120 in/lbs**.

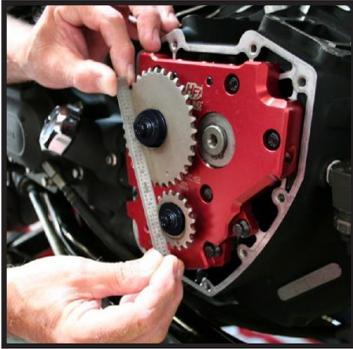
B.) OIL PUMP: Rotate engine 4-5 times to center the oil pump. Tighten oil pump fasteners in a crisscross pattern to **10 in/lbs.** then rotate the engine several more times. Step torque the oil pump bolts from **10 in/lbs, 45 in/lbs, 90 in/lbs, to final torque of 120 in/lbs.** Wait 10-15 minutes, re-torque both camplate & oil pump bolts.

Note: The engine should rotate freely throughout the whole process. If there is any binding or tight spots the oil pump should be removed and inspected for possible pinched O-rings, burrs on the gears or damage.

18. Install drive sprockets or gears (See specific instructions below).

CHAIN DRIVE

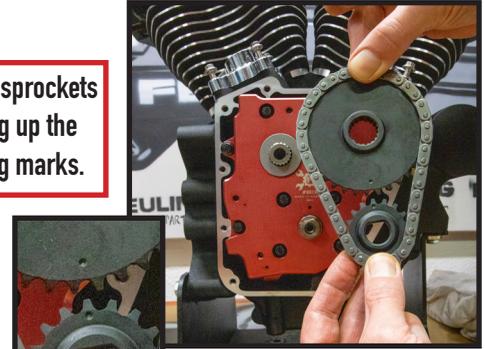
A) Install sprockets lining up timing marks. Check sprocket alignment with a straight edge, use correct thrust washer thickness behind cam sprocket to



Use a straight edge to align cam drive sprockets. Alternate size spacers can be used to move rear cam sprocket in & out as needed.

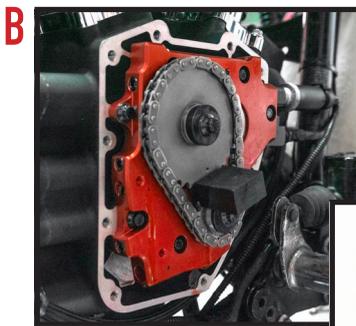


Install sprockets lining up the timing marks.



B) Using a sprocket locking tool install the outer chain & sprockets with timing marks lined up. Apply a small amount of moly lube or oil to the under head flange of the bolts/washers & Loctite 263 (Red) on the threads. Both bolts should be initially torqued to **15 ft/lbs.** and then loosened one full rotation. Final torque the pinion shaft bolt to **24 ft/lbs.** and the rear sprocket bolt to **34 ft/lbs.**

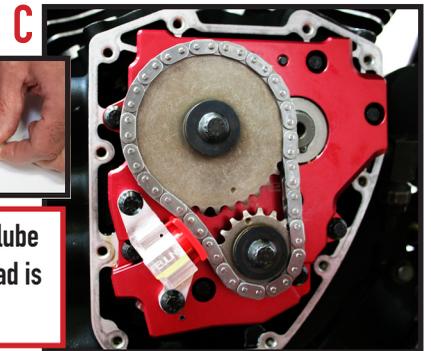
C) Install front tensioner assembly, lube pad, verify pad is square to chain & not cocked. Pad should move freely.



Use the proper sprocket locking tool & install the sprocket bolts using red Loctite. Final torque cam bolt to **34 ft/lbs** & crankshaft bolt to **24 ft/lbs.**



Install outer tensioner. Use assembly lube on the tensioner pad & chain. Verify pad is square to chain & not cocked.



GEAR DRIVE

A) Install gears lining up timing marks. Verify cam gear backlash is within tolerance. See cam gear manufacturer instructions for procedures & specifications.

B) When using Feuling X ARP fasteners, apply a small amount of moly lube to the under head flange of the bolts & Loctite 263 (Red) to the threads. Both bolts should be initially torqued to **15 ft/lbs.** & then loosened one full rotation. Final torque the pinion shaft bolt to **24 ft/lbs.** & the rear sprocket bolt to **34 ft/lbs.**



19. Pump up lifters using an oil squirt can and install into the engine case along with the anti-rotation pins. Install new lifter block gaskets and lifter block covers. Apply Loctite 243 (Blue) to lifter block fasteners and torque to **120 In. Lbs.**

Note: Feuling lifters are not directional. However, it is recommended that all lifter oiling holes are oriented the same direction.

Install new lifter block gaskets & torque to **120 in. lbs.**



OIL CAN (PART #9005)

Pump up lifters before installing into the lifter bores.



Install lifters into engine case with anti-rotation pins.



20. Prep pushrod tubes, cylinder heads & lifter blocks with new O-rings. With your sprocket timing marks aligned the rear cylinder is on TDCC, the rear lifters are ready for pushrod installation. See tech notes below on One Piece & Adjustable pushrod installation. Pump up pushrods & rocker arms with an oil squirt can during installation. After rear lifters have bled down (10-25 min) & you can rotate the pushrods by hand, you are now ready to install front pushrods. Rotate engine to front TDCC & install front pushrods. See **pro tip** below.

21. Finish assembling the motorcycle following the factory service manual. If the motorcycle is not equipped with an oil pressure gauge Feuling recommends using a remote oil pressure gauge to verify that the motorcycle has good oil pressure at initial startup. See Feuling **#9018** an **#9019**.

ONE PIECE PUSHRODS

- A) Install the rear cylinder pushrods and pushrod tubes verifying that the intake and exhaust pushrods being installed into the correct position. Prime pushrods with oil using an oil squirt can. Note: longer pushrods are the exhaust.
- B) Install new lower rocker box breather o-ring and then install the rear rocker arm support using **Red Loctite (262 or 263)** on the bolts. Using a crisscross pattern bring down the rocker arm support evenly. Once the rocker support is seated final torque the rocker arm support fasteners to **18-22 ft/lbs.**
- C) Install new breather filter element, umbrella valve and gaskets. Using **Blue Loctite (242 or 243)** torque the breather bolts to **120-156 in/lbs.**
- D) Install rear rocker cover & new gasket. Using **Blue Loctite (242 or 243)** torque the six rocker cover fasteners to **15-18 ft/lbs.** using a crisscross pattern.
- E) Verify that the rear cylinder pushrods have bled down by rotating the pushrods by hand. If the pushrods will not spin by hand the lifters have not bled down. If they do spin by hand install the pushrod tube clips.
- F) Rotate the engine over one full revolution. Your pinion sprocket timing mark should be back in the same spot and the timing mark on the cam sprocket/gear should be 180 degrees off. With your engine in this rotation you now have the front cylinder on TDCC and can install the pushrods, rocker arms, and rocker cover repeating steps A-F.

LIFTER/ PUSHROD ADJUSTMENT NOTES

Run the correct pre-load on your lifters! We recommend running hydraulic lifters just under 1/2 travel at operating temperature.

- A.) Feuling **full travel** lifters are designed to run with 0.090" - 0.110" of cold pre-load (total lifter travel = 0.200")
- B.) Feuling **short travel** lifters are designed to run with 0.060" - 0.070" of cold pre-load (total lifter travel = 0.115")

*Always start with fully pumped up lifters! When using adjustable pushrods start at zero lash & adjust the pushrod longer, crushing the lifter to add pre-load. We DO NOT recommend bottoming the lifter & adjusting back upwards.

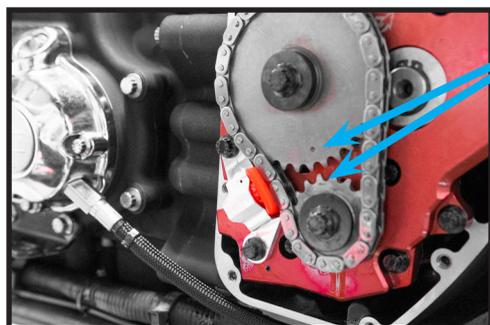
CHART FOR ADJUSTABLE PUSHRODS

FEULING FULL TRAVEL

FEULING SHORT TRAVEL

*CORRECT ADJUSTMENT REQUIRES STARTING WITH FULLY PUMPED UP LIFTERS	THREADS PER INCH	DISTANCE PER 1 FULL TURN	URNS TO .100"	URNS TO .065"
	20	0.050"	2	1.3
24	0.0417"	2.39	1.55	
28	0.0357"	2.80	1.82	
32	0.0313"	3.19	2.07	

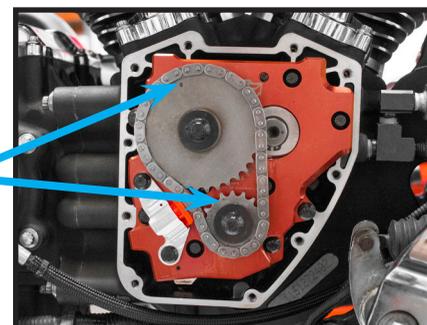
REAR TDCC



PRO TIP: FINDING FRONT & REAR CYLINDER TDCC

With the timing marks aligned, the rear cylinder is ready for assembly.

FRONT TDCC



With the timing marks in this position, the front cylinder is ready for assembly.

* With the cam cover off during top end assembly you can easily rotate the engine and determine the stroke of the engine. This is a simple and precise way to determine which cylinder is on TDCC. *

FEULING® REAPER CAM SPECS FOR TWIN CAM® ENGINES



Grind		Valve Lift	Open	Close	Duration @ .053"	Lift @ TDC	Lobe Centerline	Overlap	Description
525	Intake Exhaust	525" 535"	4° 51°	42° 5°	226° 236°	.099" .112"	109° 113°	9	A real workhorse. Bolt in for 88-103 engines. Producing strong low and mid range power. 1750-5500 RPM
543	Intake Exhaust	543" 553"	15° 56°	43° 12°	238° 248°	.160" .140"	104° 112°	27	"The Freeway Flyer". An Excellent compromise between the 525 and 574 achieving the best all around performance. Bolt in for 96 and 103 engines. 1900-6000 RPM
574	Intake Exhaust	574" 574"	15° 61°	45° 14°	240° 255°	.163" .143"	105° 113.5°	29	Wicked power band for 103 and larger engines. Respondes well to head work and increased compression. Go to bolt in camshaft for 110 engines. 2100-6500 RPM
594	Intake Exhaust	594" 604"	19° 64°	56° 16°	255° 260°	.190" .167"	108.5° 114°	35	Freight train pulling power. Works best with larger displacement engines and added compression. Will respond well to ported heads and open intake. Requires high lift valve springs. 2200-6250 RPM
630	Intake Exhaust	630" 630"	20° 60°	58° 19°	258° 263°	.188" .171"	109° 112.5°	39	Eye blurring mid and top end power. Designed for worked 120"+engines. Requires high lift valve springs. 2500-6900+ RPM

CAMSHAFT NOTE: NOT LEGAL FOR SALE OR USE IN CALIFORNIA ON ANY POLLUTION CONTROLLED MOTOR VEHICLE. Not legal for sale or use on any EPA pollution controlled motor vehicle.

FEULING® TWIN CAM® TROUBLE SHOOTING GUIDE

Having oiling, noise, sumping issues with your Twin Cam engine? Please review the trouble shooting guide that Feuling has compiled over the years to help assist you.

ALWAYS CHECK YOUR OIL PRESSURE – WHAT IS YOUR OIL PRESSURE COLD? HOT?

LOW OIL PRESSURE

1. Check and verify engine oil level.
2. Pressure gauge not reading properly – double check with another mechanical PSI gauge.
3. Pressure relief valve in the camplate is leaking, sticking open or not seating properly – see Feuling camplate PSI test tool Part #9010.
4. Pinched oil pump O-ring(s).
5. Loose camplate/oil pump bolts, stripped camplate 'dowel pin' bolts.
6. camplate scored at oil pump mounting surface, pressure gears and/or housing scored from debris running through oil pump.
7. Excessive crankshaft pinion shaft runout causing oil cavitation.
8. Intermittent oil psi loss on bagger/FL models during hard acceleration – oil tank baffle shifted & blocking oil pick up hole.
9. Mis-alignment of oil pump – center camplate to pinion shaft then oil pump to pion shaft by rotating engine over while tightening bolts.
10. Leaky piston cooling jets.
11. Leaky camplate hydraulic tensioners ('07-'17 including '06 Dyna models) – when tightening outer tensioner push tensioner toward chain.
12. '99-'06 leaking fittings and/or issues with the 90 degree rubber oil lines, sucking/pulling air. Oil line broken on the inside causing a "flapper valve".
13. '99-'06 style hydraulic tensioner camplates using bearing retainer plates – plate was not installed causing a leak through one of the bolt holes.
14. '07 & later inter connect gasket seal leaking, sucking/pulling air – check transmission to engine mounting bolt torque & oil around mating seam.

NO OIL PRESSURE

1. Check & verify engine oil level.
2. Pressure relief valve stuck open in camplate – see Feuling camplate PSI test tool Part #9010.
3. Missing plug in camplate face (boss vs. no boss).
4. Air lock in oiling system – fill oil filter full of oil – if this is initial engine start up.
5. Broken oil pump gears – gears & housings not lubricated properly during install, debris running through engine, excessive crankshaft runout.
6. Broken/loose piston cooling jets.
7. Stock oil pump installed on Feuling High Flow camplate.
8. Blocked pick up part in oil tank. Possible debris from prior failure.

TENSIONER WEAR

1. Dark discoloration – indicator of excessive heat. check tune, oil quality & oil change intervals.
2. Excessive wear – excessive crankshaft runout, excessive crankshaft end play, sprocket mis alignment, sprocket runout, burrs on chains and or damaged chains, lack of oil changes, excessive heat due to improper tune, poor oil quality.

FEULING® TWIN CAM® TROUBLE SHOOTING GUIDE (CONTINUED)

WET SUMPING / BLOW-BY

1. To verify the engine is wet sumping, run engine to operating temperature then shut down it down & pull the allen head plug from the bottom of the engine case. Measure oil & if more than 5oz. drains from the sump there is a wet sumping issue.
2. Oil level too high – run oil level no more than $\frac{3}{4}$ - $\frac{7}{8}$ full cold, check oil level per owner's manual.
3. Sub seal of oil pump mis aligned with the scavenge port hole of the engine case & or torn o-ring.
4. Piston rings not seated, creating excessive blow by & oiling system cavitation, run a cylinder leak down test – vent oil tank – See Feuling vented dipsticks & oil tank breather kits.
5. Scavenge gears and or housing scored from debris running through the oil pump causing out of tolerance scavenge side of oil pump.
6. Excessive runout in pinion shaft – causing oil pump/system cavitation.
7. Pinched oil pump O-ring(s).
8. FL/Baggers – 6 speed transmission with dipstick in rear of trans can allow more oil to be added to oil tank and not show on the dipstick.
9. Excessive RPM on rev limiter, de-seated piston rings.
10. Flapper umbrella valves in rocker box breathers stuck or installed incorrectly.
11. Rocker box breathers need to be serviced - new filter, umbrella valve & gaskets (See Part #3200).
12. Return oil passages plugged, pick-up hole in crankcase plugged.
13. '99-'06 leaking fittings and or issue with the 90-degree rubber oil lines, sucking/pulling air.

DIPSTICK BLOW OUT

1. Oil level too high, run oil level $\frac{3}{4}$ - $\frac{7}{8}$ full cold.
2. Rocker housing gaskets are wrong or were installed improperly.
3. Excessive cylinder leak down – run a cylinder leak down test.
4. Breather valves in rocker boxes installed incorrectly, it's common to find them installed upside down with the flapper below the breather element.
5. Spark knock, piston detonation, rings not seated or coming un-seated under hard acceleration.
6. Excessive RPM on rev limiter, de-seating rings.
7. Vent oil tank – see Feuling vented dipsticks or oil tank breather kits.
8. Use conventional oil over synthetic for better ring/cylinder seal.

NOISY VALVE-TRAIN

1. Lifter to lifter bore clearance too large. Feuling recommends a clearance of 0.001"–0.0015" for proper lifter performance – see tool #9004 and oversized lifter #'s 4051, 4052.
2. Pushrods flexing and hitting pushrod tubes – look for shiny ring witness mark around pushrod normally seen towards the cylinder head.
3. Low oil pressure – Check with mechanical gauge if one is not equipped on the bike, refer to low oil pressure section if necessary.
4. Rocker arms/bushings out of tolerance.
5. Bad valve spring to camshaft combination creating valve-train separation – see Feuling Beehive spring kits.
6. Insufficient clearance for roller rocker arms on underside of rocker box covers.
7. Steep ramped camshafts, valves closing so fast the valves bounce off valve seats – see Feuling Beehive spring kits.
8. Pushrod center hole plugged.
9. Leaky or broken piston cooling jets.
10. Oil filter with failed or missing anti-drain back valve, causing valve-train noise at initial start up.

ENGINE NOT ROTATING

1. Pinched O-ring in oil pump.
2. Burr on oil pump gear eliminating the side clearance of oil pump, pump locks up as soon as bolts get tight.
3. Debris inside oil pump teeth, binding gears.
4. Dry oil pump housing and gears.
5. Gear drive cams on 07-'17 not installed correctly, possible use of washer behind rear cam gear.

* STANDARD 1 YEAR WARRANTY:

- WARRANTY COVERS MANUFACTURE DEFECTS.
- DOES NOT COVER PARTS THAT HAVE FAILED DUE TO IMPROPER INSTALLATION, MAINTENANCE, EXCESSIVE CRANKSHAFT RUNOUT, OR MISUSE.
- DOES NOT COVER ANY CONSEQUENTIAL DAMAGE RESULTING FROM A FAILURE OF A FEULING PRODUCT.
- CRANKSHAFT RUNOUT MUST BE BELOW 0.005"

* OPTIONAL 2 YEAR WARRANTY:

- ADDITIONAL YEAR WARRANTY IS ONLY AVAILABLE IF PARTS ARE INSTALLED BY A PROFESSIONAL INSTALLER.
- THE ONLINE WARRANTY FORM MUST BE COMPLETED BY THE DEALER PRIOR TO BIKE DELIVERY.
- OIL TANK MUST BE DROPPED & CLEANED.
- CRANKSHAFT RUNOUT MUST BE BELOW 0.005"

NOTE: FOR FULL WARRANTY INFORMATION VISIT WWW.FEULINGPARTS.COM/WARRANTY

CAMSHAFT NOTE: NOT LEGAL FOR SALE OR USE IN CALIFORNIA ON ANY POLLUTION CONTROLLED MOTOR VEHICLE. Not legal for sale or use on any EPA pollution controlled motor vehicle.



'07-'17 (INC. '06 DYNA)
CHAIN & GEAR DRIVE



'99-'06 (EXC. '06 DYNA)
CONVERSION CAMS, HYDRAULIC TENSIONERS