TECHNICAL INFORMATION

DUNCAN RACING INTERNAIONAL INC.

4-STROKE TOP END ASSEMBLY TIPS

*Note; The following information is intended to be used in conjunction with the OEM (*Original Engine Manufacture*) service manual.

- Before beginning reassembly be sure to have all the necessary new parts required to do the complete job. Including; New piston, rings, pin clips, gaskets, o-rings, camshaft, cylinder dowels etc.
- Clean all gasket surfaces thoroughly. **They can not be to clean!** Make sure all gasket surfaces on cylinder; head, top plate, manifold etc. are clean. All gasket surfaces should be cleaned using a small pocketknife, wire brush, small file, etc. Great care should be taken to clean each surface **without causing any damage** to the surface. The final surface to clean should be the base gasket surface on the center cases. Special care must be taken to prevent any foreign material from falling into your 4-stroke lower end cavity. When you feel all gasket surfaces are clean, run your finger over all the surfaces. You should feel absolutely no obstructions on the surfaces. If it feels smooth, it is.
- Before assembly all parts must be washed thoroughly. It is recommended to wash your parts in a solvent specifically designed for washing M/C, ATV and auto parts. During the washing process inspect each part. Pay close attention for any unnecessary wear or fatigue.
- **MACHINE WORK:** When rebuilding the top end of most 4-stroke engines machine work will be required. In most if not all cases, a skilled ATV/Motorcycle machinist or engine builder must perform the machining needs of your engine. Consult these professionals regarding; cylinder boring, valve jobs, cam grinding, rocker arm hard facing etc.
- All machine work must be completed before you start the top end reassembly process.
- After all of your parts are machined, cleaned and prepped you are now ready to reassemble your engine. To start the reassembly process it is recommended that you lay out all of your parts on a clean towel or rag in a neat and orderly fashion. Make sure all pieces are accounted for and easily accessible.
- Check that base studs are tight (when applicable).
- Check piston ring end gap. All rings must be checked. As a general rule, you should allow a gap of .004" for every inch of bore. Example: A piston with a 3" diameter bore would require a ring gap of .012". After checking and setting the ring end gap, make sure to debur each ring specifically on the ends.
- Install rings onto piston. Install the oil ring assembly first. The oil ring is generally a 3-piece ring with no specific top or bottom. Make sure not to damage the oil ring which could cause your engine to smoke. **See DR TECH DOCUMENENT FOR RING INSTALLATION*
- Next, install the two compression rings. All 4-stroke compressions rings have a trademark (usually the ring size .25, .50 etc.) on them to designate the top of the ring. On most ring sets the compression rings are different colors. The top ring is usually silver; the second ring a dark gray/black color. Install in that order with the trademarks facing up.
- Install piston on connecting rod. Lubricate piston pin with motor oil. Make sure both piston circlips (retainers) are installed securely. **NOTE:** It is advisable to place a rag under piston and over crankshaft when installing circlip(s). This is advisable to ensure nothing falls into the crankshaft cavity.
- If base gasket is made from a paper material it is recommended to apply a fine coat of grease on both sides of the gasket-this will allow gasket to seat in place more efficiently.

If base gasket is of steel construction, inspect for factory sealants attached to gasket- this is common on most oem steel base gaskets- gaskets of this nature generally require no sealer. The 3rd type of base gasket that is common is a steel base gasket with not sealer- with these types of gaskets a very thin coat of silicon can be applied.
Install base gasket onto center cases. Stagger ring end gaps every 120°, then install cylinder onto cases. If cylinder is secured independently from cylinder head tighten bolts finger tight, then torque to the correct specification.

- Head gasket installation. Make sure head gasket is the correct gasket for your application. Measure I.D. of head gasket. It should be at least .010" larger than the cylinder bore. Most 4-stroke head gaskets are made from steel. Generally they do not require any sealer. But if it is deemed necessary a fine coat of high temp silicone may be applied to gasket.
- Install cylinder head and tightened bolts/nuts finger tight. Torque to the correct specification.
- **HINTS TO PROPER TORQUING:** When installing head/base nuts, bolts and washers ensure there are no burrs or worn areas that may give the torque wrench a false reading. It is also advisable to use a small amount of lubrication on nuts, bolts and washers to help them seat properly. **Always use the proper torque wrench.** A name brand (Snap-On) breakaway type torque wrench will provide the best results. Do not guess on the torque values required to correctly assemble your engine. ***Consult your OEM service manual for the correct torque Procedure and Specifications.***
- Install camshaft, cam sprocket, and set cam timing. When installing camshaft be sure that any cam bearings are lubricated properly. It is also necessary to coat the camshaft journals and lopes with a graphite type assembly lube (it must of a paste type design, because a liquid will run off parts and leave things dry)
- **Failure to set the engines cam timing correctly can cause engine damage and or poor engine performance.** Consult OEM service manual for specific instructions on setting your engines cam timing. After cam timing is set it is recommended to use some form of thread lock on the camshaft to cam sprocket bolts.
- On most models the top plate to the engine is separate from the head. The top plate houses the rocker arms. Before installing the top plate, carefully inspect the rocker arms, and tappet adjusters. These items are hard faced. If any wear is noticed on these components they must be replaced and or repaired. The top plate must also be torqued to the correct values. Consult OEM service manual for proper installation and torque settings.
- **Valve Settings**. Before setting the valves you must ensure that the engine is at TDC on the compression stroke. This is done by rotating the engine and stopping at TDC after the **Intake valve(s)** have closed. If using a stock camshaft your OEM service manual will have specs for setting valve clearance. If you are using an aftermarket camshaft, refer to the manufactures cam spec card for necessary settings. It is advisable to review the complete valve setting process illustrated in your OEM service manual before performing this exercise.
Special note for Honda 400EX owners, due to the automatic compression release. Setting the valve clearance for the RH Exhaust valve requires a special process. It is mandatory that you consult your OEM service manual.
- Install cam chain tensioner. Most tensioners have a special installation process. It is advisable to review the OEM service manual for specific instructions.
- Install new o-rings into intake manifold and valve cover caps and install.
- Install new spark plug. Before installing put a couple of drops of oil on the threads. Consult your engine builder or OEM service manual for the correct plug and plug gap. Check gap before installing.
- If engine is out of the chassis, Install engine in chassis. Consult DR ***R & R Engine Tech sheet.***

- Install exhaust pipe and muffler. Be sure exhaust studs and nuts are in good condition. If not replace them with new. Use new exhaust gasket(s). Failure do this can cause an exhaust leak, affecting performance. It is also advisable to make sure muffler packing is in good condition.
- Before install carburetor it should be cleaned and the jetting should be checked and recorded. It is advisable in most cases to richen jetting before running a fresh engine. Consult your engine tuner or a professional for more information. If your machine is fuel injected, the throttle body must be cleaned and inspected
- Clean air box thoroughly inside and out. Install new or freshly cleaned and oiled air filter.
- After machine is completely assembled and all fluids are filled. You are now ready to start your engine and begin the break in process. Duncan Racing has a very specific engine break-in procedure that is recommended to follow. Consult DR ***4-Stoke Break-In Tech sheet***.

SPECIAL NOTES

- When servicing the top end on your 4-stroke it is advisable to closely inspect your crankshaft and main bearings when cylinder is removed. Care should be taken to ensure crankshaft and main bearings turnover freely and without abnormal noise. Verify lower rod bearing cage and thrust washers are intact. Make sure rod has no up and down play. There should be reasonable side play. But if the rod has any upward movement it must be repaired/replaced. If there are any doubts to the condition of these items, consult a professional.
- **Cylinder Boring:** Cylinder reboring is often one of the most overlooked maintenance/repair issues concerning your machine. Proper boring and sizing of the cylinder when it is required is critical to both your engines performance and reliability. When this service is required be sure to have it performed by a professional.
- **Piston to Valve Clearance:** It is the responsibility of the mechanic/technician performing the engines final assembly to make sure that the piston to valve clearance is set at an acceptable tolerance. Many of the Hi-Performance items such as high lift camshafts, high compression pistons, etc. can alter the piston to valve clearance. Refer to your HP products instructions or consult a professional for more information.