Part #56
C & E Gearbox Maintenance - Changing Gears & Propshaft

By Mike Stratman

Last time we talked about general teardown and inspection of the "C" or "E" Gearbox. As we found that with basic hand tools and your mag-end flywheel puller you can get at a majority of the gearbox. But if want you to change the gear ratio or propshaft your are going to have to invest some time and money on the right equipment. This month we will illustrate several special jigs that need to be fashioned to perform certain tasks. We'll show you how to change gear sets, remove the propshaft, do a complete inspection, and update your box following the latest Rotax Service Bulletins

Pulling the Large Gear: *Here is where things start to get tougher. In order to remove the large hex nut and pull the gear you will need both a solid fixture to mount the prop shaft as well as a special puller from Rotax to actually pull the gear from it's tapered fit. In order to get a firm grip on the prop flange, construct a jig using the prop plate for a pattern. You will need 6@ 1-1/2" long 8mm studs (5/16" will work as well) mounted thru a metal plate with a 1" center hole. See figure #7.*

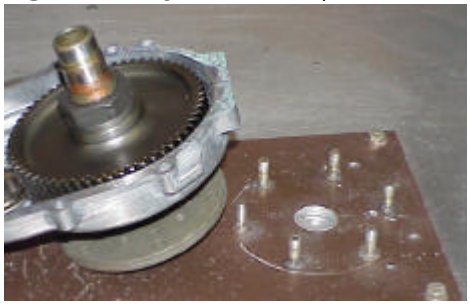
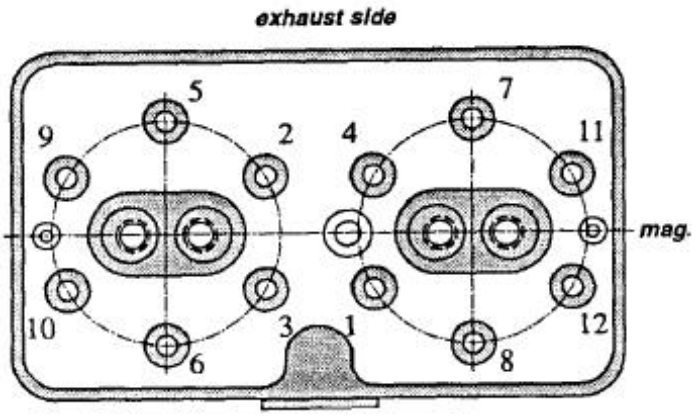


Figure #7 – Holding the prop shaft in a jig is necessary to remove the large nut holding the gear in place. A simple jig mounted to a workbench is needed to handle the large torque values.

Removing the Large Nut: *Once you have the propshaft firmly held, you can remove the 30mm nut on the shaft. Good luck trying to find a metric socket big enough to fit. A 1-5/8" socket will work as well. You will likely need to go to ¾" drive to fit this large socket.* ***Remember that the threads here are Left Hand!!*** *You may need heat to soften the Loctite on the threads. We use a 6'long iron pipe for a cheater bar to help get the snort needed handle this job. See Figure #8.*

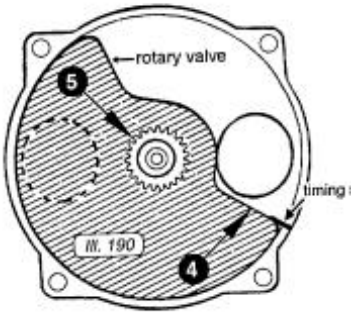
Reuse Of Head Gaskets Or Oil Rings? *- Rotax uses a special silicone o-rings to seal the top of the combustion chamber on it's 532-582-618 engines. The good part of this is that silicone resists heat fatigue. The bad part is they cost better than $10 each! Careful inspection can save you some money here. Check the o-rings with a magnifying glass for cracking or deforming. The o-ring must still be round and not take an imprint when pinched with the fingernails. If you are satisfied that these o-rings pass this inspection, reuse them and save the money. The outer square type rubber rings that seal the outside perimeter of the cylinders should not experience excessive heat unless you have run water temps over 200F for extended periods. Check them for heat fatigue, replace if cracked, torn or deformed. Cost is minimal here. Base and intake gaskets can be used again if not torn. Aluminum head gaskets can be flipped over and used a second time only if no edge extrusion is visible. Always replace the exhaust gaskets.*

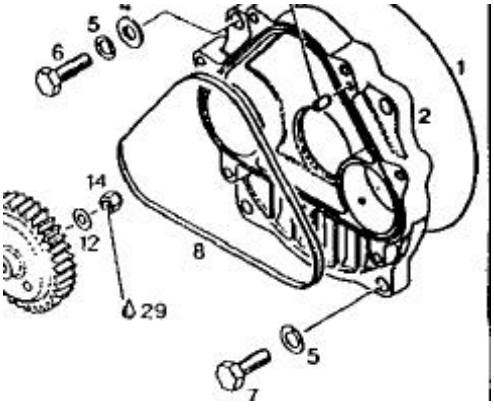
On air cooled engines the head gaskets can be reused if flipped over and retorted to 18 ft.lbs. Run the engine at least two hours, let set over night and then retorque all fasteners. See accompanying illustration for torquing sequence. If you are not sure about specs, see CPS catalog for torque value and recommended sealant on all fasteners.



Retorquing Head Nuts *- If you experience water leaks on head nuts on liquid cooled motors, chances are they are either loose or not installed properly. Use a small amount of Lithium grease at the base of the head nuts prevents galling and helps seal the flair on the bottom of the nut against the cylinder head. Note the flair shape of the head nut shown here. Use RTV Sealant under brackets and other items located under head nuts. This will keep fluid from passing around cylinder bolts.*

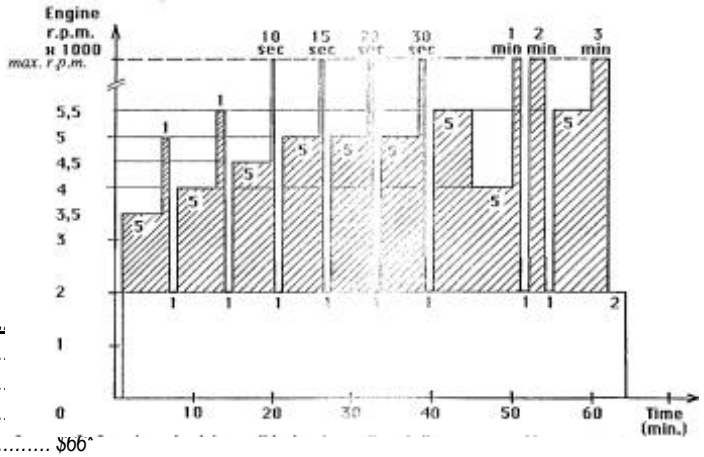
Timing the Rotary Valve *- On liquid cooled motors the Rotary Valve plate must be timed when installed. Place your dial indicator in the mag side cylinder and bring the piston to top dead center. Install the plate so that the opening is in the 11 and 4 o'clock position. The 4 o'clock or closing edge must be slightly below the bottom of the mag side port. See illustration. The plate is asymmetrical so flipping it over will give you more positioning options. If you where smart, a scribe mark before teardown would make this real simple.*





Installing the RV Cover Plate *- On liquid cooled engines there is the opportunity to break the crankcase if you are not paying attention when installing the four 8mm fasteners that hold this cover. The mounting bolts are two different lengths and when installed in the wrong position can bottom on the crankcase. Another turn or two of the wrench and the ear of the crankcase can be broken. As you can see there is no fix for this disaster! Crankcases run around $800. Work slowly and pay attention when assembling this area. See illustration for clarification.*

Break-in Procedures *- If you have replaced the piston rings and refaced the cylinder walls as previously mentioned, you must run the new engine break-n procedure. New rings and cylinder walls must reseal themselves by establishing a new wear pattern. Break-in is also described as a "controlled destruction". During the first few minutes of operation these new parts will wear at an accelerated rate. Controlling this destruction by following the 60 minute chart will mean a tighter seal and a better running engine. See illustration.*



Tool and Parts Listing - *As mentioned earlier, to make things easier the following is a list of recommended parts and specialty tools to have on hand to before getting started. We trust you have the common metric hand tools.*

Specialty Tools

Tool Part #	***Required***	***Recommended***	
#14003 Bearing slug	*X*		
#877-090 Pin Extractor		*X*	
#876-358 Wrist Pin Puller	*X*		
#877-015 Circlip Tool		*X*	*$66**
#876-570 Exhaust Alignment Bar		*X*	*$25**
#876-900 Cylinder Alignment Bar		*X*	*$43**
#15009 Timing Tool Kit	*X*		*$89**
#T149 Torque Wrench	*X*		*$129**
#9529 Flex Hone	*X*		*$46**
#9531 Cylinder Bore Kit	*X*		*$449**
#9579 Parts Cleaning Kit	*X*		*$12**

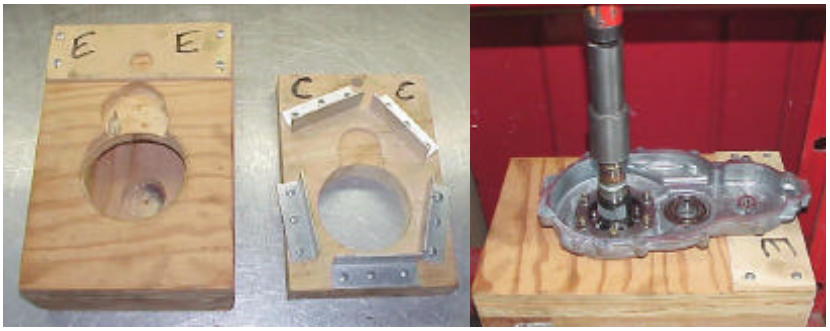


Figure # 10 & #11 – Shows both "C" and "E" custom fixtures need to support the housing during propshaft removal. If not properly supported the housing will break under the pressures needed to remove the propshaft.

Removing the Propshaft Bearing and Seal: *At this point the propshaft is out of the way and the support bearing and seal can be removed. After removing the rack of 6mm bolts holding cover plate. To remove the bearing, press from the opposite side pushing the seal and bearing out together. This will likely destroy the seal so be sure to have another on hand if you need to go this far. If you have suffered a severe prop strike you need to check the propshaft and the crankshaft end for run out. The maximum run out is .002" or 0.05mm for either. If the propshaft is bent it is best to replace this bearing as well as the seal figuring that the bearing would likely be damaged as well.*

Figure #12 – Be sure to install the Bushing/Collar in the bearing located next to the large gear. On some ratios this cannot be done after the gear is in place.

Front Housing Drive Gear Bearing: *Locate next to the large gear is a bearing that supports the outside end of the small drive gear. Special attention needs to given this bearing for a couple of reasons. First. The collar that contacts the shaft is both a bushing as well as part of the bearing and can be separated from the rest of the bearing. At this point the actual bearing rollers are no longer supported and can fall from the race. It's OK to use a light grease to keep these guys under control during assembly. Also make sure that the collar is back in place before reinstalling the large gear. On some ratios you can't do this after the gear is in place. See Figure #12. If for whatever reason you need to remove this bearing completely, heat the housing aggressively from the opposite side to expand the housing. Slap the entire housing down on a piece of wood to extract the bearing by force.*

Important Production Changes: *Due to some early problems with large gear slippage on the propshaft the tapered cone inside the large gear has been changed to a different taper on both the large gear and the cone sleeve. If you own one of the first "C" or "E" boxes it will have a different type of gear and cone. Early models, especially the higher 3.47 and 4.0 ratios, had trouble with slippage making it necessary to go to huge torque numbers on the shaft nut. If you have one of this older units refer to Service Instruction Bulletin #SI-06-98 found on our website at www.800-airwolf.com. Go to Tech Info and then Rotax Documentation. Download in PDF format. Be sure to use Loctite High Strength Sleeve Retainer #648 or #680 inside and outside the cone sleeve as well as on the threads to keep your assembly from slipping. Torque large nut to 185 ft. lbs or 250 NM.*

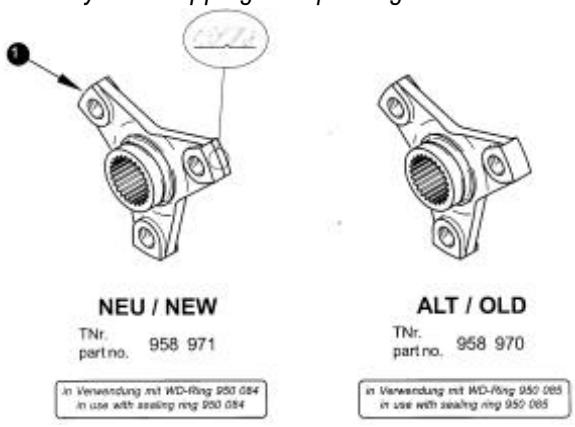


Figure #13 – New gearbox come with an improved spider and matching seal. Be sure not to mix old and new style spiders and seals. Leakage will occur.

New Spider Gear and Seal: *Also be aware that the spider part # 958-971 has been changed slightly requiring the use of a different seal #950-084 for better sealing of this area. The new spider has an identifying mark on the outer ear as shown in figure #13. See bulletin SI-2ST-004 issued in December 2001. Full document can be found on our website at www.800-airwolf.com. Go to Tech Info and then Rotax Documentation.*

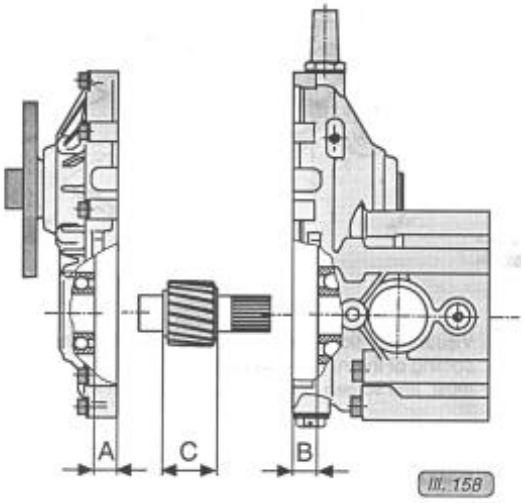


Figure #14 – Because our gears are helical cut they will want to move in either direction when load is applied and released. Proper clearance between case and gear needs to be maintained.

Shimming for Small Gear Clearance: *Because the gear teeth are helical cut they will want to move in either direction as the load is applied and released. Proper clearance between the case and gear needs to be addressed. To determine shims needed, take dimensions by depth gauge from jointing plate of housing and cover too bearing. Add dimensions A and B and compare with dimension C as shown in figure #14. Compensate with shims as shown in parts book located on the engine side of the gear shaft. You are looking for a zero differential. The thickness of the large case gasket is 0.4mm, which supplies the final clearance when assembled. Chances are the clearance is OK if you reinstall the shims present when you disassembled the box. Boxes with very high hours will likely have shimmed due to normal wear. Left unattended the gear will wear at an accelerated rate the more slop is available so pat attention to this clearance during regularly scheduled inspections.*

Preflight and Periodic Inspections: *Make it a habit to include the rubber hardy disks on your daily preflight. Use a flashlight thru the large inspection hole to view the rubber disk for cracking or deterioration. The disk should give you plenty of warning as it begins to chuck out before complete failure. Under no circumstances are you to cover or block this opening. It must remain open for proper ventilation and cooling of the enclosed parts.*

Be sure to change the oil with a good SAE 90 W GL-5 oil after the first 10 hours and every 100 hours thereafter. Drain and replace annually to eliminate the water condensation that will build up from normal operation. Remember, these gearboxes are relatively trouble free given a minimal amount of attention.