Part #62
Proper Crankshaft Evaluation

By Mike Stratman

Scheduled maintenance shows itís time for your full engine inspection. While measuring piston wear and decarboning is pretty straight forward, how do you determine the condition of the crankshaft and how much more service life can we expect. Being the single most expensive item requires replacement, you need to be able to make an educated decision.
This month weíll show you what to look for when evaluating your crankshaft. Weíll show you how to measure for straightness and runout, check bearings, check for pitting in curial areas, and generally give you a feel for what to look when evaluating your crank. If youíre the kind of guy that likes to run stuff till it quits weíll show you what grizzly and expensive consequences you can expect when the crank finally letís go.

Things that determine crankshaft life: *Engines that run infrequently or are stored for long periods are most likely to show signs of corrosion and pitting of the roller bearings and rod end needles. Here is where you will find a huge difference in the expected run life versus an engine that is run daily. If improperly stored bearings can become pitted with rust that will greatly reduce the service life. See part # 57 ìRotax Storage and Water Damageî for more on how to proper lube and store an engine.*

Consider a two cycle engine will always stop with one piston near Top Dead Center and the other at bottom. On a 447 or 503 this is not a big issue. On the Rotax 532 or 582 engines this puts the conrod crank bearing right next to the open RV port. The distance to the open air and moisture is considerably shorter than the air cooled engines that bury the crank much deeper into the lower end. Therefore the chance for moisture to attack this bearing is far greater. Also consider that the engine will naturally form condensation every time it cools from operating temps. Here is where a mineral based lubricate with do a better job of corrosion protection than a pure synthetic which tend to be hydroscopic in their ability to attract moisture. See Part #23 ìUnderstanding two-cycle Lubricatesî for more on the pros and cons of synthetic oils versus minerals based oils.

Photo # 1 - Measure crankshaft runout in the positions shown in the photo. A simple cradle allows you to spin the crank by hand. Maximum is .003”

Crank end runout: *Before you send a lot of time evaluating bearings and measuring rod ends, determine if the crank is straight. Place crankshaft in a cradle where you can pump the conrods and spin the entire crank. Using a roller contact on a dial indicator measure the runout at the points shown in the photos. Maximum allowable runout is .003î If your crank is more than this it must be straighten or replaced. There are very few individuals who are qualified to do this.*

While on a Rotax factory tour years ago I had a chance to see this done on new units. The crank was laid in a cradle where up to five different dial indicators could sample the runout on the full length of the shaft. Pumping the conrods just like already described the guy would determine the corrective action needed. A hydraulic powered device was used to either spread or pinch the journals in whatever direction needed. Or a huge aluminum hammer was used to literally whale on whatever part of the assembly the guy thought needed it. Another trip back into the cradle and the dial indicators showed the results. Usually two or three trips into the

cradle had the needles moving damm little. The most amazing thing was this guy was turning out 3 to 4 units a minute !! What ever they paid this guy was not enough for the skill level.

Crank End Bearings: *The bearings on the outside of the journals are considered serviceable while everything inside the journals is not. Carefully inspect the bearings for wear and more importantly for pitting and corrosion. They can be removed with a bearing puller shown in the parts book. The ones from Rotax do a great job of pulling the most stubborn bearing but are expensive enough to put them out of reach for all but the busier engine shops. A clamshell type automotive puller can work as well. When you install the new bearing lightly heat the bearing in motor oil and freeze the crank in your refer for an hour or so. The new bearing will literally drop into position.*

Conrod Inspection: *Here is where the vast majority of crank failures occur. While the wrist pin end on the conrod rarely fails, the crank pin and the surrounding needles need to be inspected under a 10x magnifying glass with light looking for pitting and corrosion thru the slit provided. You need to get real up close and picky in this area to get a good evaluation. All needles and crank pin must be pristine and without markings from corrosion. The photo shown here is a classic example of a conrod bearing that is literally ready to blow. Note the rusty needles and the crank pin. This crank needs to be replaced immediately.*

Photo # 2 - This photo is a classic example of a corroded conrod needle bearings and crank pin. This crank will not last but a few hours more if not replaced. Photo courtesy of Rotax Flying Club.

Radial Clearance: *Another method to check conrod ñ crank pin is to mount the crank and your dial indicator in a fixture as shown in photo. Moving the conrod in line with the dial indicator should give you a wear measurement or radial clearance. Max here is 0.00197î according to the Rotax service manual page 43. Regardless of this measurement your close inspection for pitting and corrosion is essential.*

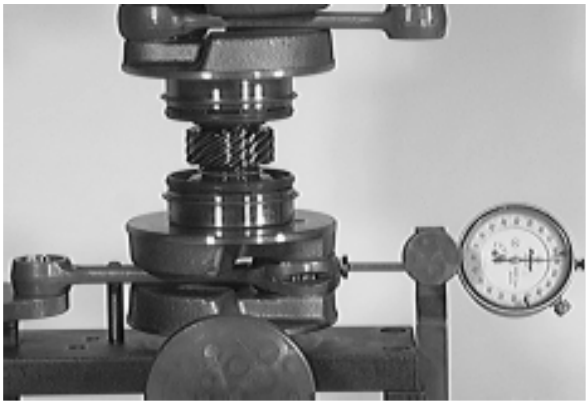

Photo # 3 - Measuring radial clearance is done by sampling the movement of the conrod versus the crank pin. Photo courtesy of Rotax Service Manual #1247.

Dimensioning crankshafts: *While the inspection we have outlined here are the key to estimating service life Rotax also provides full crank dimensions if you suspect a particular area may have been subject to excessive wear due to a particular application. (Belt drive under tension, etc.) See chart provided courtesy of the Rotax Repair Manual #1247.*

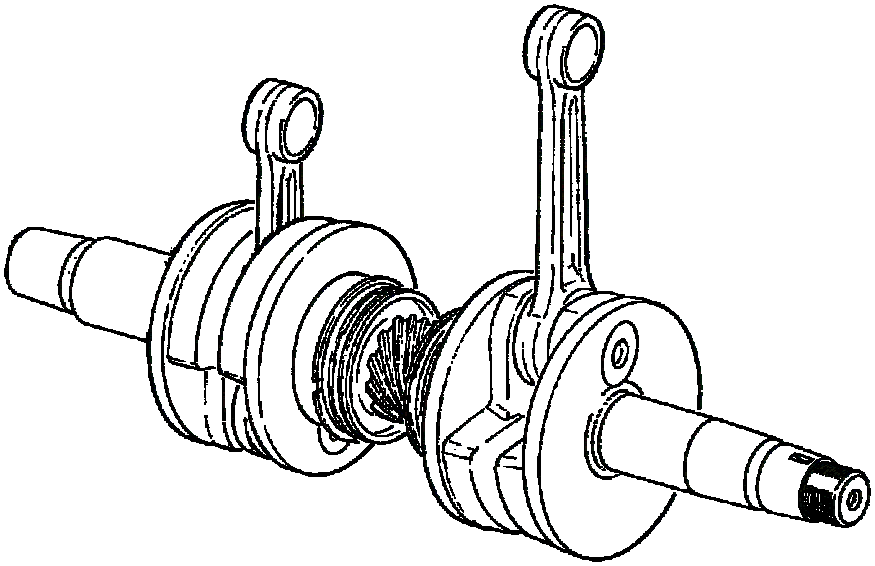

Chart #1 - All Dimensions of the Rotax 582 crank are given here along with the wear limits in both metric and inches.

Dimensions	new mm (in.)	wear limit mm (in.)
Conrod, small end	21.997 - 22.005 (0.866î - 0.866î)	22.01(0.867î)
Piston pin	17.997 - 18.000 (0.708î - 0.709î)	17.97(0.707î)
Radial clearance, piston pin	0.003 - 0.012 (0.0001î)	0.03 (0.001î)
Crankshaft ÿ, P.T.O. side	35.003 - 35.013 (1.378î - 1.379î)	35.00 (1.378î)
Ball bearing ÿ, P.T.O.6201	34.988 - 35.000 (1.377î - 1.378î)	35.00 (1.378î)
Bearing clearance	0.015 - 0.033 (0.0006î - 0.0013î)	0.05 (0.002î)
Crankshaft ÿ, magneto side	30.003 - 30.013 (1.181î - 1.182î)	30.00 (1.181î)
Ball bearing ÿ, magneto side, 6206	29.990 - 30,000 (1.181î - 1.181î)	30.00 (1.181î)
Bearing clearance	0.023 - 0.041 (0.001î - 0.016î)	0.06 (0.002î)l
labyrinth sleeve clearance, radial	0.187 - 0.257 (0.0074î - 0.010î)	0.40 (0.016î)
Labyrinth sleeve clearance, axial	0.400 - 0.600 (0.016î - 0.024î)	0.70 (0.028î)

Photo #4&5 – The two photos shown here are the results of a blown conrod/crank pin. Note how the conrod is allowed to contact the crankcase. Photo at right is the result of the contact. A fractured crankcase.

Conrod Failures: *Last but not least is what you can expect if your crank fails in use. Because the clearance from the con rod to crankcase is very tight a big end conrod failure will contact the case if run for a even a short time after the needles have failed. As you can from the photos here the conrod will score the aluminum case from the contact. If the engine is not shut down quickly the crankcase become fractured as shown in the photo at the right. This means a new crankcase in addition to the crank. A costly proposition that start get close to the ìis it cheaper to fix it than buy a new engineî question that seems to be next.*

Summary: *Because the crankshaft is the single most expensive maintenance item in the scheduled maintenance chart we need to savvy on what we are looking for. Armed with the right tools and a little close inspection there is really no reason to speculate on where or your crank is ready to be replaced or if it can be excepted to run till TBO. END*

Source: Part 62.doc