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TO ALL EXEC OWNERS

ADVISORY BULLETIN A-39

History: A failure of a secondary shaft at the bottom of the assembly in the area of the lower mount has occurred to one of our flight school aircraft. The secondary assembly had 561 hours on it and had been involved in two tail rotor strikes. The NTSB will be examining the failed shaft. Upon initial examination by the FAA and ourselves, the presence of corrosion in the fractured area indicated that the shaft was apparently cracked for some time.

Action: RotorWay currently requires the inspection of the tail rotor assembly and tail rotor drive when a tail rotor blade strike occurs. Parts that are normally replaced are the blades and tail rotor belts. Other parts of the tail rotor assembly that may require conditional replacement include the tail rotor shaft, shaft bearings, and tail rotor drive pulley bearings.

RotorWay has issued this bulletin to recommend a periodic inspection of the lower shaft area of the secondary drive assembly at the 100-hour intervals. If your aircraft has been involved in a tail rotor strike, an immediate inspection of the shaft is also recommended.

The enclosed pages show the recommended inspection of the lower secondary shaft at 100 hours, replacement of the lower secondary bearing at 100 hours, replacement of the fan drive bearing at 100 hours, and inspection of the lower secondary shaft after a tail rotor strike.

Additional information: RotorWay has utilized the same basic design of the secondary assembly for over 20 years. Any time a problem occurred the design was reviewed, and if an improvement could be made it was put into production after adequate testing. Listed below are some engineering data and details of production of the secondary shaft.

1. The material used for the shaft is 9310 VAR. This is described as an alloy that offers high strength with excellent toughness and ductility. The VAR process insures this steel is of the highest quality at high strength levels.

2. A finished machined shaft has been heat-treated in the production process to have a core hardness of 34 to 44 RC and a hardness of 60 RC (carburized) in the sprag clutch area where bearing rollers contact the shaft.

3. The single double-row spherical bearing currently being supplied is fit to the upper end of the shaft with an interference fit recommended by the bearing manufacturer. This interference fit is determined by the type of application and the bearing's internal tolerances. The bearing fits onto a section of the shaft that is not case hardened. The acceptable misalignment for the bearing is 1-1/2 (one and one half) degree. With the forward bending on the shaft, both statically and dynamically, combined with improper alignment of the entire secondary assembly to the frame, this tolerance could be exceeded.

4. Currently a stainless steel sleeve is installed just under the upper mount bearing to act as a stop for the bearing in case the bearing was to move on the shaft, which would affect the alignments of the entire drive system. Earlier shafts (prior to having the sleeve) had a step ground into the shaft that

(continued)

would have acted as a stop. Both the end of the sleeve and the step are located approximately .050 inch below the upper bearing inner race. The step was removed due to its potential of becoming a stress point around the shaft if galling occurred, from either bearing installation onto the shaft or if the bearing failed. The stainless steel sleeve is I.D. ground and is positioned on the shaft with an interference fit.

Forces and loads, controllable and uncontrollable, acting on the entire drive system:

1. Static alignments from the engine to the secondary assembly.
2. Static alignments of the secondary itself.
3. Static alignments of the rotor system itself and rotor system to secondary assembly.
4. Tension and alignment of chain.
5. Tension of all drive belts.
6. RPM of drive system components.
7. Vibrations or resonance throughout the aircraft or in certain components.
8. Airframe flexing.
9. Power applied through the drive system (gently or aggressively).
10. Aftermarket products.
11. Abuse to the aircraft within or outside of limitations placed on the aircraft.

Understanding and complying with these controllable and uncontrollable variables will result in a good service life for all of the drive system components.

Section 10: Drive Train

The drive train is a series of reduction pulleys and sprockets that transmit power from the engine to the main rotor system. No transmissions, gear boxes or drive shafts are used. The system is simple to monitor and maintain.

Reference prints: E23-2000, E27-2000, E33-2000, E49-2001

INSPECTION CHART				
PART NO.	**DESCRIPTION**	**INSPECTION INTERVAL**	**R.C.O.**	**SERVICE REFERENCE**
	Primary			
E49-6172	Main Sprocket	100 HR	1000 HR/OC	10-1
E49-7010	Sprocket Hub	100 HR	1000 HR/OC	10-1A
E00-2608	AN176H (3/8 x 3-1/8) Bolt	500 HR	2000 HR	Torque
E00-2450	AN4H12 (1/4 x 1-1/4) Bolt	100 HR	500 HR	Torque
E00-3410	Thin Locknut	100 HR	500 HR	Torque
E00-9028	Hose Clamp	500 HR	2000 HR	
E24-5110	Upper Engine Mount Clevis	500 HR	2000 HR/OC	
E24-5100	Upper Engine Mount Cup	500 HR	2000 HR/OC	
	Secondary			
E23-1002	Secondary Pulley Assembly	100 HR	1000 HR/OC	10-2
E23-5001	Upper Bearing Assembly	50 HR	500 HR/OC	10-2A
E23-6125	Secondary Shaft	100 HR	500 HR/OC	10-2
E23-1200	Lower Bearing	100 HR	100 HR/OC	10-3
E23-1210	Main Drive Belts	50 HR	500 HR/OC or 5 yrs	10-4
E23-7141	High Temp Fan	100 HR	2000 HR/OC	10-5
E23-1170	Snap Ring	500 HR	2000 HR	
E23-3001	Fan Pulley Assembly	500 HR	2000 HR/OC	10-6
E23-1221	Fan Pulley Bearing	100 HR	100 HR/OC	10-2B, 10-7
E23-6191	Retainer Plate	1000 HR	2000 HR	
	Oil Bath			
E33-7101	Top Rear Cover	100 HR	OC	
E33-7121	Lower Oil Bath Pan	100 HR	OC	
E33-7111	Top Front Cover	100 HR	OC	
E33-1170	Rear Oil Seal Assembly	100 HR	500 HR/OC	10-8
E33-1140	Tension Spring	100 HR	2000 HR	
E33-3000	Rain Shield	100 HR	2000 HR	
	Chain			
E49-1290	Drive Chain W/Link	25 HR	100 HR/OC	10-9
	Clutch Idler Assembly			
E27-6100	Idler Pulley Assembly	100 HR	2000 HR/OC	10-10
E27-1231	Idler Pulley Bearing	100 HR	500 HR/OC	10-10
E27-1160	Rod End	100 HR	2000 HR/OC	
E27-1210	Idler Spring	100 HR	1000 HR	Grease
E27-2160	5/16 Rod End	100 HR	2000 HR	
E27-9020	Clutch Tube Weldment	100 HR	2000 HR/OC	10-11
E27-9010	Pulley Arm Weldment	100 HR	2000 HR	10-12
E27-5100	Clutch Arm Casting	100 HR	2000 HR/OC	
E00-2522	AN5-30A (5/16 x 3) Bolt	100 HR	2000 HR	

SERVICE NOTES:

1. Inspect the main drive sprocket for any noticeable wear around the teeth. First indication of wear will be an abnormal amount of aluminum flakes and dust in the oil bath and oil lubrication. Contact the factory for further inspection and instructions.
   A. Check sprocket hub for backlash against the main drive shaft. This can be done by grabbing the main rotor shaft and applying pressure against the standard rotation of the rotor system. Monitor the relationship of the main rotor shaft to the sprocket hub for any movement. If any movement is apparent, contact the factory.

2. The secondary unit comes as a complete assembly and should not be tampered with or opened at any time. A visual inspection and a lock up inspection of the overrunning clutch should be done during the pre-flight inspection. Any other adjustments or work performed must be done by the factory service center at RotorWay, with the exception of the following:
   A. The upper bearing assembly (part no. E23-5001) should have 1 shot of Mystik JT-6 grease every 50 hours.
   B. At the 100 hour inspection intervals, inspect the lower secondary shaft. This requires removal of the fan pulley, tail rotor drive pulley and lower mount bearing from the secondary shaft. Both the fan pulley bearing and the lower mount bearing should have been Loctited to the shaft during construction. A gear puller and heat will be needed to remove these bearings. Excessive heat should be avoided, which may damage the shaft or other components (the shaft can be damaged if shaft temperatures exceed 400 degrees Fahrenheit). Bearings should not be reused on reassembly. The shaft should be visually inspected for surface imperfections and also by using a dye penetrant, looking for surface cracks. Recommended penetrant inspection kits are Met-L-Check Penetrant Kit or Magnaflux Spotcheck Test Kit, available from suppliers such as Aircraft Spruce. Either kit will last for many years. Your local FBO may also be able to supply the kit or inspect the shaft.

3. The lower bearing, part no. E23-1200, is removed at 100 hour intervals for lower secondary shaft inspection. The bearing must be replaced at 100 hours; do not re-use the old bearing. See Service Note 10-2B above.

4. Replace the main drive belts at 500 hours of operation, or at 5 years, or on condition, whichever comes first. Shelf life, or time before entering service, is not included if the belts have not been exposed to the environment and have not been affected by aging. Conditional replacement includes damage resulting from excessive slipping, oil absorption, cracking, glazing, abnormal wear, or any other damage.

   The main drive belts are replaced by following the procedures listed below. Pay close attention because you will follow the reverse procedures for reassembly. See also Service Note 10-2B above.
   A. Clean the new belts with a clean rag lightly saturated with acetone.
   B. Cut old belts off with aviation shears or a sharp knife. Be careful not to damage any of the parts.
   C. Remove the radiator assembly (refer to print E30-2000 and E37-2000). Remove the radiator hoses from the radiator. Plug all water openings. Place the assembly out of the way until reinstallation.
   D. Index the fan to the fan pulley assembly and remove the fan from the pulley. Remove the fan pulley assembly from the shaft by loosening the set screws, removing the snap ring and lowering the pulley. The bearing was installed with Loctite; use a puller and if necessary apply heat to the bearing to release it from the shaft. CAUTION: Too much heat can damage the shaft or other components. See Service Note 10-6 for bearing replacement. Remove any burrs on the shaft caused by the set screws, then remove the tail rotor drive pulley.
   E. Remove the two bolts that hold the lower bearing flange to the square drive tube. Then remove the two bolts that hold the lower bearing flanges together so you can lower the bottom flange, and move it from the square drive tube.
   F. Remove bolts (part no. E00-2524) and lower the upper engine mount cup (part no. E24-5100) into the upper engine pulley on the engine. Loosen the belt tension by backing out the all thread adjustment bolt (part no. E00-2525).
   G. Remove bolts (part no. E00-2531 and E00-2416). Remove the upper engine mount clevis.
   H. Take one of the four belts and slip the belt between the secondary unit and the square drive frame tube. Pull the belt forward, up and over the pulley. **CAUTION:** Do not damage the belts. Repeat this procedure with the remaining three belts. Align all belts in the correct order on both the engine and secondary unit pulleys.
   I. Reassemble all parts by following the above procedure in reverse. Follow the belt tensioning procedures shown in the Construction Manual.

5. Check the high temp fan for stress cracks on blades. Do not confuse stress cracks with excess resin cracks. Stress cracks will penetrate the fiberglass and resin cracks will be on the surface only.

6. Check pulley for wear of anodizing and for chip or sand erosion. For bearing replacement do the following:
   A. Remove the fan pulley assembly by loosening the set screws, removing the snap ring and lowering the pulley. It may be necessary to use a puller, as the pulley was originally assembled using Loctite. If necessary, use a file or fine sandpaper to remove the burrs on the shaft from the set screws.
   B. Remove snap rings on both sides of the pulley bearing.
   C. Heat the pulley in oven at 250 to 275 degrees F. **CAUTION:** Do not exceed 300 degrees.
   D. Note which end of the bearing has the set screws, so that the new bearing will be installed in the same position. Lightly press out the old bearing with a press or vise.
   E. Clean the pulley inner surface with acetone and then clean the new bearing.
   F. Again reheat the pulley to 250-275 degrees F.
   G. Insert snap ring into the pulley groove and make sure it is seated.
   H. Place the pulley on a flat surface and apply a thin coat of Loctite #609 to the inner surface of the pulley and the outer surface of the bearing.
   I. With the bearing in the correct position, lightly press the bearing into the pulley until the bearing contacts and sits against the snap ring. **CAUTION:** If a press is required, make sure you press against the outer race of the bearing and <u>not</u> the inner race.
   J. Replace the second snap ring in the pulley and let air cool. NOTE: Use Loctite upon final assembly of this part to the secondary shaft assembly.

7. The fan pulley bearing, part no. E23-1221, is removed at 100 hour intervals for lower secondary shaft inspection. The bearing must be replaced at 100 hours; do not re-use the old bearing. See Service Note 10-2B and 10-6 above.

8. For removal of rear oil seal:
   A. Remove chain and secondary shaft.
   B. With heat gun or propane torch, heat surrounding area where glue exists. **CAUTION:** Use only enough heat to pop the seal out with a screwdriver.
   C. Clean the lower oil bath pan with acetone and lightly sand any glue or uneven protrusions from the pan.
   D. Sand mating surface of the seal with 400 grit paper and clean with acetone. **CAUTION:** <u>Do not touch</u> the rubber seal with sand paper.
   E. Mix blade glue at the proper ratios and apply to both parts.
   F. Place a little oil on the rubber seal and shaft.
   G. Slide the oil seal down (correct side up) pressing down with light finger pressure until the seal seats on the oil bath. Oil seal pressure must be applied evenly.
   H. Wipe off excess glue with a <u>dry</u> rag. Let the glue cure for 12 hours.

9. Refer to print E49-2001 and chain installation instructions in the Construction Manual. Chain tension should be set to 1/2 inch movement at 10 pounds pull with a spring scale midway between sprockets. Re-check chain tension at every 25 hour inspection. Some stretching of the chain normally occurs after the first 25 to 30 hours of operation. A shim (no more than .025 inch) may be added between the lower mainshaft bearing flange and the airframe tube to achieve the correct chain tension. The shim should be removed upon installation of a new chain. NOTE: Shims should ONLY be added between the lower mainshaft bearing flange and airframe to correct for chain stretching. Initial chain tension is achieved by adding shims at the secondary shaft bearing mount locations.

10. Refer to Service Note 10-6 for bearing removal procedure. Also refer to the Construction Manual and print E27-2000.

11. Inspect at every 100 hours. Grease at every 500 hours. Remove pop rivets on the end of the clutch spring tube and unbolt the rod end from the clutch arm casting (part no. E27-5100). Remove the clutch tube piston (part no. E27-6131). Make a visual inspection for wear. Grease the piston and clutch spring tube. Compressing the piston a slight amount, install two pop rivets in the existing rivet holes. Reconnect the clutch arm casting and check for smoothness of operation.

12. Remove the pulley mounting arm bolt (part no. E00-2522). Place a thin film of grease on the bolt and mating surfaces. Reinstall the bolt and tighten it enough to allow the swing arm to pivot.

Section 22: Inspection Guide for Hard Landings, Tail Rotor Strike, or Roll Overs

After any type of accident, roll over, main and/or tail rotor strike, hard landing, etc. it is very important to thoroughly inspect any areas that may have been damaged or subjected to excessive stress. It is impossible to anticipate all the consequences of every accident, therefore individual inspections of your aircraft will depend on yourself. Non-destructive inspections (NDI) may be available locally, however RotorWay will also perform these services for you on parts or components you return to the factory. Listed below are some of the major areas of concern in case of an accident.

1. MAIN ROTOR BLADES: Damaged rotor blades can not be repaired. Associated components such as retention straps, pitch horns, and retention hardware will most likely have been subjected to undue stress and are not recommended for reuse.

2. ROTOR SYSTEM: In cases where main blades contacted the ground or other objects, several items require inspection. Elongation of pitch pin holes in the hub plate or gouges in the hub plate surface require the hub plate to be replaced. The main shaft may be bent, and any bending requires replacement. The slider ball may be damaged depending upon the location of the bent main shaft. All casting pieces should be Zyglo inspected, though if no stoppage has occurred between rotating and non-rotating parts, damage should not have occurred.

   Thrust blocks should have no sign of deformity or cracking. Control rods and rod ends should be replaced if bent. Teeter blocks and sprocket hub hardware should be replaced. The main rotor drive pin and teeter block bearings require replacement.

3. CONTROLS: Replacement of cyclic cables is required in case of a blade strike. Inspection of cyclic and collective controls is required in the event of a blade strike or swash plate stoppage.

4. SECONDARY DRIVE: If a roll over accident or blade strike occurs, the secondary unit should be returned to the factory. The secondary unit is not a field serviceable assembly. The chain requires replacement in case of a roll over.

5. TAIL ROTOR: If the tail rotor blades are damaged, the pivot pins must also be replaced. The tail rotor shaft must be inspected for any bending. The thrust bearing container should be inspected for cracks, paying close attention to snap ring groove locations. A tail rotor strike also requires replacement of the tail rotor drive belts and inspection of the lower secondary shaft (see Section 10, Service Note 2B).

6. TAIL BOOM: Location and amount of damage will determine if repair or replacement is necessary.

7. AIRFRAME: When a blade strike occurs, impact forces are transmitted throughout the airframe. After a complete teardown, inspect the airframe for deformation and cracks, primarily in the drive system area. If damage occurs in the hood bracket area or to the square drive tubes, a new airframe may be required.

   In case of a hard landing, landing gear skids may be damaged. Repair of landing gear should not be done. All landing gear attachment points and brackets associated with landing gear attachment require inspection.

8. POWER PLANT: Inspection required will depend upon the power applied during the mishap. The condition of the engine will depend on impact damage and possible damage from power applied at the time of the blade impact. Obviously more internal damage could occur if the engine was forced from full power and full RPM to a full stop in just a few revolutions. Crankshaft end play needs to be checked in case of a hard landing. The valve train needs to be inspected and freedom of the engine to be rotated by hand should be accomplished.

   Note: Log Book entries are required for inspection or rebuild of a damaged aircraft. If reusing a part or component, a log book entry needs to be made stating that the part has been inspected and found to be okayed for service.

HOURLY SERVICE CHART EXEC 162F
REFERENCE SECTION 10: DRIVE TRAIN

PART NO.	DESCRIPTION	25	50	100	200	250	500	1000	1500	2000
E49-6172	Main Sprocket			I				R		
E49-7010	Sprocket Hub			I				R		
E00-2608	AN176H (3/8 x 3-1/8) Bolt						I	R		
E00-2450	AN4H12 (1/4 x 1-1/4) Bolt			I			R			
E00-3410	Thin Locknut			I			R			
E00-9028	Hose Clamp						I			R
E24-5110	Upper Engine Mount Clevis						I			R
E24-5100	Upper Engine Mount Cup						I			R
E23-1002	Secondary Pulley Assembly			I				R		
E23-5001	Upper Bearing Assembly		I				R			
E23-6125	Secondary Shaft			I			R			
E23-1200	Lower Bearing	I		R						
E23-1210	Main Drive Belts		I				R			
E23-7141	High Temp Fan		I							R
E23-1170	Snap Ring						I			R
E23-3001	Fan Pulley Assembly						I			R
E23-1221	Fan Pulley Bearing			R						
E23-6191	Retainer Plate							I		R
E33-7101	Top Rear Cover			I						
E33-7121	Lower Oil Bath Pan			I						
E33-7111	Top Front Cover			I						
E33-1170	Rear Oil Seal Assembly			I			R			
E33-1140	Tension Spring			I						R
E33-3000	Rain Shield					I				R
E49-1290	Drive Chain W/Link	I		R						
E27-6100	Idler Pulley Assembly			I						R
E27-1231	Idler Pulley Bearing			I			R			
E27-1160	Rod End			I						R
E27-1210	Idler Spring			I					R	
E27-2160	5/16 Rod End			I						R
E27-9020	Clutch Tube Weldment			I						R
E27-9010	Pulley Arm Weldment			I						R
E27-5100	Clutch Arm Casting			I						R
E00-2522	AN5-30A (5/16 x 3) Bolt			I						R

I INSPECT
R REPLACE