REVOLUTION
HELICOPTER CORP., INC.

Mini-500

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September 03, 1997

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(#383, 384, 86, 347, 348, 8, 11, 370)
REVOLUTION HELICOPTERS
AUSTRALIA PTY LTD
MS 461, PETERS ROAD
KALBAR
QUEENSLAND 4309

Revolution Helicopter Airworthiness Directive (AD) #09031997

Affected aircraft: All Mini-500 Helicopters.

AD Type: Urgent (Must Be Complied With Before Further Flight)

Subject: New Dynamic Main Rotor System Balancing Procedures.

The reduction of rotor blade system vibrations is, and will always be the most difficult challenge to any helicopter manufacturer, especially within the kitbuilt market. For example, a certified helicopter is completely built, test flown and dynamically balanced by experienced personnel using sophisticated equipment and knowledge gained from years of experience toward the same model. The kit builder is always at a disadvantage, because they are not only in a learning process, but are also dealing with assembly, rigging, and part tolerance discrepancies. Certified manufacturers also deal with this, but they have the experience to better troubleshoot. On the average, it takes 10 to 15 hours of flight time to rig and dynamic balance a new Robinson R-22, and that's with experts! Therefore, be realistic on the time you think YOU could take.

From further experience gained from helping customers in the field, we have designed a new and improved dynamic balancing procedure. All Mini-500s must now be re-dynamic balanced with this new method before further operation. This version replaces all previous versions.

In order for the dynamic balancing to be successful, it is imperative that your Mini-500 first be in its complete finished and flying form, CG (Center of Gravity) complied with and all systems functioning correctly. Any discrepancies, modifications or omitted parts could prevent a successful dynamic balancing. If the rotor components and connecting linkage are not rigged and working properly as to their design, it may be impossible to balance the rotor system for hover or forward-flight.

Dynamic balancing must be applied to the Mini-500 as often as needed, but at least once a year. If the rotor blades are removed, or trailered while on the aircraft, repaired or bumped, or basically anything that could change their shape or position, then the dynamic balance must be rechecked to ensure that the vibration levels are within limits. Do not operate the Mini-500 if the hover one-per-rev vibration level is above 0.25 ips, or if the forward-flight one-per-rev is above 0.150 ips, or if the forward-flight two-per-rev is above 0.25 ips.

Warning: Severe Damage to aircraft and operator may result if variations to this procedure are implemented. Do not make or add your own procedures and expect to obtain optimum dynamic rotor balance.

Dynamic Balancing Equipment:

The following instructions and balance charts are specifically to use with the "Micro-Balancer" #S0028, sold by RHCI, but can be used with other balancing equipment. If other equipment is used, the data acquisition for two-per-revs may need to be obtained differently. Refer back to your equipment's instructions.

Transducer Location:

Mount the transducer in the vertical direction on the outside aircraft nose at the "T" junction point, as shown in the Mini-500 Assembly Manual on section 7, page 8, Fig. 19 and 25. Attach the photo cell probe to the cabin's "dog-house" to measure the rotor systems rotational position, as shown in the Mini-500 Assembly Manual on section 7, page 8, Fig. 26. Install a 4 inch piece of reflective tape lengthwise under the "A" rotor blade next to the hub.

NOTE:
If aircraft has been dynamically balanced before, then remove all previously installed balance weights from hubs. The use of pitch-link weight has been discontinued, and should be removed and never used again. The use of pitch-link adjustments for correcting the head-shift or hub-weight is no longer to be used for hover balancing. It may not be necessary to take out previously made head-shift adjustments. Start dynamic balancing where the head-shifted where it is, but adjust if called for by the solution. Only use the enclosed new Hover-Flight and Forward-Flight Balancing Charts.

Solution:

Hover Balancing Procedure:

1. Aircraft should be fueled to 5 gallons and mark the quantity height on fuel sight tube. Refuel every 15 minutes of flight time during testing to maintain consistent aircraft weight. The intention is to load the rotor to the weight that it will normally be operating at the most. If heavy equipment is added to the aircraft the rotor may require re-balancing. Aircraft should be within proper CG limits (Center of Gravity). The wind must be as little as possible, but should never be above 8 mph at anytime during the data collection process to obtain accurate results.

2. Loosen blade retaining bolts and lift up on both blades enough to remove any binding at the hub, and sweep each blade back by applying approximately 15 pounds of pressure to the leading edge, one blade at a time. This will position the natural play against the outer retaining bolts, allowing for repeatability. Use 3 people to apply this procedure, with one person on each blade, and one person to tighten the blade retaining bolts. While one blade is being swept, tighten it in place, and repeat procedure to the other blade. Torque the blade retaining bolts to 24 foot-pounds and install safety pins. It may be necessary to tighten the castle-nut to the next hole alignment, and then install safety pins.

3. Adjust blade pitch setting to -0.5 to -0.9 degrees leading edge down at the outer tip for initial testing for autorotation position. Measure blade pitch setting degree off the top of the Upper Control Block #0016. If further adjustments are required to maintain stable autorotation rotor speed, then adjust both blades evenly, and recheck dynamic balance.

4. All tracking must be at NEAR HOVER so the blades are loaded and conning. Track blades with a stick and brush using shoe polish and achieve perfect tip track (touch blade with brush three times, being softer and moving in 2 inches each time). If any changes are made to the pitch-change linkage, the change must be divided equally between both A and B blades. (You should find that a 90 degree turn on the pitch-change barrel will move that blade tip about 1 inch.)

5. Hover aircraft to collect one-per-rev data and obtain an accurate vibration level and phase angle. Using the new "Hover-Flight Balancing Chart," plot and apply solution. Only use head-shift and/or hub-weight to adjust. First, if called for in the solution, adjust hub-weight, then, if called for in the solution, adjust head-shift in that order. When both head-shift and hub-weight adjustments are needed, it is best to adjust the hub-weight to cause the next vibration movement to plot on the head-shift move line. To accomplish this, you will either have to over adjust or under adjust the hub-weight, depending where the vibration plots on the "Hover-Flight Balancing Chart." When the vibration plots directly on the head-shift move line, adjust the head-shift.

NOTE:
The balancing charts give the weight required for the amount of hub-weight needed. We have found that if you apply "2 inch Duct-tape" about 6 inches from the end of the light blade, can prevent the need to sweep the blades every time you loosen the blade retaining bolts to add or remove balance washer-weights. This will significantly reduce the time needed to balance the aircraft. The weight needed on the tip of the blade will be about $1/10^{th}$ of what the hub-weight balance charts call for. When using the tape for weight, apply tape starting from trailing edge -- around leading edge -- and back to trailing edge. Tape seam must always be to trailing edge so not to peel off. After completing the entire dynamic balancing procedure in both hover-flight and forward-flight, remove and weigh the tape. Drill a hole in the top of the main rotor blade about 6 inches from the tip, and about 2.5 inches from the leading edge. Drill the hole only big and deep enough to install lead balance weights that equal the weight of the tape, then glue in place and touch-up with paint. Final adjustments or corrections can be made by adding hub-weight to the hub.

6. Adjust until the one-per vibration level is 0.15 ips or less. Next, recheck and adjust to perfect tip track. If a tracking adjustment was necessary, you must recheck the dynamic balance, and then recheck tip track again. It is important to repeat this procedure until achieving a perfect blade tip track with one-per vibration levels below 0.15 ips. It is not needed to go lower than a 0.150 ips one-per during the hover-flight dynamic balancing procedure.

7. Dynamic balance the tail-rotor according to the procedures in the Mini-500 Assembly Manual.

Forward-Flight Balancing Procedure:

Aircraft should be fueled to 5 gallons. Refuel every 15 minutes of flight time during testing to maintain consistent aircraft weight. The intention is to load the rotor to the weight that it will normally be operating at the most. If heavy equipment is added to the aircraft, the rotor may require re-balancing. Aircraft should be within proper CG limits (Center of Gravity). The wind must be as light as possible, but should never be above 10 mph at anytime during the data collection process, to obtain accurate results. Data collected during turbulence will also affect the results. The smother the conditions, the better the results.

2. Fly aircraft at 75 mph indicated airspeed, straight and level, and collect data to obtain an accurate one-per-rev vibration level and phase angle. Using the new "Forward-Flight Balancing Chart," plot and apply solution. Only use hub-weight and pitch-link to adjust. First, if called for in the solution, adjust Hub-weight, then, if called for in the solution, adjust pitch-link. When both hub-weight and pitch-link adjustments are needed, it is best to adjust the hub-weight to cause the next vibration movement to plot on the pitch-link move line. To accomplish this, you will either have to over adjust or under adjust the hub-weight, depending where the vibration plots on the "Forward-Flight Balancing Chart." When the vibration plots directly on the pitch-link move line, adjust the pitch-link. Adjust until the one-per vibration level is 0.10 ips or less. It is not necessary to go lower then a 0.05 ips during the forward-flight dynamic balancing procedure.

NOTE:
Do not use head-shift as part of the solution in forward-flight, unless the two-per-rev vibrations need to be corrected, which will be explained in the following steps.

3. It is now necessary to obtain the two-per-rev vibration level. Add another 4 inch piece of reflective tape to the "B" blade. Fly aircraft at 75 mph indicated airspeed, straight and level, and collect data to obtain an accurate two-per-rev vibration level. The two-per-rev ips should be no higher than 0.25 ips.

NOTE:
Follow step 4 only if the two-per-rev vibration level in forward-flight is above 0.25 ips.

4. Two-per-rev vibrations are mainly caused by out-of-track conditions. No two rotor blades are exactly the same, and they may need to track slightly different in hover to fly smoothest in forward flight. Rotor blade

track adjustments affect dynamic balance, and dynamic balance adjustments affect rotor blade track. To reduce the two-per-rev, adjust one rotor blade slightly up or down with pitch-link until a 0.25 ips or lower two-per-rev vibration level is reached. This will increase the forward-flight one-per-rev vibration levels by changing the dynamic balance. Using the "Forward-Flight Balancing Chart," fly the aircraft at 75 mph indicated airspeed, straight and level, and collect data to obtain an accurate one-per-rev vibration level and phase angle. By applying only a head-shift move and/or hub-weight change, formulate and apply the proper solution to lower the forward-flight one-per-rev vibration to 0.10 ips or below.

5. Hover aircraft to obtain an accurate one-per-rev vibration level and phase angle. It is normal for the hover-flight one-per-rev vibration level to increase after forward-flight dynamic balancing has been completed, but one-per-rev vibration should never exceed a 0.25 ips in hover-flight.

NOTE:
Follow step 6 only if the one-per-rev vibration level in a hover is above 0.25 ips.

6. If hover-flight one-per-rev vibration is too high, a compromise may need to be met between the hover-flight and forward-flight vibration levels. To correct hover-flight one-per-rev vibration, without exceeding the forward-flight vibration limits, use the "Forward-Flight Balancing Chart" to find a solution that would use small amounts of head-shift and hub-weight, that will correspond with the needed solution called for by the "Hover-Flight Balancing Chart". Attention to the sensitivity levels between hover-flight and forward-flight will give a better understanding of what the expected effect would be to apply a solution move to one chart, in order to correct for a balance condition on the other chart.

7. Remove any Duct-tape from the blade, and then weight. Replace the weight of the Duct-tape with equal lead weight, as described earlier, and then verify dynamic balance if necessary. Further operation of the aircraft may resume.

Please date and sign this AD and fax or mail it back to Revolution Helicopter Corp.

If you have any questions, contact:

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Tel: (816) 637-2800
Fax: (816) 637-7936

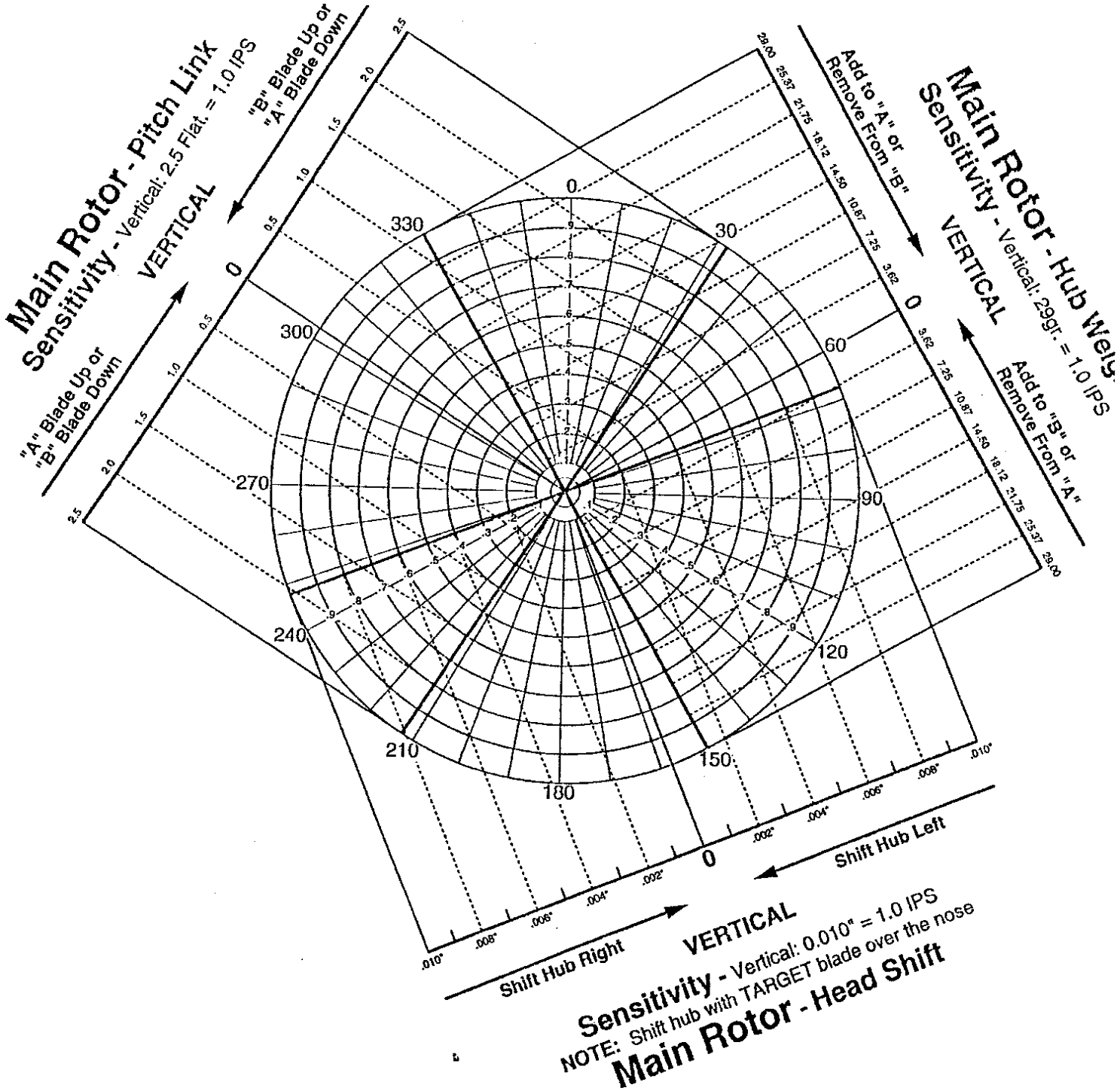
Print Name:_____ Serial #_____

Signature:_____ Date:_____

Forward-Flight Balancing Charts

For the Mini-500 Helicopter

Sep. 11, 1997



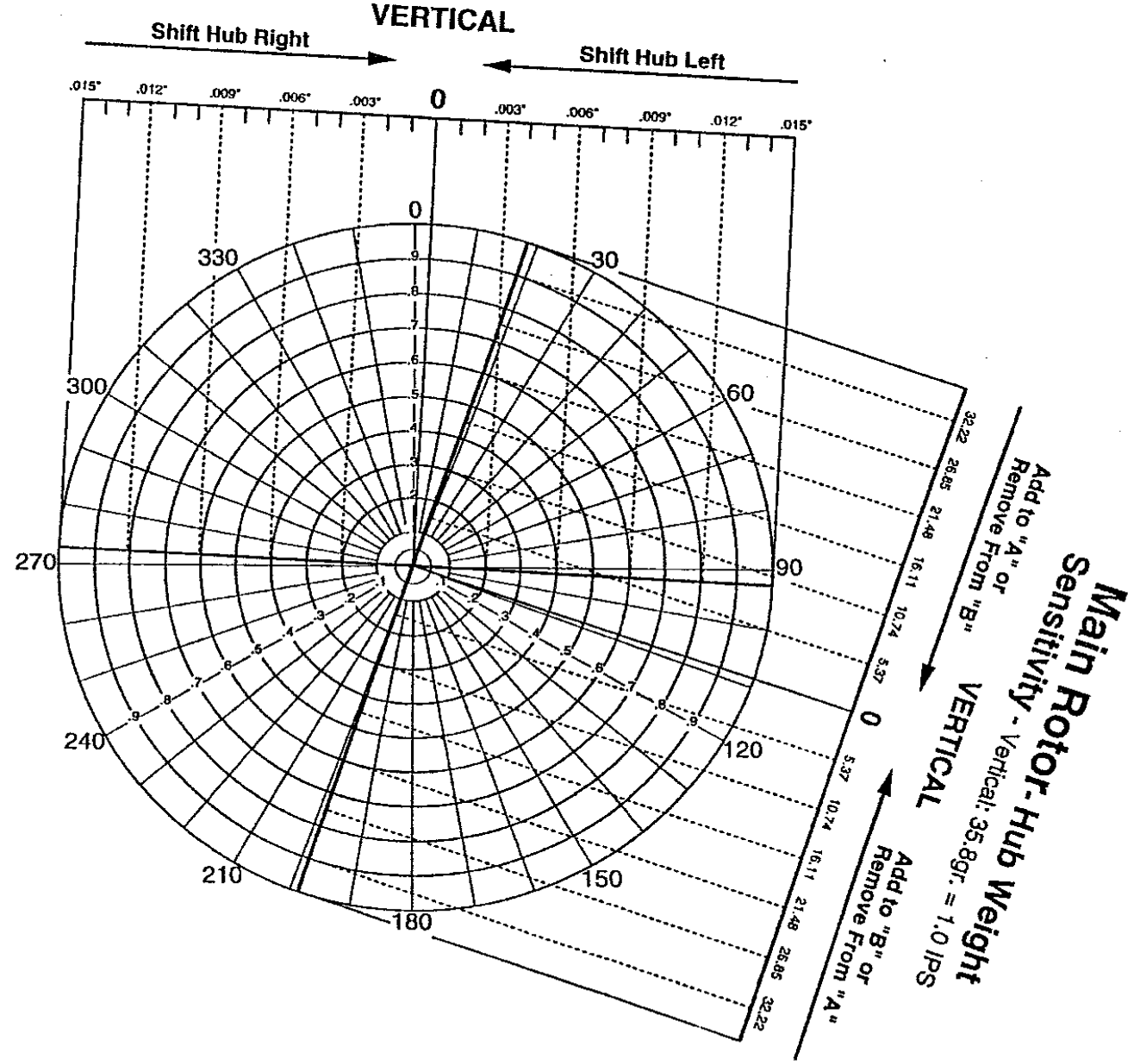
This Chart must be used in combination with the Airworthiness Directive (AD) #09031997

Hover-Flight Balancing Chart
For the Mini-500 Helicopter
Sep. 11, 1997

Main Rotor - Head Shift

NOTE: Shift hub with TARGET blade over the nose

Sensitivity - Vertical: 0.015" = 1.0 IPS



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