



THE ENSTROM HELICOPTER CORPORATION

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SERVICE INFORMATION LETTER

SERVICE INFORMATION LETTER NO. 0177

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The content of this Service Information Letter (SIL) No. 0177 incorporates an updated main rotor blade tracking procedure to be used when tracking with the Chadwick 2000 system. Other systems, such as the ACES Model 1700, 2000 or 4000 Series Analyzer or the MicroVib™II can be used by modifying these procedures as required for the specific system.

This updated procedure supersedes the procedure originally published in SIL No. 0121; however, SIL No. 0121 remains valid for main rotor system troubleshooting.

DATE: August 19, 2011

1. SUBJECT: Main Rotor System Tracking
2. MODEL: F-28A, F-28C, F-28F, 280, 280C, 280F, and 280FX
3. EFFECTIVITY: All Serial Numbers
4. BACKGROUND:

The purpose in tracking the main rotor blades is to obtain a smooth ride. This is accomplished by adjusting the blade track to reduce vibration. An out-of-track condition will produce a one per rev vibration, which is felt as a vertical vibration.

With the advent of digital tracking equipment it has been found that the best ride is not necessarily a condition of the blades flying in plane, but in a track that gives the least amount of vertical vibration.

For this reason, Enstrom recommends that the strobe light only be used on the ground for initial rough track or for initial hover track if the ride is unacceptably rough to begin hover tracking.

NOTE

This procedure should be followed when using the MicroVib™II and ACES systems with modifications required by the individual system used.

NOTE

Do not change the tip weights in the blades from original factory settings.

The tracking procedure is summarized by the following flow chart (Figure 1).

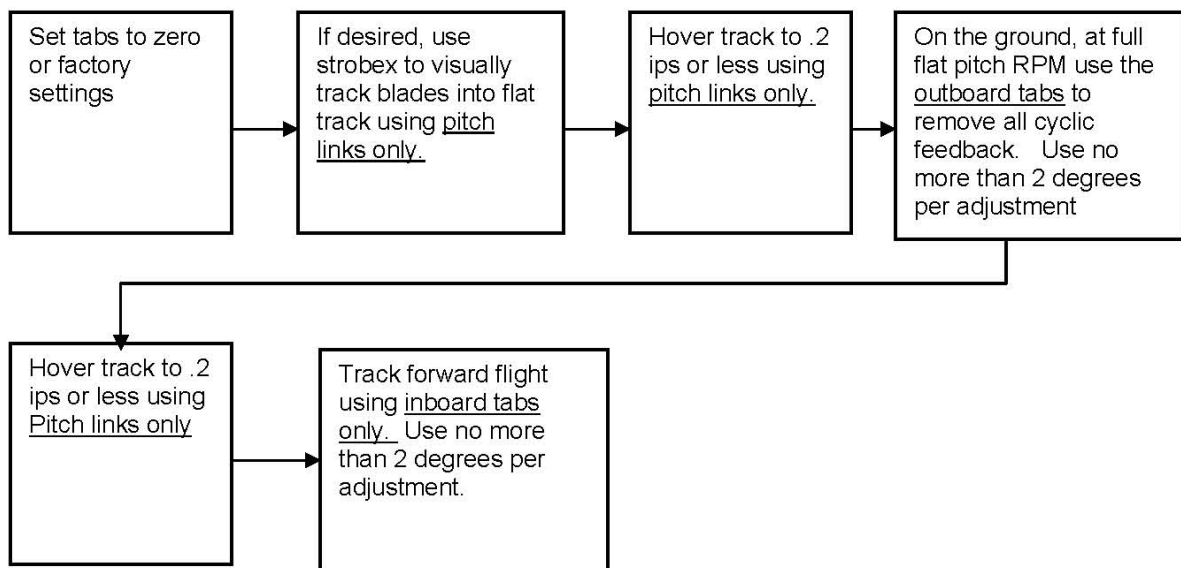


Figure 1: Tracking Procedure Flow Chart

A. Installation of Equipment

1. Install the optical sensor on fuel tank. Note: Mount the bracket under the fuel tank mounting screws on F-28 series helicopters. Note: Install the bracket for the magnetic pick-up on the fiberglass scoop for the 280FX (Figure 2).



Figure 2. Optical Sensor installed on 280FX air scoop.

2. The number one blade (target blade) must be at the 12 o'clock position relative to the front of the helicopter when the magnetic pick up is opposite the interrupter on the swashplate, or when the optical sensor is opposite the reflective tape on the mast.
3. Install the velocimeter on the lower instrument panel (Figure 3).



Figure 3. Velocimeter installed on the lower instrument panel (280FX shown).

4. Install the strobe light, if desired, or if there is reason to believe that the initial hover will be unacceptably rough.
5. Set up the analyzer using the manufacturer's instructions and the parameters listed below.
 - a. Three main rotor blades
 - b. Counterclockwise rotation when viewed from above
 - c. A Series: 332 RPM; C and F Series: 350 RPM

B. Tracking Procedure

1. Grease the main rotor head.
2. Bleed the main rotor dampers.
3. Set the tabs at recorded angles on the “Blade Information Sheet” or zero all the tabs.
4. Ground run the helicopter with the rotor engaged at full “flat pitch” rpm.
5. If the strobe light is being used, observe the track of the blades and use pitch links to adjust the track into a reasonable flat track.
6. Hover the helicopter into the wind (A Series at 332 blade RPM) (F & C Series at 350 blade RPM).

NOTE

The best results are obtained if the helicopter is loaded so that the helicopter is relatively heavy. Normally, adding weight will make the blades fly at a higher angle of attack and will increase the roughness of the ride, where as the helicopter gets lighter from fuel burn, the ride will improve.

7. Record the ips reading and the clock angle. Using the Vertical Accelerometer Polar Chart (Figure 4), adjust track for ips readings of less than 0.2 using pitch links.

C. Tabbing Out Feedback

Cyclic feedback is a pulsing felt in the cyclic stick at main rotor 1/rev frequency. Tabbing out cyclic feedback is the most difficult and the most important procedure in achieving optimum ride in Enstrom helicopters with minimum cyclic vibration. Less than optimum outboard tabbing will result in excessive inboard tab to achieve a smooth ride and also excessive cyclic stick vibration.

NOTE

Unfortunately there is no reliable method of determining the correct outboard tab other than trial and error (known as the “Witch Hunt”).

1. Create a chart such as the one shown below to record the results of the tabbing runs.

Tab	Result
1 Up	
1 Down	
2 Up	
2 Down	
3 Up	
3 Down	

2. Operate the helicopter on the ground at full flat pitch blade RPM.
3. Move the cyclic six to eight inches in a forward and aft movement at approximately one cycle per second and feel for feedback in the cyclic motion.

NOTE

Feedback will not necessarily be indicated by cyclic stick shake, although stick shake will result from significant feedback.

NOTE

This procedure can be done with the collective in the full down position.

4. Stop the blades and add two degrees up to the #1 blade outboard tab.
5. Run the helicopter again using the same procedures and again check the cyclic for feedback. The purpose of this procedure is to check the amplitude of the current blade tab configuration with the original and with the previous tab settings. Normally, the severity of the feedback will stay the same, get better or get worse. Record this result in the table in Step C.1.
6. If the feedback is eliminated, this procedure is finished. If the magnitude of the cyclic feedback either stays the same, or worsens, then change the setting on the same outboard tab to two degrees down. If the feedback gets better but is still present, add one more degree. Do not use more than 4° in any tab.
7. Run the helicopter again and using the same procedure, compare the magnitude of the cyclic feedback. Again, it should either be eliminated, stay the same or get worse. If it stays the same or gets worse, then set the #1 blade outboard tab back to zero, and add two degrees up to the #2 blade outboard tab.

8. Continue this procedure until each blade has been checked for both up and down tab, or until the feedback has been eliminated.
 9. By following this procedure it should be possible to eliminate the cyclic feed back with one outboard tab adjustment on one blade.
- D. Using pitchlinks, re-track the hover to less than 0.2 ips. If the above procedure is followed, once the hover has been tracked smooth, the cyclic feedback should not reoccur.
- F. Forward flight is tracked using the inboard blade tabs.
1. Fly the helicopter at normal cruise settings (24 in MP for A Models), (28 in MP for C Models), (29 in MP for F Models), and record the ips reading and the clock angle.
 2. Using the same polar chart (Figure 4), adjust the forward flight to less than 0.2 ips with the inboard tabs.

NOTE

If addition of inboard tab affects the hover, take that tab out again and try opposite tab on the other two blades.

NOTE

If a tab change does not improve the ips reading, it is advised to take the tab adjustment out again and try adjusting the inboard tab on another blade. Failure to follow this procedure will result in excessive tab amounts on all the blades.

3. Continue this procedure until the forward flight ips reading is 0.2 or less.

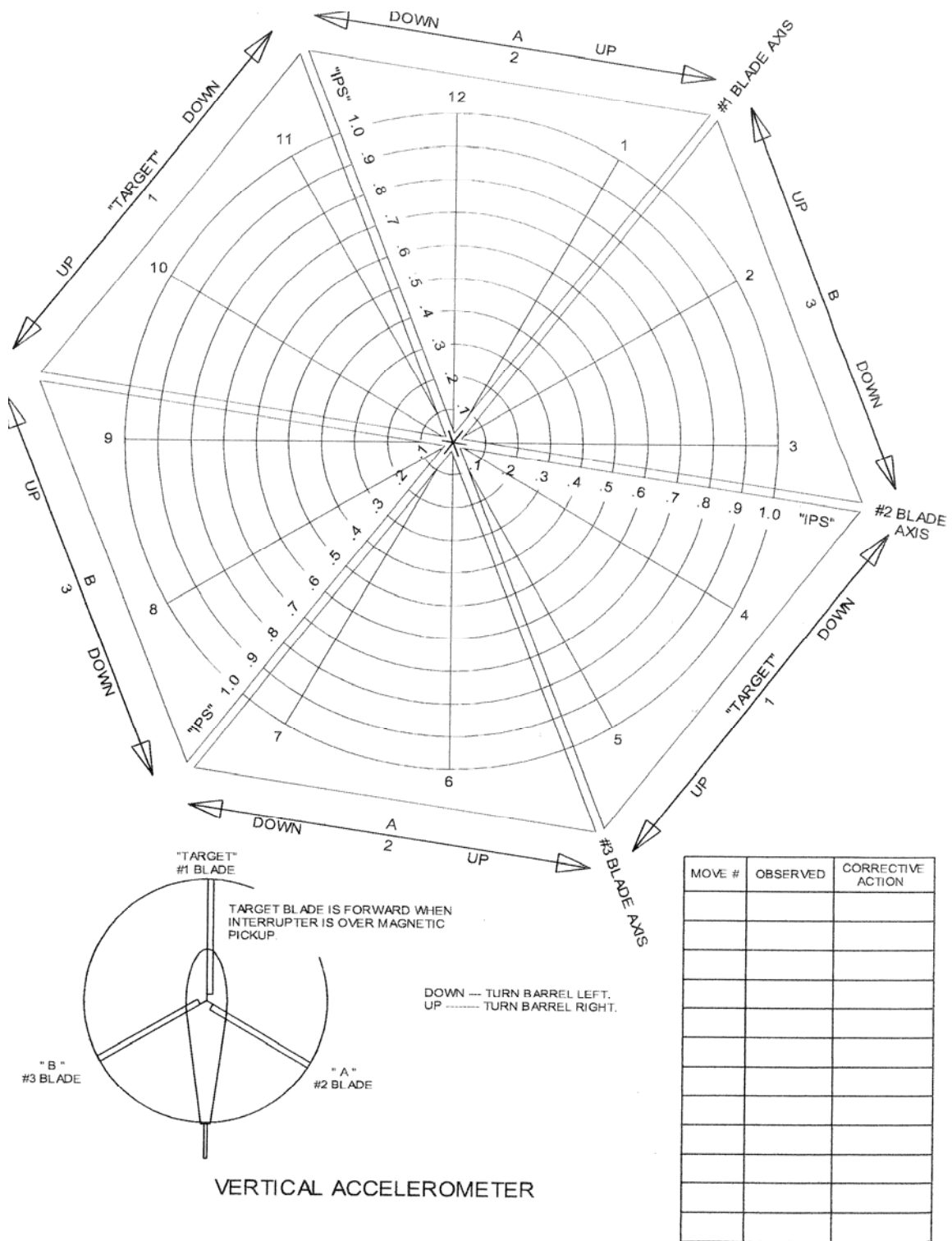


Figure 4. Vertical Accelerometer Polar Chart

D. Clock Angle Corrections

It is quite common for plotted blade track corrections on a polar chart to not follow the expected move lines on the polar chart. This procedure outlines the methods of correcting the clock angle on a polar chart.

Simply put, a clock angle correction is used if a blade track adjustment is made, and when the next plot is taken, the clock angle moves in some direction other than what was expected.

A clock angle correction is needed when a series of track adjustments move in a circular direction rather than moving toward the center of the chart as shown in the example below (Figure 5).

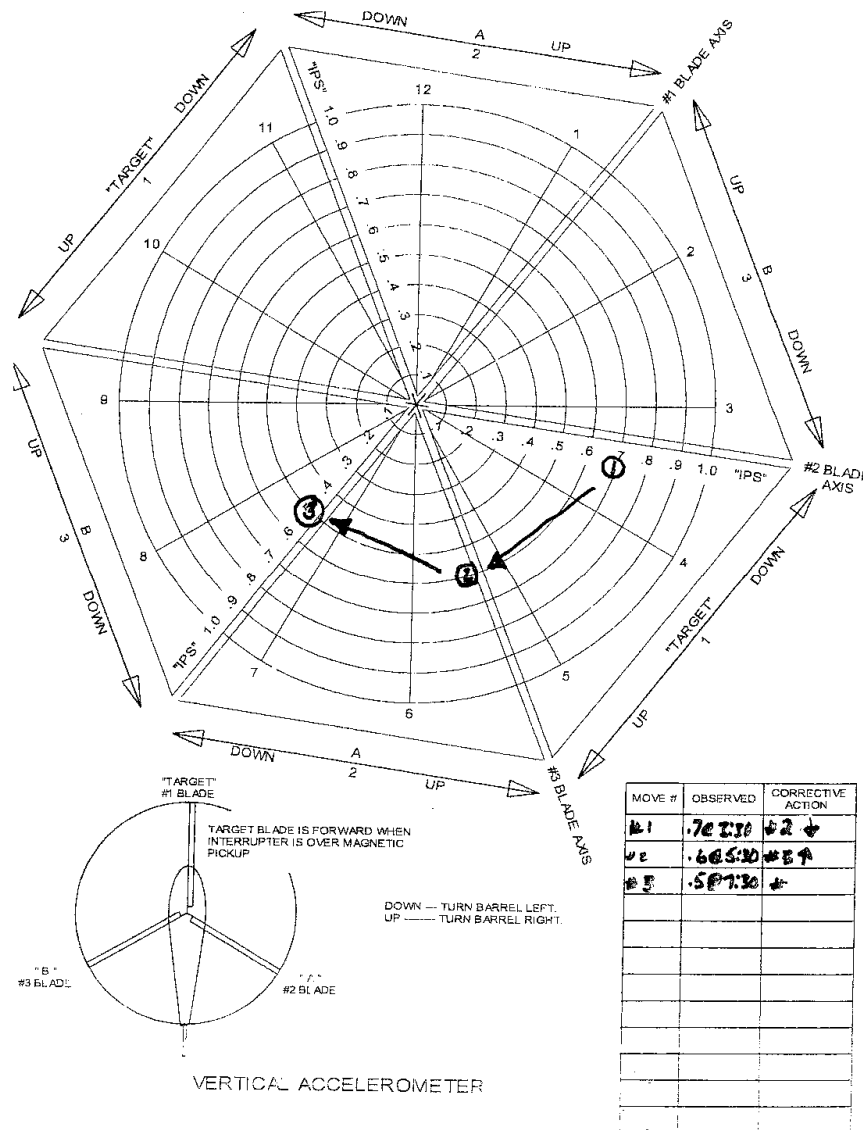


Figure 5. Circular Blade Track

The following example is an example of a typical situation where a clock angle correction can be used to adjust the polar chart to match the helicopter being tracked when using a Chadwick Vibrex 2000 balance system.

The procedure can be adapted for use with any of the digital balance boxes when the internal learning program isn't being used.

On the first hover run, the Chadwick records a plot of 0.6 ips at a clock angle of 3:30. The plot on the vertical accelerometer B chart would look like the example in Figure 6.

The blade track correction line shows that the #2 blade should be pitch linked down approximately 1/3 flat.

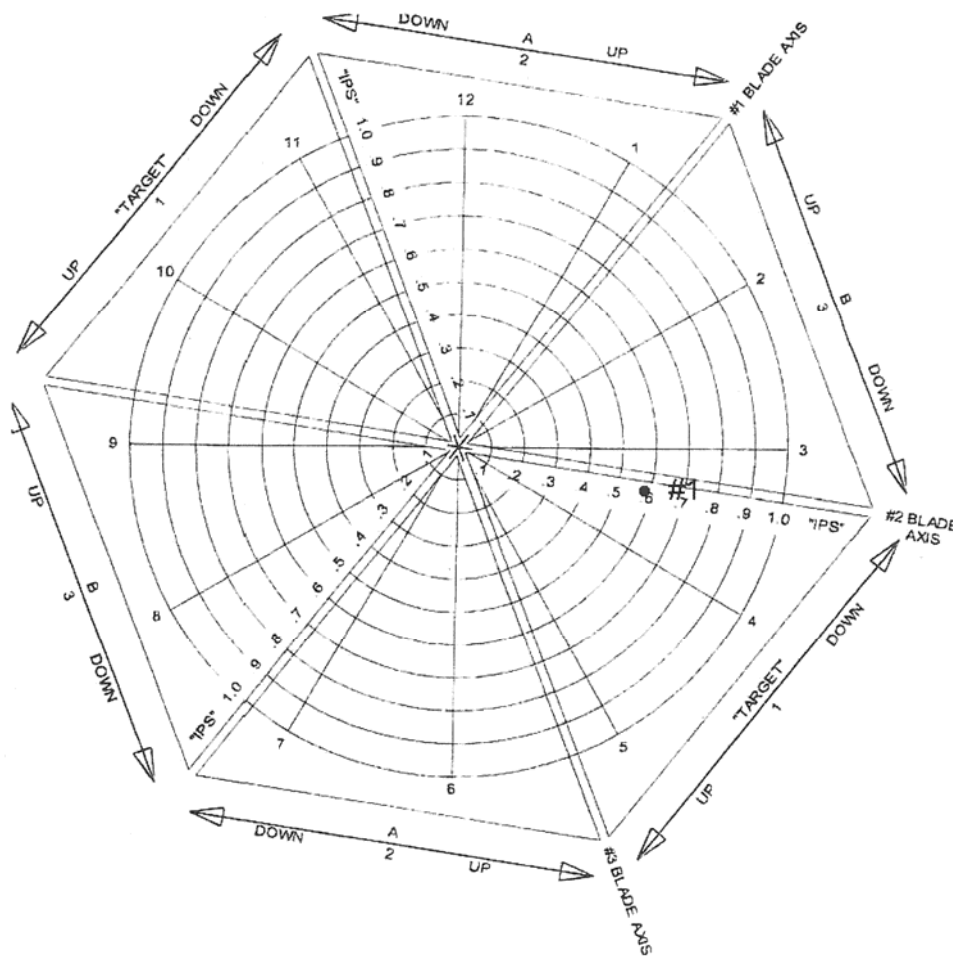


Figure 6. First Hover Run, 0.6 ips @ 3:30

After adjusting blade #2 down, the helicopter is hovered again, and a second plot of 0.5 ips @ 1:30 is recorded. The plot is shown in Figure 7.

Clearly, the helicopter did not respond to the pitch link move as expected, indicating that the polar chart is not correctly aligned to the helicopter.

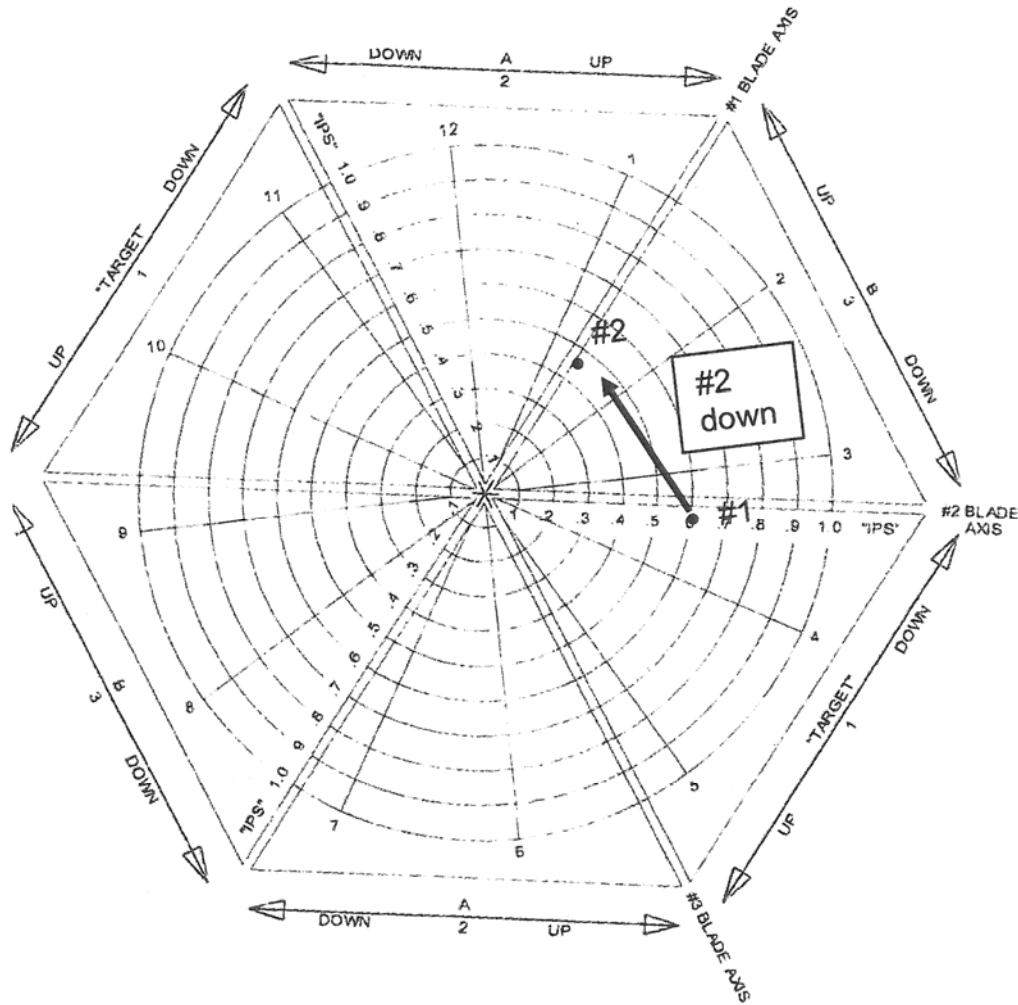


Figure 7. Second Hover Run, 0.5 ips @ 1:30

The solution is to alter the chart to match the helicopter. If we look at (observe) the move line from the #1 plot to the #2 plot as shown in Figure 8, we can see that instead of following the #2 blade axis line as expected, the move actually followed the #3 blade axis line. If we re-mark the outside of the chart, we can make the chart reflect what actually happened.

Here we have switched the blade correction move line from the #3 blade to the #2 blade, which reflects what really happened when we pitch linked the #2 blade down.

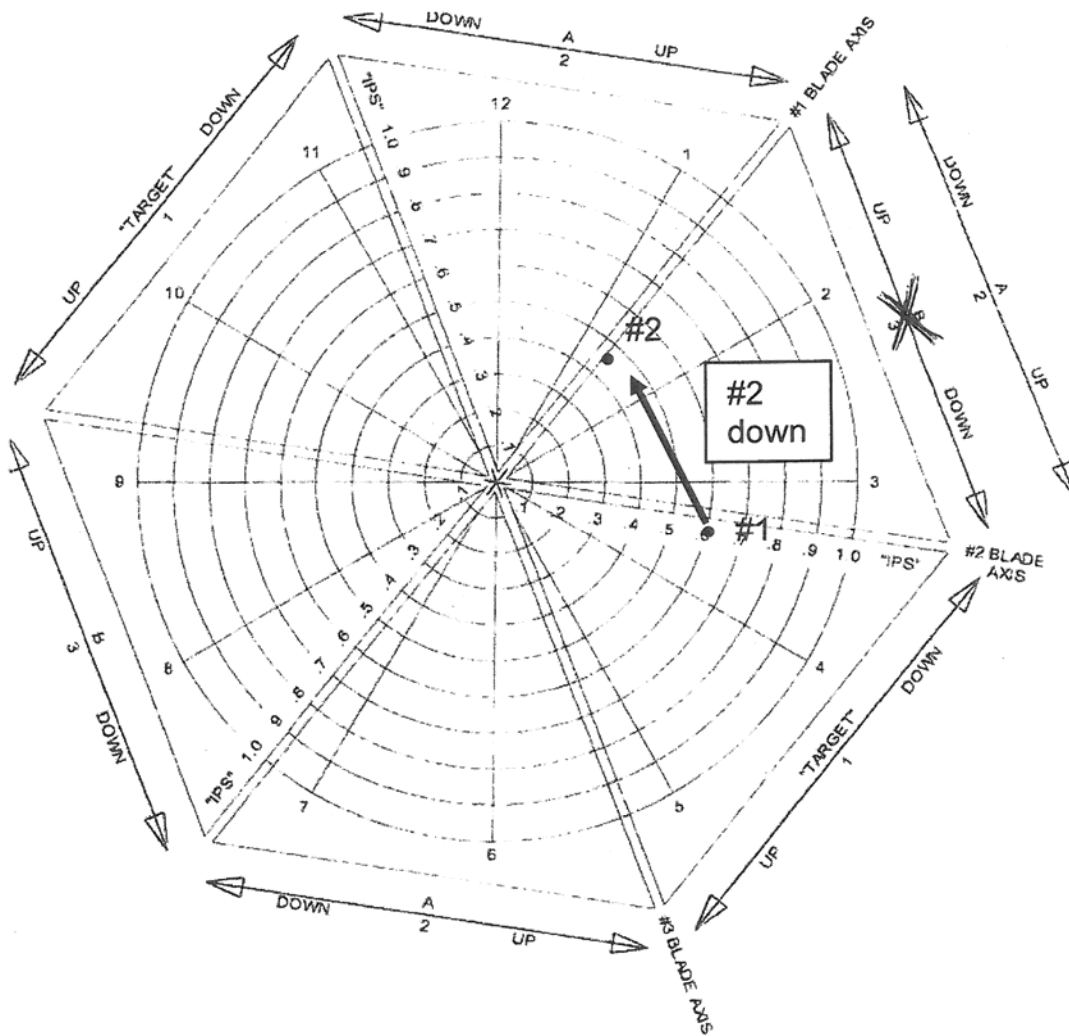


Figure 8. Chart correction re-marking

To alter the polar chart so that it matches the helicopter, we have to move all of the blade correction lines around the chart in the same direction, and the same amount as in the previous adjustment.

If you look at the inside ring of blade corrective moves, and turn them all around clockwise one flat (60°) you end up with the outside ring of blade correction moves.

This is called the Clock Angle Correction. The chart now looks like the example in Figure 9.

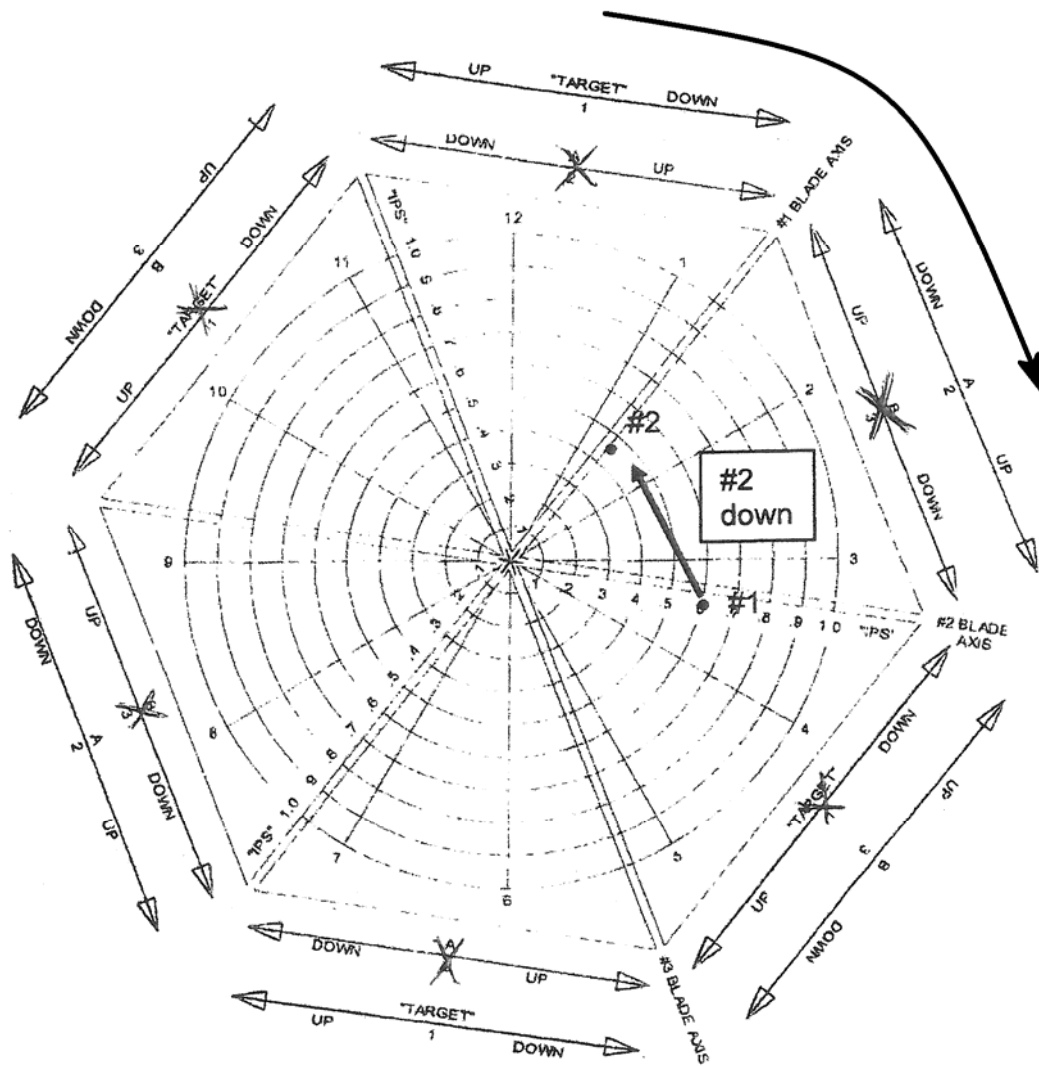


Figure 9. Correction Applied

According to the corrected chart, that is, the outside ring of blade correction move lines, the next move (#3) should be to adjust the #3 pitch link 1/3 flat down.

The helicopter is hovered again and if everything works as planned, the plot should look like the example in Figure 10.

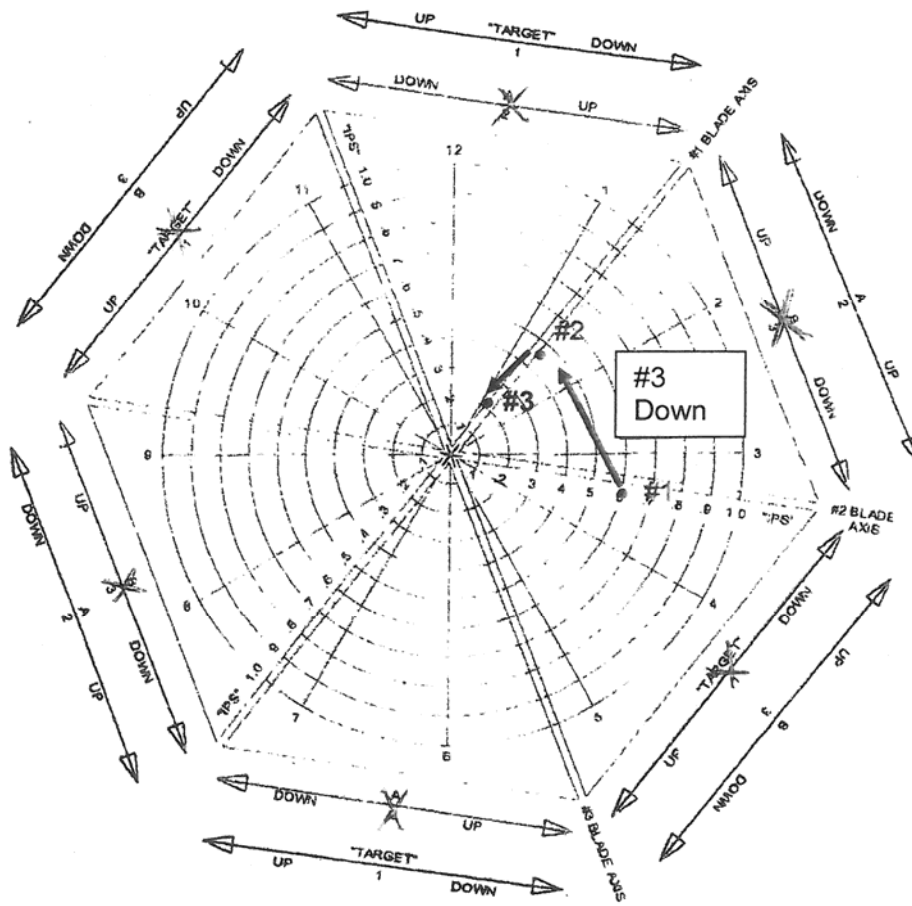


Figure 10. Verification of corrected chart

Notes regarding Clock Angle Corrections:

Clock angle corrections are related to how well the balance equipment matches the helicopter so most helicopters will use the same clock angle correction when they are balanced using the same balance equipment.

The clock angle correction is seldom the same in hover as it is in forward flight so when the tracking progresses to the forward flight phase, a new chart should be used, and the correction will have to be figured again.

In some cases, particularly when the ips readings progress from a large number to a small number, the clock angle correction may change or go away entirely. The technician needs to plot all the moves and to be ready to recalculate or abandon the clock angle correction, if needed.