

## **Ground Bounce (Ground Rock)**

For the most part, ground bounce (Ground rock) is caused by either damper problems or landing gear oleo problems, and if you think about it, they are really the same thing. So it is helpful to know a few things when troubleshooting ground bounce.

Ground bounce is caused by a blade being slightly out of phase. (This means that the blades are not 120 degrees apart) If you could look down at the top of the hub and the helicopter was square or round, you would see the hub moving around in a circle. Because the helicopter is longer than it is wide, and because of the dynamics of the landing gear, the motion is evidenced as a rocking back and forth and not so much as around in a circle.

Piston powered Enstroms often will rock back and forth noticeably while the blades are being engaged, and run up to around 220 RPM. This is completely normal because the Enstrom uses hydraulic dampers that have no centering mechanism. For the hub to be "still", it must be in balance; the blades must be effectively 120 degrees apart. Because there is no centering mechanism in the dampers, there is no reason for them to be in any particular position. While the rotor is starting up and increasing speed, the blades are resting on the droop stops and the natural balancing tendency of a rotating mass just isn't working.

Once the rotor speed increases to a speed that brings the blades off the droop stop, the dampers allow the hub and blades to act as a harmonic balancing system. The natural tendency of the rotor system with hydraulic dampers is always to dampen the out of balance vibrations that cause one-per out of track conditions in flight, and ground rock on the ground.

Schweizers and MD 500's which have the same type of articulated hub normally don't have this ground rock on start up because their elastomeric dampers center, and keep the blades at 120 degrees apart. The exception is the older 269 with the friction dampers. Those helicopters would actually go into ground resonance and come apart if the blade rotation was initiated with the dampers out of phase. Enstroms are not subject to this phenomenon.

## **Trouble Shooting Ground Rock**

When the helicopter is sitting static, do the oleo struts look like they have the same extension. Ideally the helicopter should be sitting pretty level with two or three inches of chrome showing on all the struts. The 280FX has landing gear fairings and the fuel dip stick can be used to gauge the strut extension.

When the Enstrom is pushed in or out of the hangar on its wheels, the rear struts often collapse leaving the helicopter sitting tail low. To get an accurate look at the oleo extension, the helicopter may need to be hovered and then set back on the ramp. (If it is landed in the grass, the oleos won't compress.)

Oleo induced ground bounce can be caused by struts that are either too (firm) high, or too (soft) low. If the helicopter is sitting properly, then usually you can determine whether the problem is struts or dampers as follows.

With the helicopter running on the ground, at full flat pitch, lift up on the collective until the helicopter begins to rise on the oleos. If the ground rock goes away at this point, (while the oleos are extending) and returns when the helicopter is light on the skids, then the problem is oleo related.

If the helicopter is rocking between the time that the full weight of the helicopter is on the oleos and the point where the oleos are fully extended, the problem is most likely in the head. If the helicopter is smooth between these two points the problem is most likely the oleos.

The piston Enstroms that have dampers with two reservoir caps are susceptible to a ground bounce when the helicopter is light on the skids. Again, this is because the rotor hub is articulated. When the helicopter is light on the skids, the oleos are fully extended and are therefore rigid; the dampers are not keeping up. In this case, the helicopter will be smooth during the period of time that the oleos are extending, bounce when light on the skids, and smooth as soon as it's off the ground.

If the ground bounce continues as the helicopter is rising on the oleos and stops just after the helicopter lifts off, then the problem is in the hub, most likely a damper.