



## Maxwell Propulsion Systems, Inc.

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### ***One Torsional Vibration Myth***

The subject of torsional vibration is surrounded by mysticism. One myth is that ANY level of torsional vibration will INEVITABLY lead to a catastrophic failure of the prop shaft, gears, or other flight critical component. In truth, as long as the level of vibration is kept below the fatigue strength of each system component, there will not be a failure due to torsional vibration. It is the responsibility of the engineer/designer to incorporate appropriate safety factors into the design, and then to test the finished product, to ensure the level of reliability one expects in an aircraft.

### ***What potentially caused the A40 Sprag clutch failure?***

In Fall 2006 Maxwell Propulsion System, Inc. (MPS) evaluated Lance's A40 PSRU. This evaluation revealed some inadequacies. As a result, MPS decided to engineer a totally new PSRU rather than trying to fix Lance's poor design. We will continue to offer assistance to A40 owners as best we can, but the final solution will be to replace the A40 with the new MPS MX1.

MPS has not had the opportunity to examine Dave Wobril's A40/A12 that failed. However, from Dave's description, the most likely source of the sprag clutch failure is a misalignment problem, e.g., misalignment between the A40 and the interface plate, or between the interface plate and the engine. There are two ways a sprag clutch can fail: it can lock up or it can spin free. There is no way to ensure that a sprag clutch will lock up before it spins free.

By design, all the sprags must engage together to achieve the full torque rating. Misalignment of even 0.002 inches may cause only a portion of the sprags to initiate the engagement. Up to a point, the clutch is self-centering, since the cage will force the remaining sprags to engage and bring things into alignment, however, this is not a long term solution. If the sprags on one side of the clutch engage first, the cage transmits the force to engage the remaining sprags. When this occurs over and over, the cage fatigues and the life of the clutch is reduced considerably.

### ***What is the A41?***

In Fall 2006, after being notified of two A40 failures, MPS developed the A41 as a stop-gap measure to assist former NSI customers until the MX1 PSRU was available. The MX1 PSRU is conservatively rated at 2000 hours with the normally aspirated EJ-25. Since we are so close to completing testing on the MX1 PSRU we have decided to no longer offer the A41 option.

### ***What vibration dampening devices are commonly used in an aircraft?***

A typical way to ensure that the resonant frequency of the engine coupled to the propeller is outside the normal RPM operating range is to add an elastomeric coupler between the engine and PSRU. These devices have a low enough spring rate that it lowers the resonant frequency significantly.

### ***What torsional vibration control system will be used in the MX1?***

The MX1, scheduled for release 4<sup>th</sup> quarter 2007, will have a Lords elastomeric coupler. This approach to handling torsional vibration is designed to ensure that the resonant frequency of the engine coupled to the propeller is not in the normal RPM operating range. The elastomeric coupler between the engine and PSRU has a low enough spring rate to lower the resonant frequency significantly. The mathematics are not overly complex, but some testing is always required to rule out any unusual resonance problems.

### ***Where is MPS in the MX1 PSRU testing process?***

The first MX1 prototype PSRU has been run for 50 hours with a clutch installed. Additional ground testing with an elastomeric coupling will be done prior to flight testing. Prior to release Jim Vanek at SportCopter will complete the flight testing in the new Super Sport ([www.sportcopter.com](http://www.sportcopter.com)). Following its release, the MX1 will continue being tested for hundreds of hours under severe conditions...gyrocopter training is a lot tougher on an engine package than regular flight.

### ***Will the MX1 PSRU fit into the NSI cowling?***

Yes! By design, the MX1 PSRU has the same distance between the engine face and the prop flange as the A40/A12. The elastomeric version weighs approximately 15 pounds more than the A40/A12 however, the horsepower capacity has been doubled and the TBO is intended to be 2000 hours with normal maintenance.