Currawong Engineering's CBS-15 CAN Brushless Servo is a highly reliable servo intended for actuation of control surfaces. Currawong seeks to use the CBS-15 as a throttle actuation servo and has hence conducted an extensive endurance test to determine the expected lifetime of the servo and modes of failure in typical use cases. This report summarises the methodology and results of the first round of testing.

Test Conditions

The servo (serial number 20) was subject to an aggressive accelerated wear test totaling 575 hours, with the servo typically running for eight hours continuously each day and then turned off overnight. The commanded position profile consisted of ramp and square wave motion across the entire range of the servo followed by deliberately induced high frequency movements to simulate random loads on the servo while holding a fixed position, with the profile repeating after 50 seconds.

The servo drove a zero-offset linear torsional spring with a load of 5.1 kg-cm (0.5 Nm) at full deflection that mimics the loads produced by control surfaces under flight conditions.

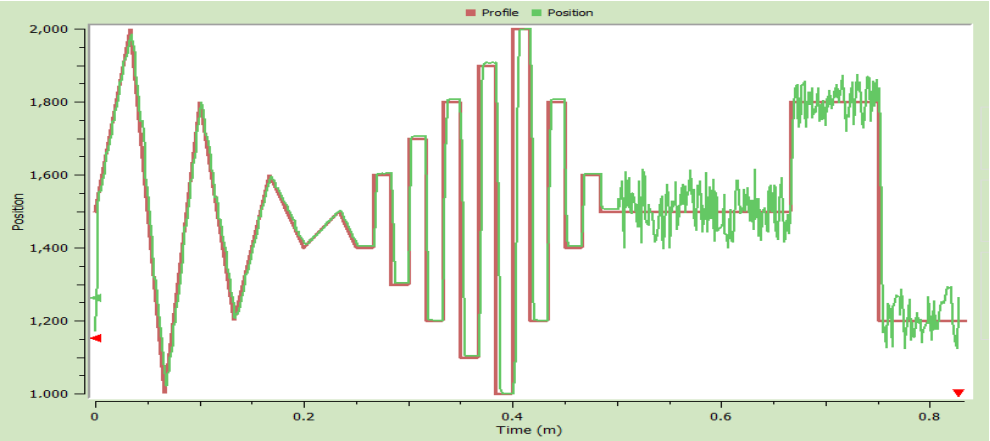

Figure 1 Test profile

Results

The performance and condition of the servo was evaluated after 60, 200, 500 and 575 hours of testing. The examination at 60 and 200 hours revealed no wear to the servo and tests of linearity and backlash were nominal. After 575 hours of testing the nonlinearity of the servo had increased to 2.5% deviation from full scale, compared to 1.6% at zero hours.

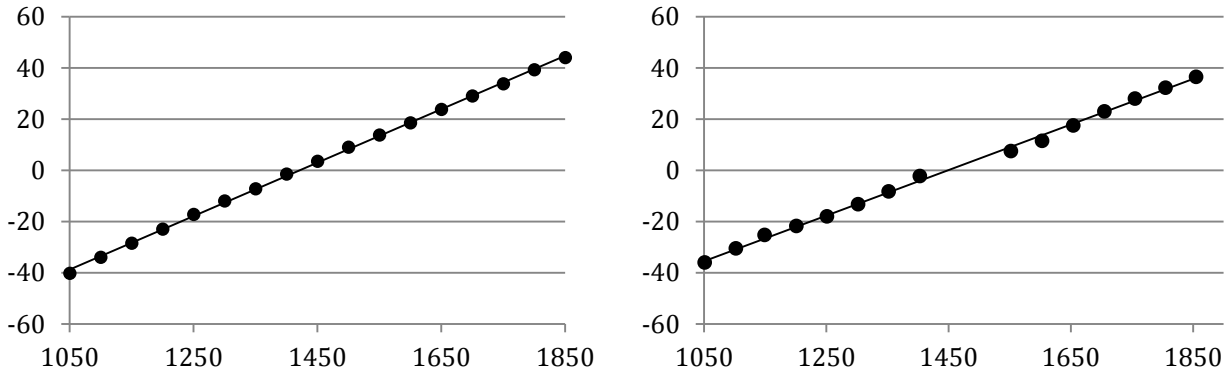

Figure 2 Feedback position v. angle, at zero hours (left), at 575 hours (right)

At 575 hours the servo had accumulated more than ten million cycles and was disassembled and examined under a microscope. Minor wear was observed on the flanks of one gear in the assembly, pictured below, with no wear apparent on any other gear.

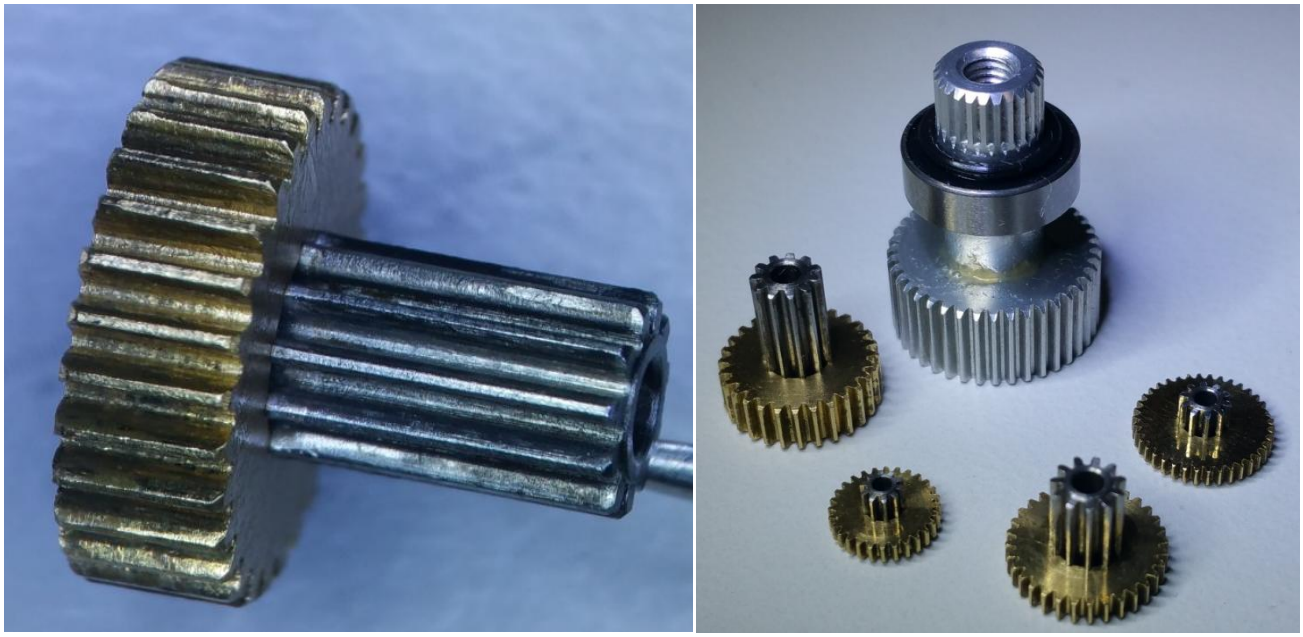

Figure 3 Gear showing wear on flanks (left), inspection of all gears (right)

The servo had developed a tendency to become unstable and oscillate when commanded to positions near the centre of the servo range (approximately 1500 microsecond commanded position input). This is speculated to be the result of degradation of the position feedback potentiometer contacts causing noisy measurement of the servo position and hence instability in the control loop. The specific location of this instability can be attributed to the test profile, which had a majority of servo movement in the centre region.

Conclusion

The endurance testing has revealed that the lifetime of the servo is at least 500 hours of continual, aggressive use. Currawong has developed new software for the servo that now tracks which regions of the servo are being traversed, hence enabling a better estimate of the wear level and remaining lifetime.

A new endurance test is currently being conducted with a no load triangle wave profile of at least ten million cycles. This test will evenly distribute wear across the entire range of the servo in order to confirm that the potentiometer contacts are the limiting component of the lifetime of the servo.