AM-0914 (PG71 Gearmotor) Dynamometer Test Method

Five sample gear motors were provided for testing. One sample came from the 2012 FRC parts of Team 3620 (Average Joes) in St. Joseph, Michigan. Four samples came directly from the supplier (AndyMark) of Kokomo, Indiana.

The laboratory DC power supply was set for a regulated voltage (12V or 14V) and electrically connected through the wattmeter to the motor being tested by approximately 15 feet of 10 AWG lead wire; i.e., 15 ft. positive lead and 15 ft. negative lead. This connection should be expected to add about 30 milliOhm to the test circuit, so the voltage drop between the supply and the motor will be about 0.3 Volt when the motor draws 10 Ampere.

Each sample was tested three times at 12V supply and three times at 14V supply. During each test, the motor was started with no load apart from relatively small residual drag in the dynamometer set-up, and the load was increased steadily over a period of about three seconds until the speed was reduced to about half of its initial value. Electrical and mechanical measurements were captured every thirty milliseconds, so a data set for one test comprises about 100 values each for time, voltage, current, electrical power, torque, speed, and mechanical power. Please refer to the Setup Photos for views of the motor mounting, mechanical coupling, and brake. Please refer to the Results Summary for details of the electrical and mechanical instruments.

From the raw data described above, plots were made using Microsoft Excel 2007 showing speed, mechanical power, and current on vertical axes vs. torque on the horizontal axis. Three plots each of speed, power, and current are shown on one graph for each motor at each voltage (12V and 14V), for a total of ten graphs with nine plots each. Trend lines were calculated for each plot, and the parameters of each trend line are shown on the graphs. Comparison of the trend lines indicates good repeatability of test results. Graphs are shown in the Results Summary. Analysis of the trend line parameters is shown in the Parametric Summary.

It should be noted that sample 1 was received in the lab two days earlier than samples 2-5, and that sample 1 was used extensively during that interval for set-up and tuning of the test equipment. Samples 2-5 were tested on the day that they were received, without significant running time beforehand. As a consequence of additional running time before the start of testing, the grease inside the gearbox of sample 1 is likely to have been warmed and distributed more advantageously than the grease in samples 2-5. This might explain the higher peak mechanical power observed from sample 1.

Results Summary

- At 12V, sample 1 developed 51 Watts peak mechanical power, and its extrapolated stall torque was 25 N-m (18.5 lbf-ft). At 12V, samples 2-5 averaged 44 Watts peak mechanical power, and their average extrapolated stall torque was 22 N-m (16.6 lbf-ft).
- At 14V, sample 1 developed 68 Watts peak mechanical power, and its extrapolated stall torque was 28 N-m (20.7 lbf-ft). At 14V, samples 2-5 averaged 59 Watts peak mechanical power, and their average extrapolated stall torque was 25 N-m (18.5 lbf-ft).

AM-0914 (PG71 Gearmotor) Dynamometer Test Conclusions

- Measured performance on the dynamometer was repeatable as indicated by the trend lines for each plot on the graphs, as shown in the Results Summary.
- Variation of measured performance, and of calculated values for peak mechanical power and extrapolated stall torque, was within expected limits for a well controlled production process (2*sigma < 5%) for motors of this type.
- Peak mechanical power and extrapolated stall torque for sample 1 were higher than the average for samples 2-5; this correlates as expected with the longer pre-test running time for sample 1.

As a final observation, based on many seasons of experience in the FIRST Robotics Competition, our laboratory noted that the PG71 Gearmotor performance matches well with performance we have previous measured for the Globe Gearmotor (no longer available to FRC teams). That motor proved very useful in many FRC designs, so we are hopeful that this one will also. Of course, our dynamometer test results do not provide any insight to long-term durability of the PG71, relative to that of the Globe.