

Bottom-line Savings

Servo gearboxes and system efficiency

Alex Howe
Applications Engineer
Wittenstein Inc. Bartlett, Ill.

According to the U.S. Department of Energy, greater attention to motor system management can reduce motor energy costs by up to 18 percent while also boosting productivity, reliability and profitability. It is good to see OEMs paying attention to these important facts, with nearly two-thirds of motor systems specified today include energy efficiency in the specifications. Motor-driven equipment in manufacturing currently accounts for more than 2.3 quads of energy use which equals nearly 23 percent of all electricity sold in the United States. These numbers indicated that even small efficiency improvements can have dramatic economic, as well as environmental results.ⁱ

With OEMs focusing their purchasing power on the importance of networks instead of focusing only on the mix and match potential of components, greater emphasis can now be placed on the appropriateness of all components and the value which they, as a system, bring. A likely choice for most servo systems, gear reducers are another component which can be sourced individually; however, should be evaluated with the entire system. Proper analysis of requirements and system specifications can lead to a gear reducer becoming one of the most cost saving components of the system. With upwards of \$30 billion being spent on electricity dedicated to electric driven systems, nearly 70% of that amount is dedicated to motor systems. Careful attention to electricity uses on servo systems is paramount.ⁱⁱ

It is vital for OEMs to be completely familiar with their system, as further analysis of the components provides valuable insight into the complete system. Optimized components allow systems to perform at their best. Gear reducers are components that, if appropriately sized for the application, provide reliability, measurable efficiency and optimal performance.

To obtain maximum efficiency from the complete system, a gearbox must be appropriately sized. Two vital characteristics for optimal sizing include:

1. Choosing a servo-rated gear reducer. Servo-rated standards have been derived from the alpha cycle, the servo testing protocol developed by Wittenstein. This alpha cycle determines the wear behavior under sinusoidal load in relation to running time. These ratings have also been verified by the leading servo motor manufacturers.

2. Using system analysis and servo sizing software. Only through in-depth analysis with software and application requirements can a gear reducer and servo motor be appropriately sized for the application.

As an application example, let's compare an appropriately sized gearbox and an oversized gearbox. We can use as an example an application with the system operating in a cyclical motion profile for one (1) continuous month of operation (744 hours) and the energy cost at \$0.1069 per kilowatt/hour.ⁱⁱⁱ For both gearboxes:

- Nominal output torque = 33 Nm
- Average output speed = 528.2 rpm
- Three year expected life with no maintenance required

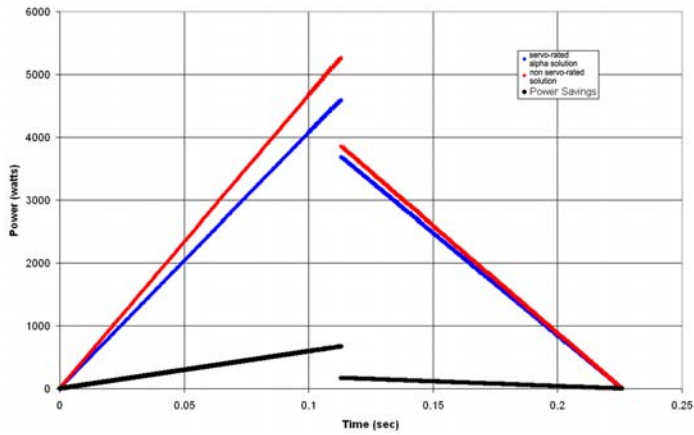
The application we will be using is a belt & pulley drive. For the application:

- Duty = 100% - back and forth movement
- Load = 20kg
- Pulley Diameter = 80mm
- Cycle Time = 0.226 sec
- Move Distance = 500mm

To analyze this example, we will be running it through Wittenstein's cymex[®] servo sizing software. Application analysis through tools like cymex, allow you to "try before you buy" – fully analyzing application specifications, motor utilization and gear selection. For this belt & pulley example, two (2) gearboxes could be chosen based on your comfort level of the validity of the catalog ratings:

Requirements	Servo-rated Gearbox Rating	Oversized Gearbox Rating
RMS Torque	8.0 Nm	8.8 Nm
Max Torque	8.8 Nm	10.0 Nm
Nominal Speed	2640.8 rpm	2640.8 rpm

As can be seen by the power versus time graph on the following page, power savings in using an appropriately sized gearbox increases directly with time. Energy cost savings in this application for using a servo-rated gear reducer equals \$87.10 per axis/per month. This tangible and dramatic cost savings highlights the importance of analyzing system components and using the right tools and right manufacturers to create an efficient system. A further advantage of using the appropriate gearbox for the application, you very well may be able to use a smaller motor for the application, thus providing an even larger efficiency and energy cost savings.



For further information on optimizing servo system efficiency or to analyze your specific application, please contact our technical team at 888-534-1222 for more information or email us at info@wittenstein-us.com.

ⁱ Consortium for Energy Efficiency, Inc., *Motor Decisions Matter Energy Efficiency/Usage Fact Sheet*,
http://www.motorsmatter.org/press/energy_facts.html.

ⁱⁱ http://www1.eere.energy.gov/industry/bestpractices/motor_challenge_national_strategy.html

ⁱⁱⁱ Average US energy rate, 2006, according to Energy Information Administration,
www.eia.doe.gov