

TOUGH JOBS

FOCUS ON:

PATIENT LIFT



Mike Vander Zwaag
Regional Account Manager,
Groschopp Inc.

Quiet Strength Under Load

Noise is often the single toughest challenge faced by design engineers when developing products for medical applications. Such was the case for a leading global company that designs, manufactures, and installs patient lifts in healthcare facilities.

Obviously, the motor needed to be powerful, reliable, and very quiet. It was the last requirement which was the toughest job. The inherent noise issue with many types of motors is the brushes. Brushes create mechanical and electrical noise due to friction against the commutator, as well as arcing caused by current conducting through the brush and commutator.



DC Gearmotor customized
for ultra-quiet operation

"Reliability was a given," said Mike Vander Zwaag, Regional Account Manager. "It was their desire to have the quietest possible motor for their mobility-impaired end users that was the driving force behind the engineering of this motor." A standard permanent magnet DC (PMDC) motor that is powerful enough to lift patients operates around 52 decibels (dBA). This is about the sound level in a room with a window air conditioner.

Groschopp engineers tried a variety of schemes to reduce the noise while still maintaining performance specs. A special varnishing process was used first to reduce the sound. Next, working with the carbon brush supplier, a brush was designed that would meet the noise and life requirement of the customer. In order to complement the brush design, additional machining tolerances were examined and tightened to achieve noise level reduction. It was ultimately a combination of adapting existing technology, selecting and testing a variety of materials, and adjusting manufacturing techniques that delivered the final product.

"We spent a year on this design to meet their exacting noise specifications. The motor normally operates around 52 dBA, but after five prototypes, thorough testing in the sound lab indicated we were operating at an average 42 dBA. The customer was delighted. This application shows that with the right know-how and patience, we can meet some really tough specs," said Vander Zwaag.

This reduction in noise level of some ten decibels was an impressive achievement. The decibel scale is logarithmic, not linear. Every three dB decrease of the sound level cuts the intensity of the sound by half. At 42 dBA, the sound is only marginally louder than a private office or quiet room.

"Our partnership with this customer is a prime example of the challenging obstacles that can be overcome when two companies are willing to work together to meet a specific goal," said Vander Zwaag.

The Challenge

- "Super quiet" motor
- Ability to lift intermittent loads up to 600 pounds
- Highly reliable and tested for performance at maximum load
- Long life

The Solution

- PMDC Motor customized for ultra-quiet operation
- Modifications to brushes and holders to reduce noise
- Noise levels averaging 42 dBA
- Tighter balance specification

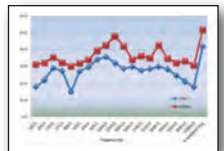
The solution was ultimately a combination of adapting existing technology, selecting and testing a variety of materials, and adjusting manufacturing techniques that delivered the final product. Other adjustments were the armature balance and bearing tolerances. The balance tolerance on this project was cut to half the range of the standard product, and a more precise bearing was also employed to decrease the radiated noise.

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Design Checklist

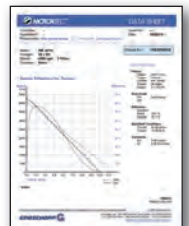
Noise

The sound level requirement in this application was critical. The reduction was dramatic. For more details on the sound levels before and after motor customization see page 2.



Motor Torque

The motor for this application required high starting torque to lift potentially heavy patients. The PMDC motor was an excellent choice because of its high starting torque and a relatively flat speed/torque curve. For complete motor specifications and speed/torque/efficiency data, see page 3.



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▶ DATA SHEET

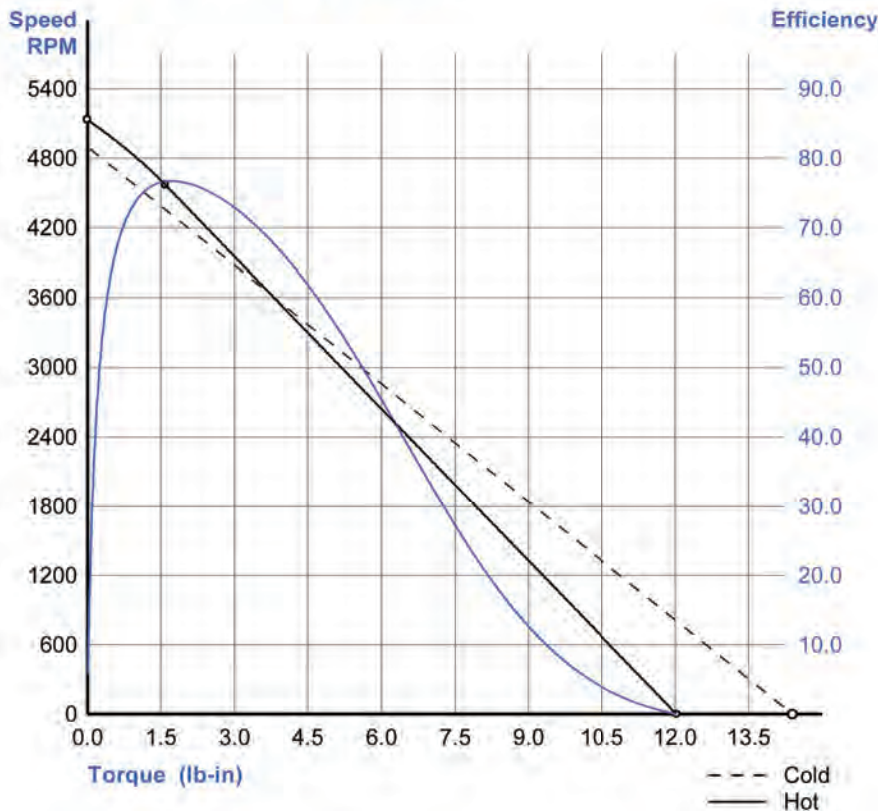
Customer: ---
 Application: ---
 Prepared by: **Mike Vander Zwaag** - 712-722-4135 x1226 - mikez@groschopp.com

Quote No: ---
 Date: **08/22/08**

Motor: **PM 6015**
 Voltage: **24 v DC**
 Speed: **4600 rpm 2 Poles**
 Gearbox: **None**

Design No: **MXJMGHUX**

Speed, Efficiency Vs. Torque



SPECIFICATIONS

Rating:
 Speed: 4572.0 rpm
 Torque: 1.6lb-in
 Current: 4.41 amps
 Output: 86 watts
 Output: 0.1152 HP

Duty Cycle:
 On: Continuous
 Off:

Efficiency:
 Gearbox:
 Motor: 76.7 %
 System: 76.7 %

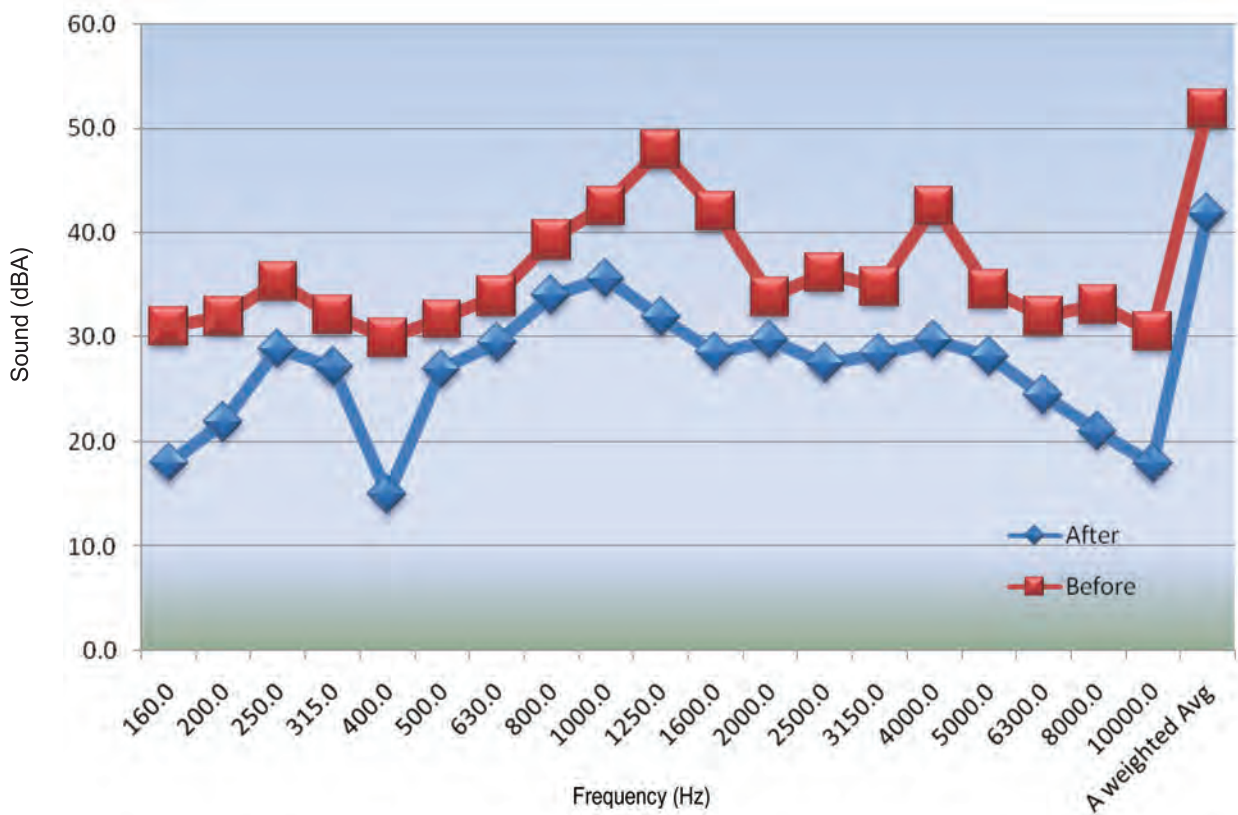
Start/Stall Conditions:
 Current: 42.49 amps
 Torque: 14.40 lb-in

Constants:
 Ke: 4.99 v/krpm
 Kt: 0.42 lb-in/amp

Notes:

▶ DC MOTOR SOUND DATA

The data shown in this graph represents the 1/3 octave band testing data taken before and after the motor customization techniques were implemented. A weighted average is applied to the data. The sound level was reduced by 10 dB over the course of the project. Because the decibel scale is logarithmic, not linear, the sound intensity was significantly reduced. Every 3 dB decrease in sound cuts the intensity of the sound by 1/2.



For design engineers working on a noise reduction project, the motor design is only a part of the challenge. Radiated noise can be amplified through the other components in the system. Here are some additional tips for reducing noise:

- Avoid using sheet metal and structural components that will resonate with the motor
- In some cases the use of vibration isolators to mount the motor can help
- Accurate alignment of the driven components to the motor is also critical

As a note, the higher the RPM of the motor, the more sound will be radiated from the motor. Also, quieter motor technologies besides the PMDC are available, but other factors such as cost must be taken into consideration.