APPLICATION NOTE

QuickStick® Mean Time Between Failures (MTBF)

Purpose

Provides the mean time between failures (MTBF) data for the QuickStick 100 (QS100) and QuickStick HT (QSHT) product lines. MTBF data can indicate the probability of a unit failing within a period of time based on 24/7 operation.

Introduction

The QuickStick motors have been designed for high reliability and low maintenance. The motor's design does not consist of parts such as bearings, chains, and conveyor belts; therefore reducing the need for scheduled maintenance and the need to replace major components. The only moving parts on the propulsion system are the captive wheels that provide guidance and hold the magnetic gap, which are part of the customers' system and are not considered in our modeling effort.

MTBF Prediction Results

Data of internal electronic parts and components are collected from manufacturers. MTBF is calculated using ReliaSoft Lambda Predict software, for Bellcore TR-332 Issue 6 standard, Quality Level II. Results assume ambient temperature of 30°C, coil board temperature of 50°C and operation time of 24 hours per day and 7 days per week.

Table 1: MTBF Bellcore Results

Model	MTBF (Hours)	MTBF (Years)
QS100 1-Meter	195,000	22
QS100 ½-Meter	343,000	40
QSHT 1-Meter	4,800,000	553
QSHT Controller	700,000	80
QSHT 1-Meter Motor + Controller	615,000	70

Field Results

QuickStick100 Stator

For the QS100 product, the demonstrated field annual failure rate (AFR) is between 0.5% - 1%, as of March 2015. A 1% failure rate for 24 hours per day operation would yield a 100 year MTBF. A 0.75% failure rate for 12 hours per day operation would yield a 65 year MTBF. Based on this data, the Bellcore model is very conservative and under estimates by at least 2X actual performance.

QuickStick 100 Vehicle and Magnet Array

MagneMotion does not provide the guiderail system or vehicle, so the MTBF on these components is specified by the provider of these items. The reliability of Magnet Arrays provided by MagneMotion is very high and is dictated by the life of the magnet. Magnet Arrays have no moving parts and therefore will not wear out. The magnet array's magnetic field will not degrade under normal, specified operation.

What Factors Impact QuickStick MTBF?

The two factors that have potential for reducing the life of the QS stator product are the average ambient temperature the components are exposed to and the operating voltage.

- Ambient Temperature - The product's failure rate is very low when operated below the specified 50°C maximum ambient temperature. Based on reliability modeling of the electronics, the QS100 and QSHT Stator MTBF is estimated to reduce by a factor of 2 for every ambient temperature increase of 10°C.

- Operating Voltage - During operation, the voltage at the QS100 will rise above the nominal 48V supply voltage we recommend due to regeneration effects. Our MTBF assessment is predicated on not exceeding 57V DC during such events. It is possible to limit peak voltages seen at the QS100 to lower than 57V DC through a variety of means. Doing so will provide very modest improvements in MTBF. For the QSHT product, operation at 300V DC vs 400V DC will yield some modest improvement in MTBF performance.

There are several factors that can contribute to the degradation of Magnet Arrays. The risk of these factors is very low for most applications.

- Ambient Temperature - Magnetic field will degrade if the magnets are subjected to temperatures exceeding 50°C.

- High External Magnetic Fields - Exposure to external magnetic fields above ¼ tesla [T] can cause degradation to the magnetic field.
- Corrosion - Magnet Arrays should not be allowed to be abraded and/or exposed to a highly corrosive environment.
- Hydrogen Embrittlement - Exposure to an atmosphere with high hydrogen content can cause Magnet Array embrittlement.
- Sharp Impacts - Sharp impacts such as collisions with Magnet Arrays can cause damage to the magnets.

A common question on what impacts MTBF is the number of acceleration or deceleration events over time. In general, velocity, and accelerations are not the main drivers of MTBF. Applications can have high accelerations with a light payloads which results in low thrust/current requirements. Similarly, velocity is not a main driver. The faster you go, the less time a specific stator is called upon to provide thrust. So even if currents are higher, the duration is lower.

More Information

MagneMotion Website: www.magnemotion.com

Questions & Comments: www.magnemotion.com/about-magnemotion/contact.cfm

Revision History

Rev.	Change Description
A	Initial release
B	Addition of Field Results and What Factors Impact QuickStick MTBF sections