Vacuum Motors – General Questions and Answers

Frequently Asked Questions

Why do standard commercially available motors fail in a vacuum?

Commercial motors are designed for lowest cost, without consideration of possible use in a vacuum. Glues, insulation's, varnishes, greases and other materials selected for lowest cost, typically evaporate or outgas very quickly in a vacuum. In addition special attention needs to be given to open connections to prevent arcing when the insulation effects of air are removed. Finally, without the cooling medium of air, the motors run hotter than normal, the higher temperatures lead to rapid failure.

What will happen if I try to operate a standard motor in a vacuum?

Typically a standard motor will operate for a short time and then fail. In general, standard motors will not survive in a vacuum of 10^{-4} Torr or lower for very long. The primary reason is that the lubricants and the insulation materials will evaporate, a phenomenon known as outgassing. In addition to destroying the motor, outgassed materials can contaminate optical components, delicate mechanical devices and other sensitive equipment inside the vacuum environment.

What makes a motor vacuum rated?

Careful attention to details which are not normally considered by a designer of commercial motors. It has taken Empire Magnetics, Inc. many years to assemble all of the details which allow us to build premium motors for vacuum applications. Experience and hard work allow us to offer a quality product with the assurance of a warranty.

Can I obtain a list of materials?

Empire Magnetics, Inc. considers its materials lists and processing specifications to be proprietary information. In those situations where an economic basis and specific customer needs can be demonstrated, material lists will be provided after appropriate non-disclosure agreements are executed.

Where can I get more information on vacuum equipment?

Some sources of useful hardware are: MDC @ 510-887-6100 or ISI @ 510-887-8664. The Northern California American Vacuum Society may be reached at 408-737-0767.

Can I get cables on vacuum rated motors?

Yes, we do offer cables as an option. The vacuum grade motors are normally made with 12 inch lead wires. It is possible to splice a cable to the lead wires or we can build a cable into a custom built motor at the time the windings are installed. When a cable is added it is necessary for the customer to specify the final winding configuration, (series or parallel)

Addition of cable options may significantly impact delivery schedules.

What other vacuum rated products can you offer?

In vacuum rated products Empire Magnetics, Inc. can offer: stepper motors, resolvers for feedback, brushless servo motors, brakes, gearheads and assorted support materials.

Why doesn't your company publish data on "standard" motors?

It is quite common for customers to ask us if a less expensive "standard" motor will work in their vacuum application. In this situation the word standard has no useful definition since there are thousands of possible variations of commercial motors. Since there is a cost associated with testing and publication of the test data with no apparent reward to our company for these efforts, our stockholders feel we have better uses of our resources. Therefore we don't have data on products we do not sell.

You offer steppers and brushless motors for vacuum applications. Do you offer brushed DC motors?

No. The technical problems associated with brushed DC motors in a vacuum have been left to others. We wish them luck.

Can you design a lower cost product?

The products detailed in our price list are the least expensive versions we know how to produce in the quantities justified by the marketplace. Custom designed versions incur additional engineering and tooling costs so they will normally cost more than products we have already developed. There is an exceptional case, when a product will be used in high volumes for a carefully defined application, it may be possible to design a product which has a lower production cost in volume. However unless a commitment to production can be made, the costs of the design and tooling can not be absorbed.

Should the torque output of the motors be de-rated for a vacuum application?

No, the motor will have the same torque/speed characteristics in a vacuum, as they do in air. However they motors will typically be hotter for lack of cooling.

Can Empire Magnetics provide motors for vacuum pressure levels less than 10^{-7} Torr?

Yes, with some material and process improvements. The key to being able to reach a hard vacuum is to select materials that have a very low vapor pressures. These materials will also maximize the motor life inside the vacuum. However these materials may not be easily used in the making of rotary components, so the expense increases.

Are the laboratory grade motors space rated?

No, the laboratory grade motors often satisfy many but not all of the space application requirements. Typically space applications include shock, vibration, thermal cycling, and reliability issues not addressed in off-the-shelf vacuum rated motors. Including such items

in the general product offering would make them too expensive for commercial users.

Empire Magnetics has supplied numerous motors for space applications on a custom basis. The laboratory grade motor is a good starting point, but in each program a detailed specification was eventually developed which was beyond the scope of a standard product. (refer to Space Rated notes in the FAQ section)

What bearing lubricants are used for the laboratory grade motors?

There are two bearing lubricants used for the laboratory grade motors: a PTFE based grease and a dry film lubricant. The PTFE based grease has a vapor pressure of 10^{-12} Torr at 20°C and the dry film lubricant has a vapor pressure of 10^{-14} Torr at 20°C. In terms of wear life the PTFE based grease can be expected to last four times long.

Can Empire Magnetics' vacuum rated motors be used for cryogenic applications?

No, our cryogenic motors can be used for vacuum applications, refer to CYVX grade products.

Where can I buy a vacuum rated electrical feed-through?

Vacuum rated electrical feed through are available from MDC (510- 265-3500).