Outgassing in Vacuum Motors

Frequently Asked Questions

What is outgassing?

Outgassing is the evaporation of oil, dirt, or any other substance from a surface after it is placed in a low pressure or vacuum environment.

How much outgassing can I expect from my vacuum rated motor?

The amount of outgassing depends on the vacuum grade. If the amount of outgassing is a concern, Empire Magnetics recommends its laboratory grade motors and related products. Some years ago a prominent aerospace company performed outgassing tests on two of our laboratory grade motors. After being baked at 125°C for 24 hours at less than 5×10^{-5} Torr, the two motors had a total mass loss of 0.00107 grams and 0.00088 grams. This far exceeds NASA specification SP-R-0022A "General Specification Vacuum Stability Requirements of Polymeric Material for Spacecraft Application."

We also sent some laboratory grade motors to a National Lab for testing. They were able to provide some qualitative data via spectral analysis (i.e., identify what substances were present) but to date they have not been able to quantify the amount of material loss as it was so minimal.

Do you have test data on outgassing rates?

For some sizes of VX grade motors, tests of condensable outgas products (COP) have been conducted. For a VX-U21 that had been baked at 125 degrees C. in a vacuum of 10^{-5} torr for 24 hours, the amount of material that collected on a cold plate in the vacuum chamber was 0.00088 grams.

We hasten to add that 125 degrees Centigrade is significantly higher than normal operating temperatures of the motors. Since vapour pressure and outgassing rates increase rapidly with temperature, this test result is much worse than a typical application. From experience we have found that optics designers want to have zero outgassing. While our testing shows the amount of material is not zero, we are not aware of any motor technology that provides lower material losses.

Many sources of vacuum equipment reference NASA Specification SP-R-0022a. This specification requires that condensable outgas product, (COP) shall be 0.1% or less. In our test the COP was less than 0.0004%

The amount of material collected is so small that quantification has proved to be very difficult. Efforts by one of the National Labs to quantify the materials have not yet been fruitful.