

Miniature Vacuum System for Portable Instruments

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NASA, other government agencies, and commercial industry have acute needs for miniaturized high vacuum systems. Advances in sensor technology in academia, at NASA, and in commercial laboratories have led to the development of miniaturized and rugged mass spectrometers. However, the vacuum systems required to support these sensors remain large, heavy, and power hungry. In particular, high vacuum systems of adequate performance continue to be too large for systems such as time-of-flight, quadrupole, and ion trap mass spectrometers that are intended to be man-portable or to be deployed on UAVs, balloons, or interplanetary probes. The terrestrial, man portable applications impacted by this problem include military and homeland defense systems for detecting hazardous materials as well as portable leak detectors for commercial use.

For over 10 years, Creare has been developing the technologies required to design and build miniature high vacuum systems. Recently, we designed a vacuum system that consists of a custom turbomolecular/molecular drag pump and a low power diaphragm roughing pump. Our pumping system has the following pumping specifications: an ultimate pressure for air of approximately 10^{-7} torr; a pumping speed of about 5 L/sec; and an exhaust pressure of 1 atm; and the following physical characteristics: Mass of approximately 750 g, a diameter of approximately 2.0 in., and an overall length of approximately 6.6 in. Data will be presented that show the performance of a brassboard prototype.