

## Post-Test Analysis of the Deep Space 1 Spare Flight Thruster Ion Optics

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The Deep Space 1 (DS1) spare flight thruster (FT2) was operated for 30,352 hours during the extended life test (ELT). The test was performed to validate the service life of the thruster, to study known failure modes and identify unknown failure modes. Several of the known failure modes involve the ion optics system. These include structural failure of either the screen grid or accelerator grid due to sputter erosion from energetic ions striking the grid, sputter erosion enlargement of the accelerator grid aperture to the point where the accelerator grid power supply can no longer prevent electron backstreaming, unclearable shorting between the grids caused by flakes of sputtered material, and rouge hole formation due to flakes of material defocusing the ion beam.

A post-test examination of the grids was conducted to determine the extent of grid sputter erosion that occurred during the ELT. The electron backstreaming limit at full power was exceeded during the test—although the thruster could still be operated at lower power levels. The thickness of sputter material from the accelerator grid that deposited on the screen grid was measured. No rouge holes were found during post-test examination of the ion optics. The implications of these results on the service life capability of the NASA 30-cm ion thruster technology are discussed.