

Ultra-High Vacuum Test Platform for Mini-CubeSat Subsystems Technology Readiness Level 5 Qualification

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**This material is based upon work supported by the Nasa NVSGC Grant No.
80NSSC25M7094**

Abstract

The successful transition of mini-cubesat subsystems to Technology Readiness Level 5 (TRL 5) requires rigorous testing in a relevant environment, necessitating an ultra-high vacuum environment of approximately 10^{-9} torr. This stringent vacuum requirement is primarily mandated to perform a critical bake-out and validation process aimed at mitigating outgassing. Outgassing is the release of volatile organic compounds from spacecraft materials, which in the vacuum of Low Earth Orbit (LEO) can condense on and critically degrade the performance of sensitive surfaces, particularly optical components and thermal radiators. The high-vacuum test ensures component thermal control operates solely via conduction and radiation, verifying overall system integrity under flight-like conditions. This report focuses specifically on the rigorous preparation and qualification protocols executed to achieve the necessary vacuum conditions, a critical precursor to full system integration (TRL 6).s