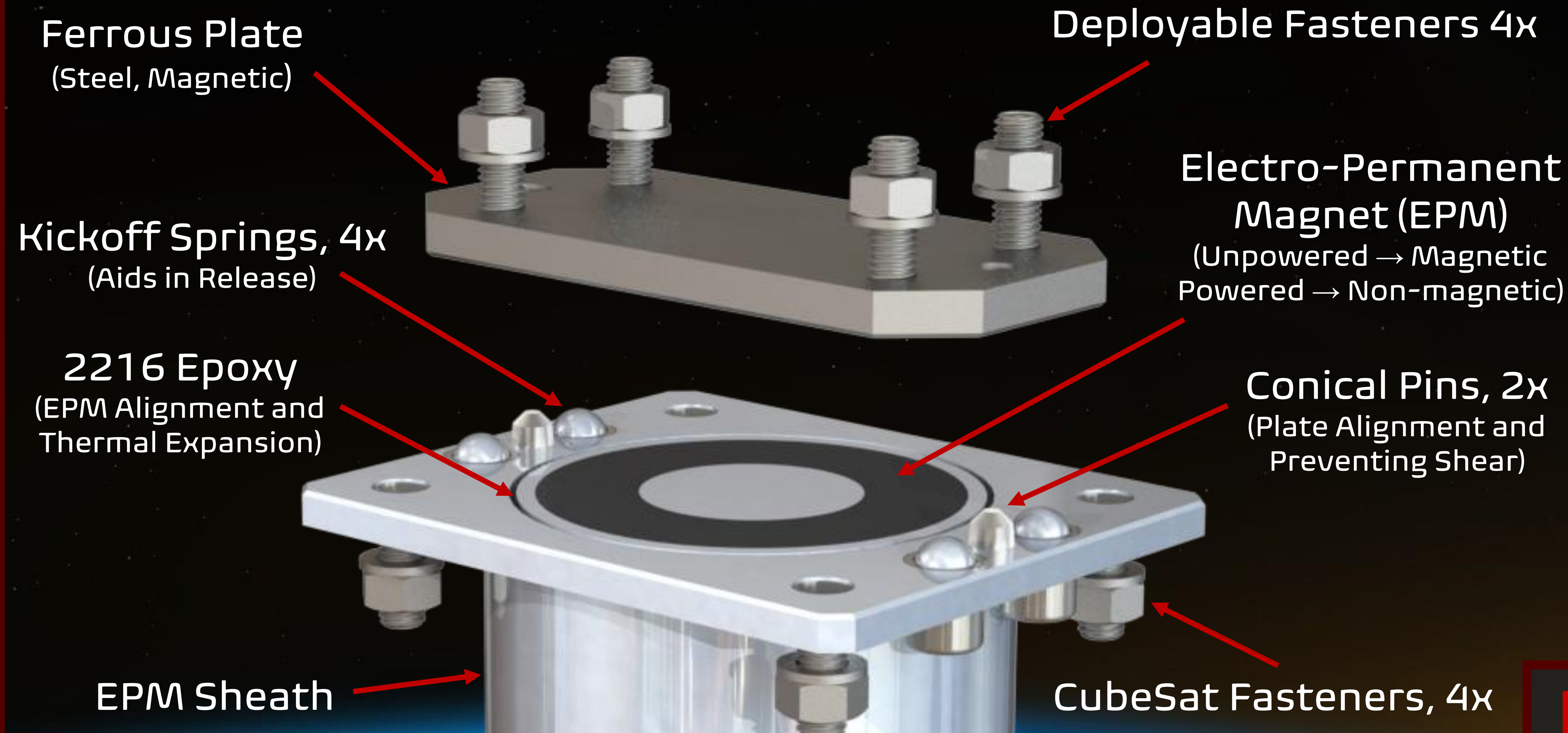


Overview

A Hold Down and Release Mechanism (HDRM) is a device used to secure and subsequently release deployables, such as a solar array, in aerospace applications. Existing HDRMs, like burn wires and frangible bolts, often rely on consumable components and moving parts, posing challenges for repeatable testing. This alternative HDRM prototype design utilizes an electro-permanent magnet and ferrous plate to attach a deployable to a Cube Satellite. Flight performance was verified by exposure to NASA's General Environmental Verification Standards (GEVS) for vibration, thermal, and vacuum conditions.

Key Requirements

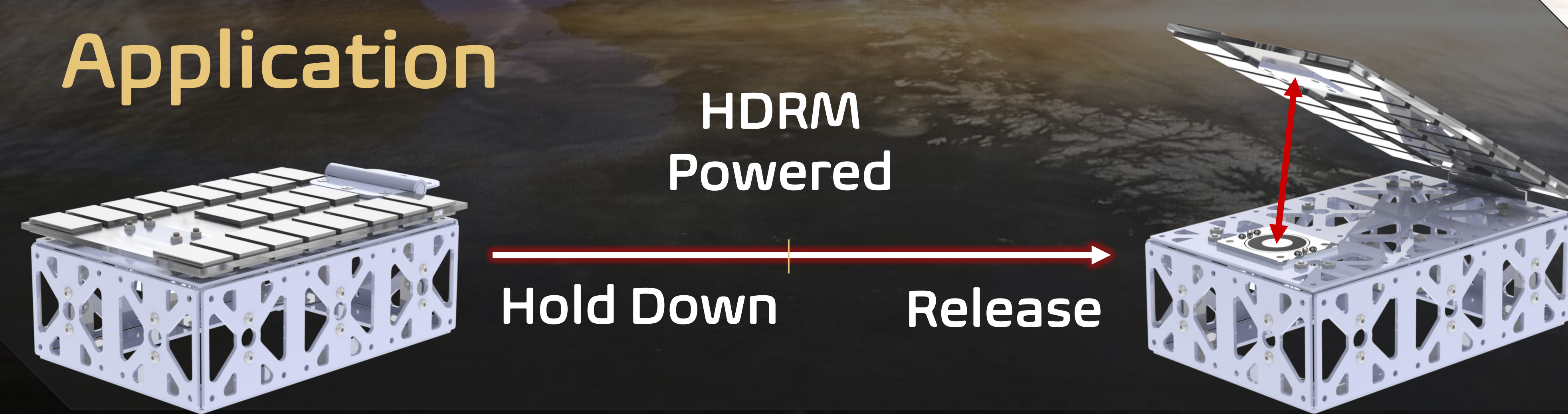
- ✓ Secure a 1kg deployable without power
- ✓ No moving parts required for release
- ✓ Withstand launch vibrations (GEVS)
- ✓ Withstand extreme temperatures and pressures in space
- ✓ Run on existing CubeSat power source
- ✓ Size (7.5 x 5.8 x 3.25 cm, 7.5 x 3 x 0.3 cm)
- ✓ Flight equivalent materials (STD-6016B)
- ✓ Compatible with a wide range of
- ✓ Cube Satellite sizes



Advantages

- Zero moving parts required for release
- No consumable materials for testing
- No pyrotechnics or outgassing for release
- Easily resettable

Application



Features

- Mass: 0.550 kg
- Overall Size: 7.5 x 5.8 x 3.55 cm
- Power Requirement: 12 V, 0.86 A
- Activation Time: 425 ms
- Acceleration: 37.5 G (peak), 12.5 G (RMS)
- Compatible Deployable: ≤ 1 kg
- Operational Temperature: -40 to 60 °C
- Survivable Temperature: -73 to 120 °C
- Vacuum Pressure: 1.15 E-5 Torr

Testing Sequence

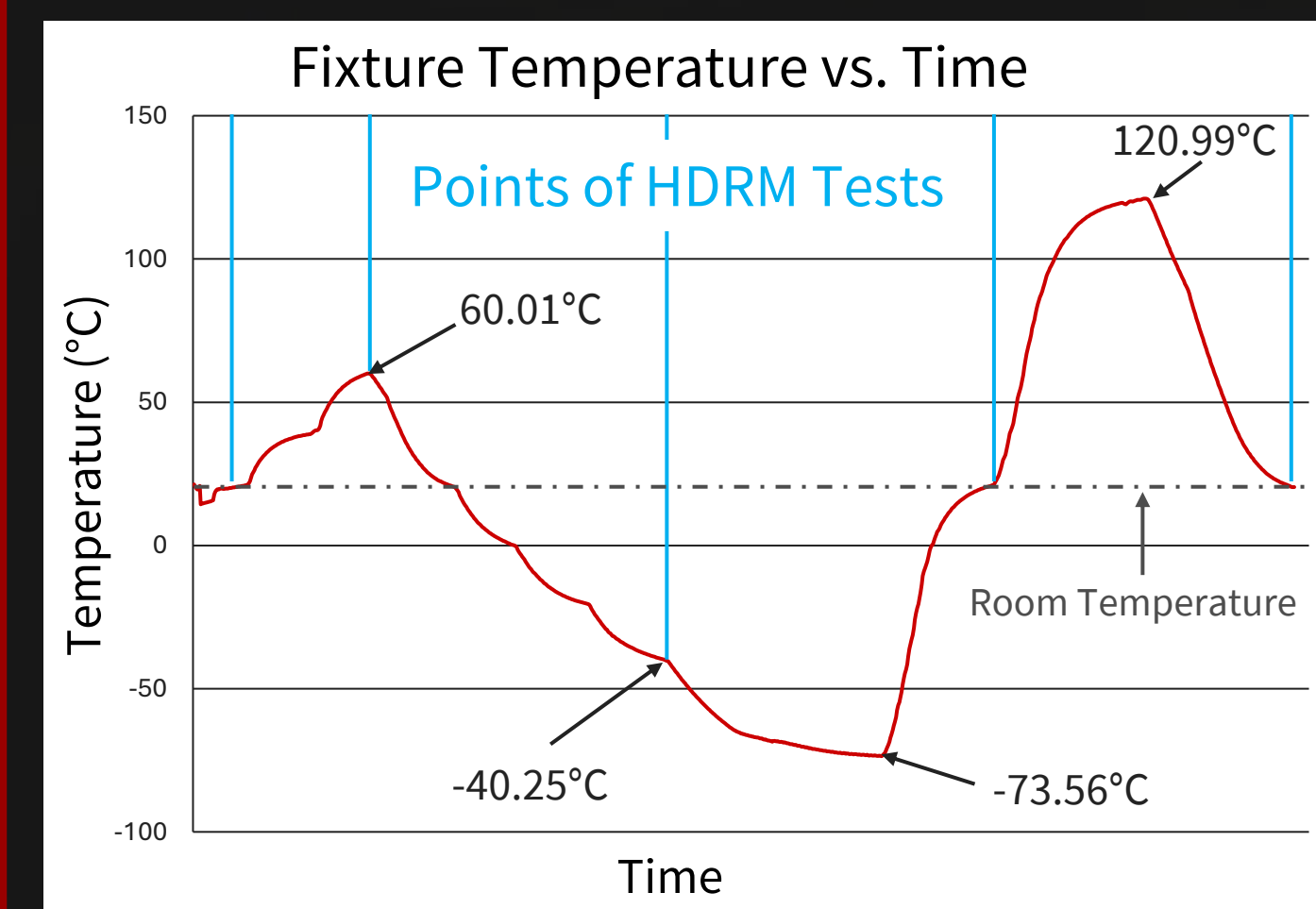
Thermal

Equipment: Bake Out Chamber

- ⊗ Target: Functional: -40 to 60 °C
Survivability: -80 to 120 °C

- ⊙ Outcome: Functional: -40.25 to 60.01 °C
Survivability: -73.6 to 120.9 °C

HDRM Test
Pass Criteria:
EPM powered,
Weight released



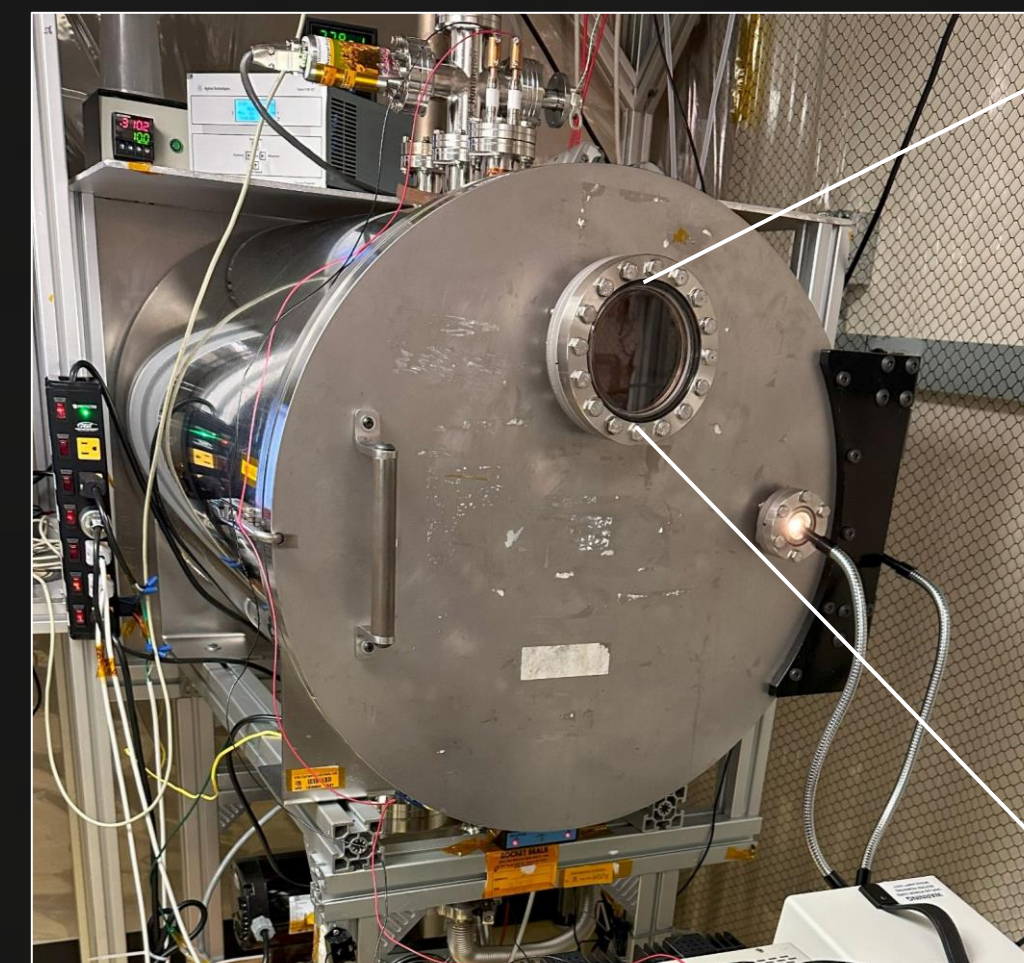
Vacuum

Equipment: Vacuum Chamber

- ⊗ Target: Functional Pressure: 1.00 E-5 Torr

- ⊙ Outcome: Functional Pressure: 1.15 E-5 Torr

HDRM Test
Pass Criteria:
EPM powered,
Weight released



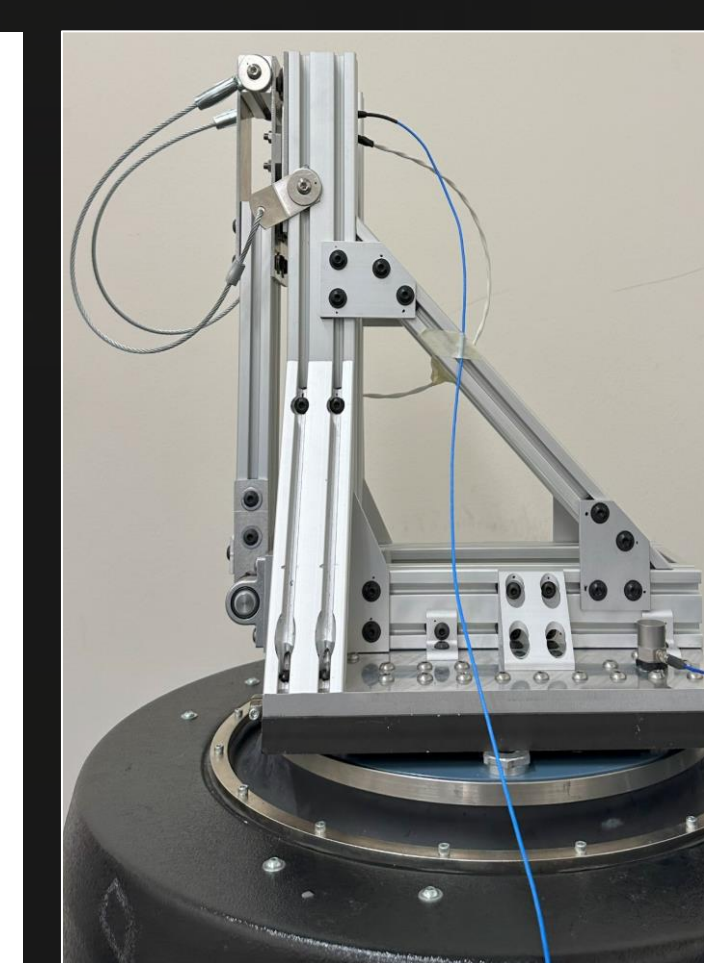
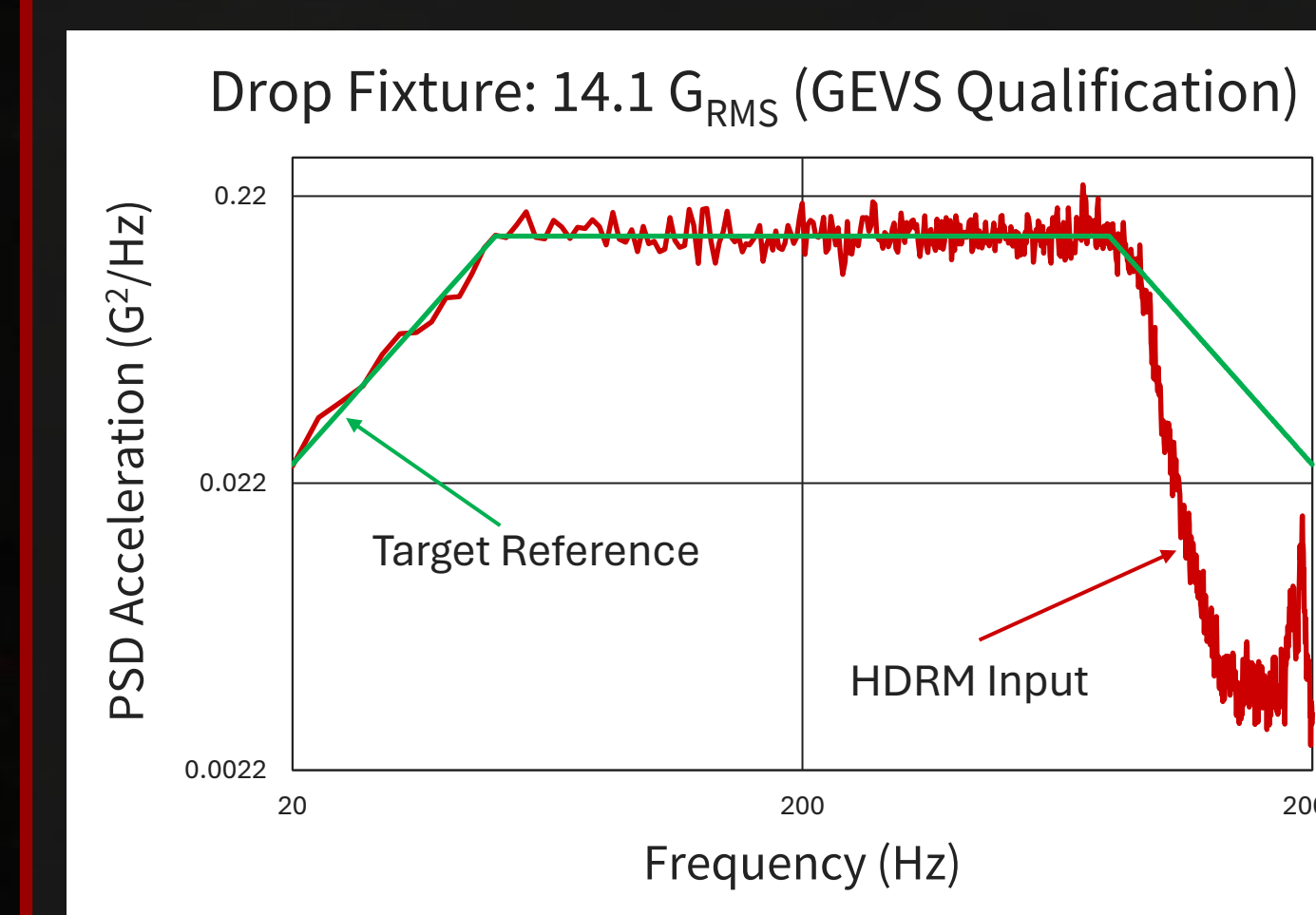
Vibration

Equipment: Shaker Table

- ⊗ Target: Random vibration (20-2000 Hz)
14.1 G_{RMS}, 42.3 G_{PEAK}

- ⊙ Outcome: Random Vibration (20-2000 Hz)
12.52 G_{RMS}, 37.55 G_{PEAK}

HDRM Test
Pass Criteria:
Holding under
target vibration

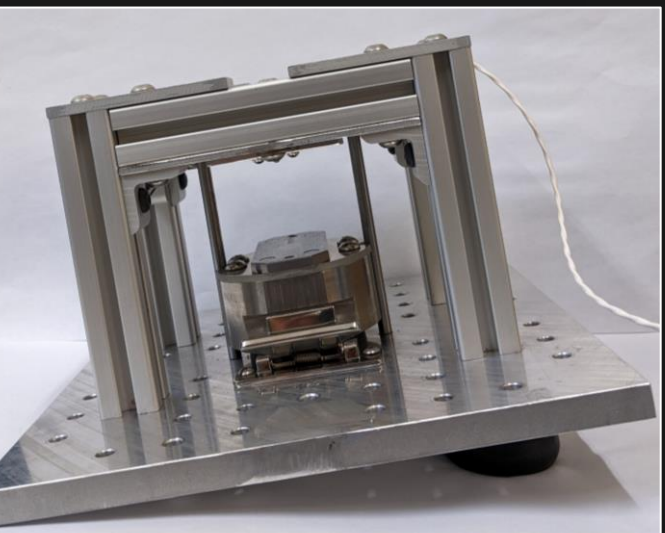


Lifecycle

- ⊗ Reliability Target: 95% Confidence
99% Reliability
298 Release Cycles, 0 Failures

- ⊙ Outcome: 95% Confidence
98.4% Reliability
298 Release Cycles, 1 Failure

HDRM Test
Pass Criteria:
EPM powered,
Weight released



EPM Holding Force Degradation

Equipment: UTS Machine

- Before Environmental & Lifecycle: 391.74 N
- After Environmental & Lifecycle: 391.78 N

