CRaTER Pre-Ship Review (I-PSR)

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Contamination Requirements

- From LRO 431-PLAN-000110 Rev –
  - Cleanliness at delivery to LRO level = 450 A/2
    - Particulate (450) -> 0.14% Area Coverage
    - Molecular (A/2) -> NVR Limit = 0.5 ugm/cm^2
  - Outgassing
    - TQCM deposition rate <5.0E-11 gm/cm^2/sec
- CRaTER Project does not have a complete facility for making the contamination measurements.
  - Arranged with LRO Project to do the surface cleanliness certifications at GSFC as part of incoming inspection. Instrument will be cleaned to the needed level prior to leaving MIT and double bagged for shipment. In addition, the outgassing certification of the instrument will be done in a GSFC certification chamber if deemed necessary by LRO Contamination Engineers.
  - The CRaTER thermal chamber was instrumented with a TQCM, but does not have a cold plate operating doing the outgassing test, so the outgassing results cannot be directly compared to requirements.
- Accommodations are built into the instrument to allow for the planned weekly nitrogen purge of instrument during spacecraft I&T.

Outgassing Test Results

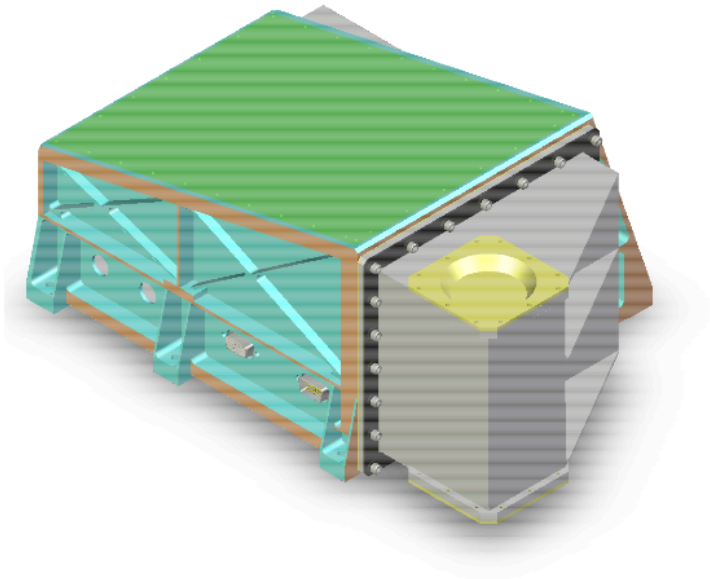
- A TQCM was instrumented in the chamber used for CRaTER Thermal Cycle Testing
- Methodology Used
  - Unit was held at 10C above max operating (i.e. held at 35C).
  - TQCM was held at -20C.
  - Pressure in chamber was <1E-6 Torr.
  - No cold finger/scavenger plate was used.
  - Rates were determined after 5 hours
  - Deposition rate for each instrument was determined by the difference between chamber with and without instrument.
- For CRaTER SN2
  - 6.37E-11 gm/cm^2/s
    - 127% of specification
- For CRaTER SN1
  - 5.65E-11 gm/cm^2/s
    - 113% of specification
    - Deposition rate was still nonlinear after 5 hours, so last hour rate was used
    - Further vacuum bake out of unit is being completed.

Shipping, Handling & Logistics

- The flight unit will be packed as follows:
  - Mounted to it's handling fixture
  - Double bagged and nitrogen purged.
  - Put in it's ruggedized Hardig shipping containers with custom foam cutouts.
  - The shipping containers will have shock watches affixed to the container and handling fixture.
- The flight unit will be transported by ground vehicle from MIT to GSFC by two members of the CRaTER Team (about an 8 hour drive from MIT to GSFC). Other CRATER GSE will also be transported at that time.
- After the instrument arrives at GSFC and moved to clean area, it will then await the arrival of CRaTER technical staff to arrive and perform a long form functional test using CRATER GSE. At the initial unpacking of the flight unit, LRO contamination engineers will verify that CRaTER meets it's surface cleanliness requirements.

Spares/Maintenance Plan

- The CRaTER Project completed and fully qualified a flight spare instrument.
- The CRaTER Project has a reasonably high fidelity engineering model for doing most of the instrument support functions, without having to rely upon the flight spare.
- The flight spare will be stored in the MIT flight materials bonded stock area in a double nitrogen purged bag, with desiccant and humidity monitors in the outer bag. After launch, then the PI will determine the disposition of the flight spare.
- Sufficient spare components exit to be able to repair a unit if desired in the case of a one off part failure (including a thick or thin detector), but the baseline plan would be to swap out the flight unit with the flight spare.
- CRaTER is a low maintenance instrument. It does have a weekly nitrogen purge requirement during spacecraft I&T levied on LRO I&T, but that is about it. There are no consumables or limited life items that need replacement between delivery and launch.



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