

Active and Passive Storage Solutions for Low Temperature Lunar Sample Return

Greg Schunk and Carlos Gomez, Thermal Analysis and Control Branch, NASA/Marshall Space Flight Center



- Active and passive thermal storage solutions to return lunar biological, physical science and/or geology samples to the Earth are under development.
- Temperature requirements for biological/physical science sample conditioning range from -100°C to -153°C and possibly down to -253°C for geological samples.
- The lower limit for geological samples is derived from the temperature of permanently shadowed regions on the lunar surface and the sublimation temperature of specific volatiles of interest (i.e., H_2O , NH_3 and CH_4). Individual samples for the lunar application are expected to be less than 50 kg.
- Requiring no electrical power or heat rejection, passive approaches, comprised of high- performance insulation and consumable phase change or Joule-Thompson cooling, may be preferred for shorter duration missions (< 30 days) to provide significant mass savings.
- Active storage approaches with cryogenic cooling may be necessary to preserve samples for longer periods of time.
- A notional storage concept with an internal vapor cooled shield is shown but other types of shields are possible.

- The vapor cooled shield contains the sample and is isolated from the outer container with concentric reflective rigid shields and conventional multi-layer and/or aerogel insulation on the outer layer.
- A special removable, insulating end cap to stow or retrieve the sample is included.
- For an effective emittance of 0.005 through the insulation, the heat leak is expected to be below 1.5W for a 30L sample volume (relative to a 20°C environment).

