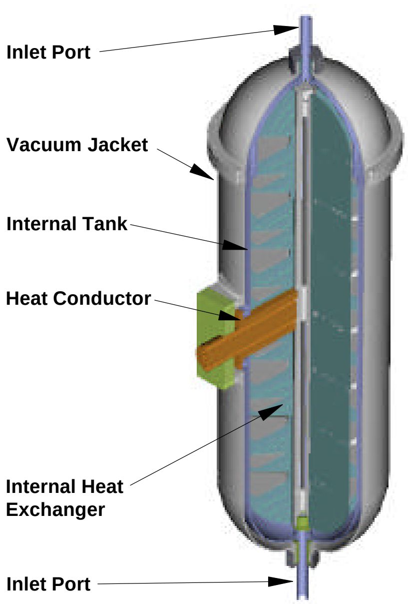
**MARS ATMOSPHERIC ACQUISITION AND COMPRESSION SYSTEM - INITIAL RESULTS.** D. L. Clark, Lockheed Martin Astronautics, P.O. Box 179, Mail Stop H0341, Denver CO 80201, USA (larry.d.clark@lmco.com).

**Introduction:** Most concepts for In-Situ-Resource Utilization (ISRU) on Mars require the acquisition and compression of atmospheric carbon dioxide. One of the most favorable compression methods is the use of an adsorption bed in terms of reliability and power consumption. The cold Martian environment can provide enough cooling to adsorb up to 16 percent of the bed mass with CO2. Heating will then drive off and compress the CO2 with some of the thermal energy provided by waste heat from the propellant production process. A large, flight-like adsorption compressor was designed, built and tested at Lockheed Martin Astronautics in the Engineering Propulsion Laboratory in Denver, Colorado under a contract with NASA-Jet Propulsion Laboratory. The size and performance was designed to provide the quantity of CO2 expected for a sample return mission. The target value for CO2 production selected was 3 kg of CO2 per sol.

**Design Considerations:** The sorption pump was designed to operate in a diurnal cycle where the acquisition took place during the Martian night when the coldest temperatures could be obtained with radiators. The CO2 would then be released and compressed during the day during the propellant production period when solar power is available.

The compressor design was intended to include flight-like features yet provide a flexible system. The compressor included an aluminum, vacuum-jacketed tank with removable domes. An internal, finned heat exchanger evenly added and removed heat from the sorbant bed. A centrally located heat conductor provided the transfer point for external cooling. Flow through the bed was enhanced with an central flow distribution bar and an outer screen plenum to minimize pressure drop.




Total volume of the sorbant bed is 40 liters which held 20.5 kg of Zeolite 13X after reductions from internal hardware. Seal on the tanks were made with o-rings to enable removal of the domes and penetrations for later reconfiguration. Multi-layer insulation was applied to the inner tank inside the vacuum space.

In order to promote purging of the non-condensable gases found in the Martian atmosphere, an external blower was installed in the lower inlet. This centrifugal blower was designed to provide 28 liters per minute through the bed at Martian conditions. Solid conduction thermal transfer was used to cool the bed for acquisition. The cooling source must be disconnected during the production period and a large-capacity thermal switch was designed and built to perform this function. The thermal switch was motor driven with large-surface area contacts which closed the thermal connection.

**Initial Test Results:** Carbon dioxide storage was substantial when operated with pure CO2 under a temperature swing from -70 C to 150 C. Over 3.3 kg of compressed CO2 was supplied. This represents over 16% of the sorbant mass. Although testing was limited in this initial study, results with Martian simulant gas reduced the mass storage fraction to less than 8%. It is unlcear why the reduction was so severe, even with extensive circulation of fresh atmosphere mix for the entire adsorption cycle. Mass spectrometer data detected significant quantities of the trace gases in the product stream, suggesting that adsorption of the trace gases is taking place.