SAMPLE ACQUISITION DRILL FOR VENUS IN SITU EXPLORER (VISE)

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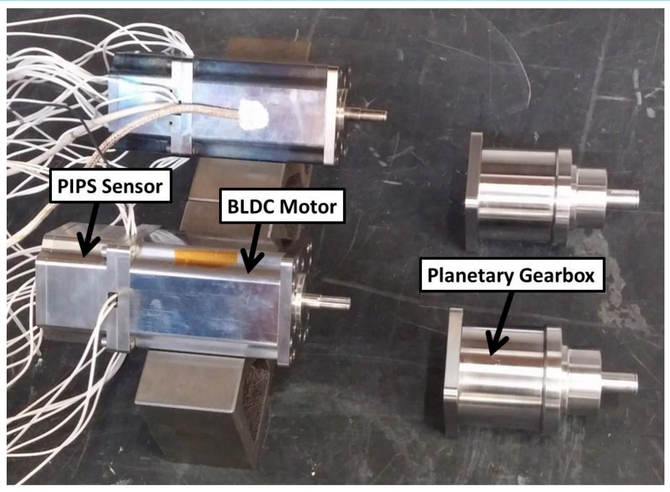
Background

The surface atmosphere of Venus is extremely hot and dense (95% CO_2 at 462°C and >90 bar pressure), presenting significant environmental challenges to robotic exploration. Most of the subsystems comprising a Venus lander are housed inside an insulated pressure vessel providing a controlled environment for the duration of the mission. The surface sampling subsystem, however, must be mounted outside the lander to interact directly with rocks and soil at the landing site. Environmentally "hardened" robotic mechanisms are needed to deploy to the ground, drill into rock and transport samples into the lander. These mechanisms must be designed from the ground up with materials and construction compatible with operation at high temperature and pressure.

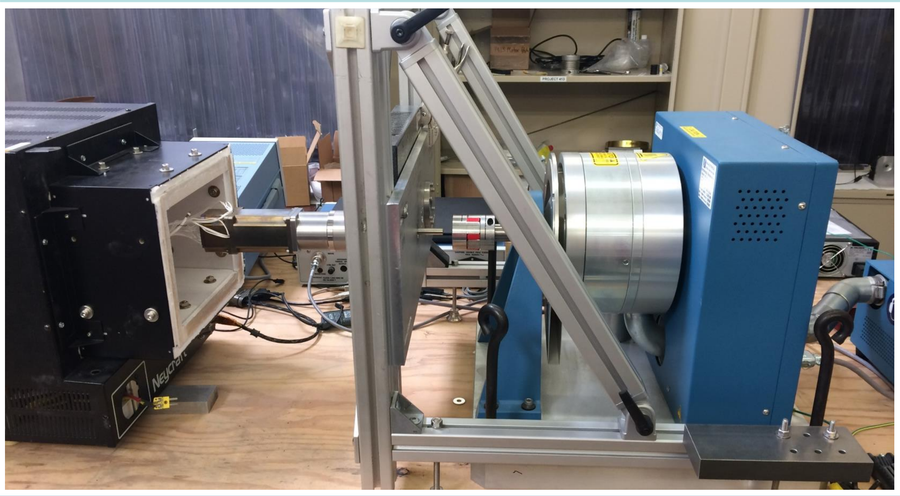
We have been developing a sample acquisition and delivery subsystem for a New Frontiers Venus In Situ Explorer (VISE) mission. The requirements for the VISE sampling subsystem are to capture samples from up to 5 cm depth. The entire drilling and pneumatic sample delivery sequence must occur in approximately 10 minutes because of the stringent mission timeline. We successfully demonstrated drilling under Venus conditions in 120 MPa analog rock (Saddleback Basalt) and the feasibility of using pneumatic suction for sample transport.

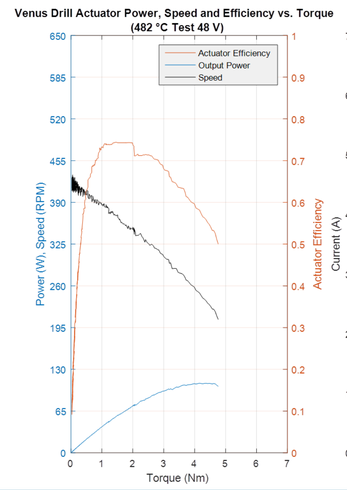
80 Watt Venus Motor, TRL 5/6

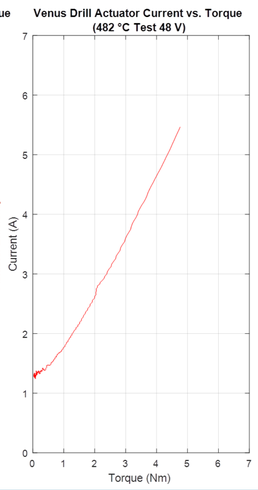
VISE Electromechanical Actuator



Dynamometer Tests at 482 °C (Venus Surface Temperature + 20°C)

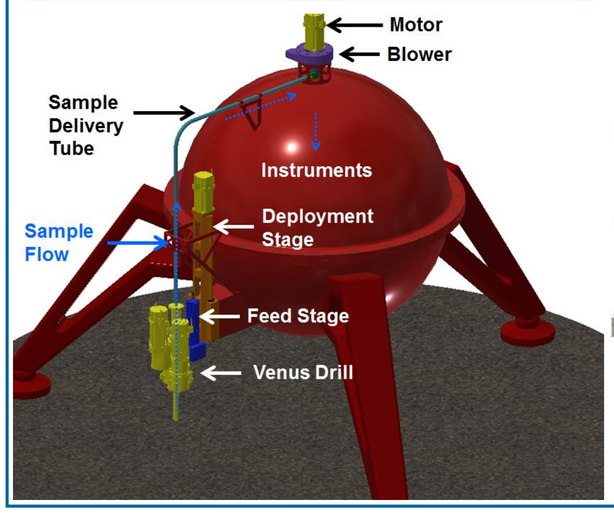




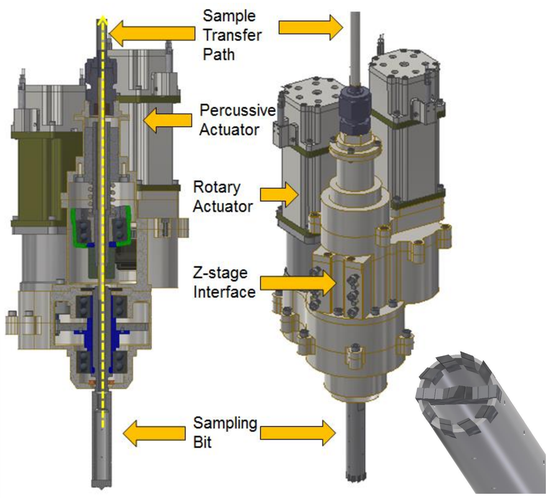


Venus Drill and Pneumatic Transfer, TRL 5/6

VISE Mission



Venus Rotary Percussive Drill



Two Axis Drill Head

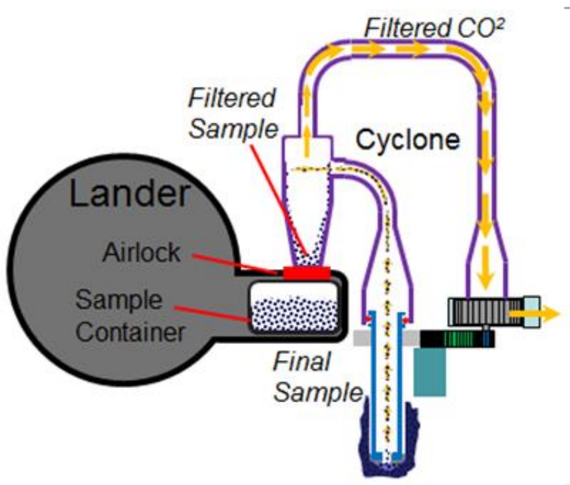
Auger
- BLDC motor w/ PIPS commutation sensor
- 14.6:1 planetary gearbox
- Additional 1.86:1 spur reduction
- Nom output speed: 107 rpm
- Cont. torque: 2.3 Nm, Stall torque: 12 Nm

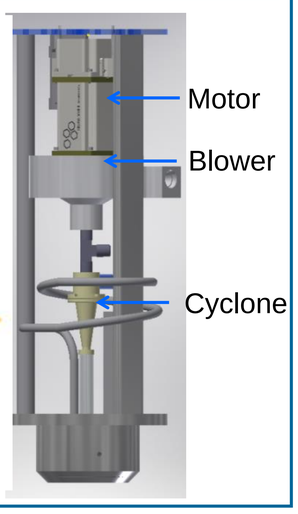
Percussion
- BLDC motor w/ PIPS commutation sensor
- Additional 3.33:1 spur reduction (2 stages)
- Percussive energy: 2.1 J/blow
- Nom output speed: 840 bpm

Mass: 10.4 kg (not including Feed)

Overall Height: 16.5"

Pneumatic Transfer



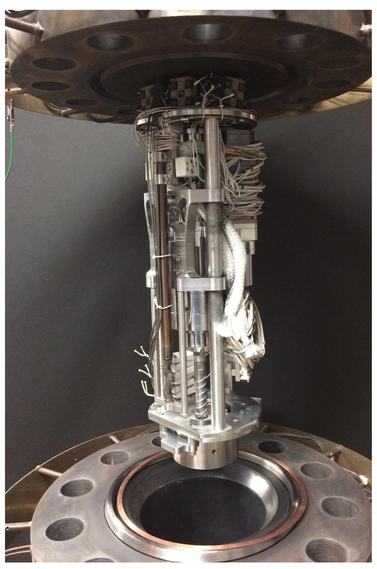


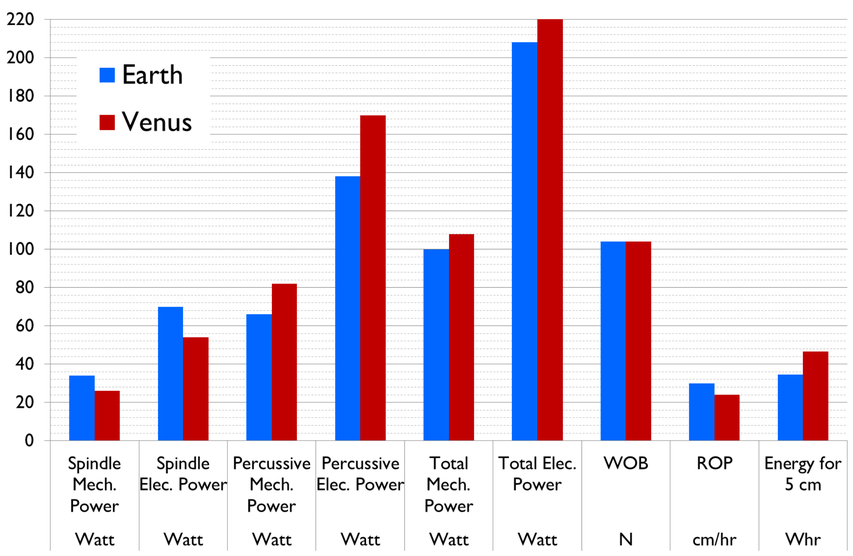
Functional Testing in JPL's Venus Chamber

Drilling Tests in 120 MPa Saddleback Basalt

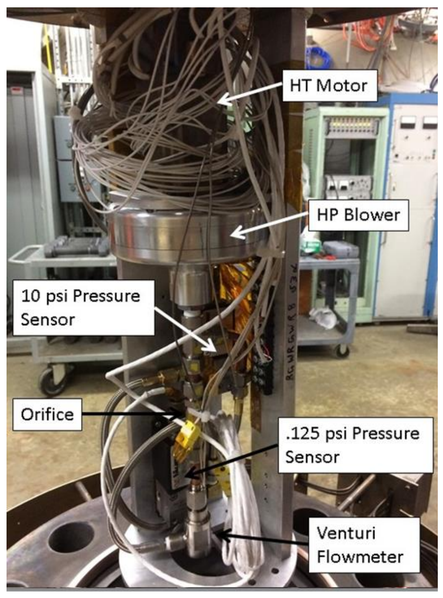
STP Tests

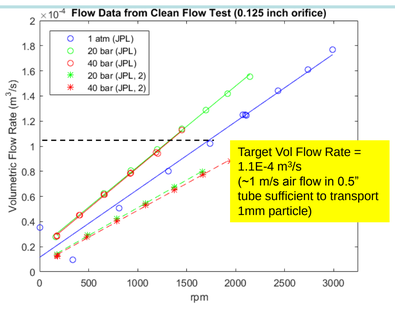
Venus Tests

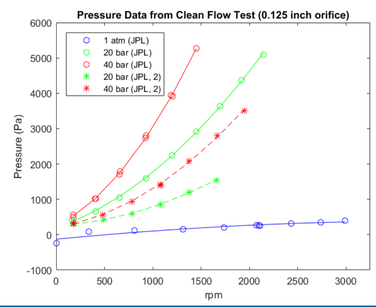




Pneumatic Tests







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