Technology Focus: Test & Measurement

Cryogenic Chamber for Servo-Hydraulic Materials Testing

Goddard Space Flight Center, Greenbelt, Maryland

A compact cryogenic test chamber can be cooled to approximately 5 to 6 Kelvin for materials testing. The system includes a temperature controller and multiple sensors to measure specimen temperature at different locations. The testing chamber provides a fast and easy method to perform materials testing at lower than liquid nitrogen temperature (77 K). The advantage of this chamber is that lower than 77 K temperatures are achievable, and the temperature can be controlled and stabilized during a test.

The purpose of the chamber is to cool a composite lap shear specimen to approximately 20 K so that tensile test force and displacement data may be acquired at this cryogenic temperature range. Other specimens of similar size and possibly different geometry can also be tested using the same technique with minimal chamber modification.

The chamber is constructed from commercially available supplies and materials. A copper pipe is capped at the ends, allowing a segment of the specimen to pass through each side and attach to a tension-testing machine. A coil of tubing wraps around the outside to allow cooling with cold gas from the end of a transfer line that is inserted into liquid-helium supply dewar. The transfer line feeds liquid helium into the tube coil of the chamber through a gas-tight quick-connect fitting. The cold helium gas cools the chamber and flows inside the chamber to cool and exchange heat before venting through the outlet. The inlet and outlet lines are thin-walled stainless-steel tubing that traverses a thick layer of high-performance insulation. Stainless-steel wire is adhered with epoxy to the outer chamber wall and functions as a heater for temperature control. The temperature of the chamber and specimen are monitored, and a standard PID (proportional–integral–derivative) control is applied to the heater circuit to regulate temperature.

This work was done by John J. Francis and James Tuttle of Goddard Space Flight Center. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810. GSC-15694-1

Apparatus Measures Thermal Conductance Through a Thin Sample From Cryogenic to Room Temperature

Goddard Space Flight Center, Greenbelt, Maryland

An apparatus allows the measurement of the thermal conductance across a thin sample clamped between metal plates, including thermal boundary resistances. It allows *in-situ* variation of the clamping force from zero to 30 lb (133.4 N), and variation of the sample temperature between 40 and 300 K. It has a special design feature that minimizes the effect of thermal radiation on this measurement.

The apparatus includes a heater plate sandwiched between two identical thin samples. On the side of each sample opposite the heater plate is a cold plate. In order to take data, the heater plate is controlled at a slightly higher temperature than the two cold plates, which are controlled at a single lower temperature. The steady-state controlling power supplied to the hot plate, the area and thickness of samples, and the temperature drop across the samples are then used in a simple calculation of the thermal conductance.

The conductance measurements can be taken at arbitrary temperatures down to about 40 K, as the entire setup is cooled by a mechanical cryocooler. The specific geometry combined with the pneumatic clamping force control system and the steady-state temperature control approach make this a unique apparatus.

This work was done by James G. Tuttle of Goddard Space Flight Center. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810. GSC-15698-1

Rover Attitude and Pointing System Simulation Testbed

NASA's Jet Propulsion Laboratory, Pasadena, California

The MER (Mars Exploration Rover) Attitude and Pointing System Simulation Testbed Environment (RAPSSTER) provides a simulation platform used for the development and test of GNC (guidance, navigation, and control) flight algorithm designs for the Mars rovers, which was specifically tailored to the MERs, but has since been used in the development of rover algorithms for the Mars Science Laboratory (MSL) as well.

The software provides an integrated simulation and software testbed environment for the development of Mars rover attitude and pointing flight software. It provides an environment that is able to run the MER GNC flight software directly (as opposed to running an algorithmic model of the MER GNC flight code). This improves simulation fidelity and confidence in the results. Further-