



## STRAIN GAGE

In August 1994, an eight-legged mobile robot named Dante II, developed for NASA by Carnegie Mellon Robotic Institute, descended into the depths of Alaska's Mount Spurr. An active volcano that had erupted three times in 1992, Mount Spurr was considered too dangerous for human exploration, so Dante II, equipped with a multitude of sensors and imaging devices, was sent to rappel down the inside wall of the crater and communicate its findings. The volcano expedition was an important scientific investigation and, at the same

gage application developed especially for the project by HITEC Corporation, Westford, Massachusetts. Carnegie Mellon selected HITEC for the job because the company specializes in experimental or otherwise unusual installations of strain gages and thermocouples. The demanding job assigned HITEC was to develop a strain gage-based solution for measuring bending forces on the legs of Dante II; the sensor was intended to provide a warning to the robot's human controllers, who could shut Dante down if, for example, one of the robot's legs got caught up in the rocky terrain and the kickout load on the leg exceeded design limitations.

The addition of the sensor was a late decision and HITEC had only a month to conduct the extensive research required and produce a solution. HITEC engineers managed it. They came up with a sensor system consisting of four strain gages, two of them measuring bending in tension at the surface strain on one side, while two pages on the opposite side measured compression bending.

The work on Dante benefitted HITEC because it expanded the company's technological capability. HITEC senior applications engineer Robert Magee reports that "it allowed HITEC to further develop its



technology for taking existing customer-supplied components and turning them into accurate and reliable transducers. The work on the robot explorer has furthered our experience in strain gage-based sensor applications." HITEC uses similar techniques providing strain gage services in creating transducers out of such components as "Indy" racing car suspension pushrods (left) NASCAR suspension components and components used in motion control. Generally, HITEC applies sensors to measure strain, stress and loads on automotive, gas turbine and structural components. **Above** is the first U.S.-manufactured bobsled for the U.S. Bobsled Team; HITEC installed sensors on the four skate runner shoes to measure vibration forces.

time, a demonstration of technology applicable to future planetary rovers.

Among a number of innovations incorporated in Dante II was a unique strain

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