Press Release

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French SEIS seismometer safe and tight under protective wind and thermal shield

A domed shield has been successfully placed over the InSight lander's main SEIS scientific instrument to shield it from wind and temperature variations on the surface of Mars.

The InSight mission has reached a new milestone after lowering a dome-shaped shield into position over the French SEIS instrument (Seismic Experiment for Interior Structure) in order to further improve the accuracy of data collected from the surface of Mars. SEIS is now in its final configuration to allow the mission science team to probe the red planet's deep interior for the first time and seek new clues to how rocky planets form.

The Wind and Thermal Shield (WTS) offers extra protection to the instrument, which is highly sensitive to any wind-induced turbulence that adds 'noise' to recorded data. The aerodynamically shaped dome presses down when wind blows over it, while a chainmail skirt combined with a thermal blanket tightly 'hug' the ground and settle easily over any rocks to stop wind blowing in, although there are few rocks at InSight's location.

An even bigger concern for SEIS is temperature change, which can expand and contract metal springs and other parts inside the seismometer. Where InSight landed, frigid temperatures fluctuate by about 71ºC over the course of a Martian day, or sol.

"Temperature is one of our biggest bugaboos," said Bruce Banerdt, InSight Principal Investigator at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California. JPL is leading the InSight mission and developed the WTS. "Think of the shield as putting a cosy over your food on a table. It keeps SEIS from warming up too much during the day or cooling off too much at night. In general, we want to keep the temperature as steady as possible."

On Earth, seismometers are often buried a little more than a metre underground or in vaults, where the temperature is stable. Because InSight can't build a vault on Mars, the mission is relying on its specially designed shield, which is white to reflect sunlight, keeping it from heating up too much during the day.

In addition to the shield, SEIS is also relying on a special system to correct for wild temperature swings on the Martian surface. The seismometer was built so that as some parts expand and contract, others do so in the opposite direction to partially cancel the effects. The instrument's sensors are also housed inside a vacuum-sealed titanium sphere that insulates the sensitive components and reduces the influence of temperature.

The sphere and all of the systems around it are protected by an extra layer of insulation in the form of a hexagon-shaped Mylar box visible during SEIS's deployment. The walls of this box are honeycombed with cells that trap the thin air of Mars and keep it from moving, just like fibreglass insulation in the walls of a house. Mars provides an excellent gas for this insulation: its thin atmosphere is primarily composed of carbon dioxide, which is especially slow to conduct heat at these pressures. With these three insulating barriers, the most-sensitive sensors are well-protected from thermal 'noise' that could mask the seismic waves the InSight and SEIS teams want to study. "Designing all of these elements and then assembling and testing them to confirm that everything met the mission's performance requirements, and all in record time, was an exacting but exciting human adventure and feat of engineering," said Philippe Laudet, SEIS instrument Project Leader at CNES.

"When the wind died down and before the WTS had been deployed, the noise levels we had measured were already very low," noted Philippe Lognonné, SEIS Principal Investigator at the IPGP[1] global physics institute and Professor at Paris Diderot University. "We are now in the ideal configuration to detect 'marsquakes' and more broadly any ground movements on the Martian surface with a resolution less than the width of a single atom."

InSight's teams are now readying for the next step: deploying the German heat flow probe, called the Heat Flow and Physical Properties Package (HP^3), onto the surface within the next few days. SEIS will then be in the perfect position to record seismic waves generated by HP^3 as it hammers itself into the ground.

CNES is lead contractor for SEIS and IPGP (CNRS/Paris Diderot University) is the instrument principal investigator. CNES is funding French contributions to the mission, coordinating the international mission consortium[2] and was responsible for integrating, testing and supplying the complete instrument to NASA. IPGP designed the very-broad band (VBB) sensors and tested them before delivery to CNES. Several research laboratories attached to the French national scientific research centre CNRS and the ISAE-Supaero aeronautics and space institute are on the teams analysing data from InSight.

1 Institut de Physique du Globe de Paris
2 In collaboration with Sodern, JPL, the Swiss Federal Institute of Technology (ETH Zurich) and the Max Planck Institute for Solar System Research (MPS, Göttingen, Germany), and Imperial College London and Oxford University, which supplied subsystems for SEIS.

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