



High Level Shock Tests for Mars MetNet Penetrator

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During the next 8 years a Finnish-Russian-Spanish team will deploy a network of meteorological observation stations on the surface of Mars. This Mars MetNet mission is based on a set of small 20 kg landing units deployed from different Mars orbiting satellites. As no parachutes but only aerobraking devices are used, all included sub-systems have to survive the impact shock of the semi-hard landing.

In order to qualify the Mars MetNet Mission pressure (MetBaro) and humidity (MetHumi) devices, the 500g shock tests were made by using the special aircraft testing cannon at the Spanish INTA facility close to Madrid which was modified for these shock tests. The used cannon works with compressed air and is normally used to test the resistance of different airplane parts to the impact of birds. In this case, the instruments under test were shot instead of birds, being themselves placed inside a bullet of expanded polystyrene.

The required shock of 500g for 15 to 20 ms was achieved by attaching a metallic plate to the tip of the cannon and by a polystyrene bullet that was loaded into the cannon through its barrel. The g-forces were measured by using a special accelerometer designed by INTA. The accelerometer was powered from batteries, measured the acceleration profile and stored it inside a memory that was downloaded after the impact. The shock which the instrument experienced was measured along all three main axis (x, y and z).

Instrument accommodation: For each test axis a separate bullet made of expanded polystyrene was formed and two holes carved into it, into which the respective instruments were fitted tightly in the orientation required for the planned test. The instruments were placed into small plastic bags to prevent contamination by the polystyrene during the impact of the bullet with the target.

Before each shock test, both instruments were tested in the laboratory to ensure that they were fully functional. These results were used as reference for the functional test following each of the 500g shock tests. The actual shock test was performed in three phases. In the first shooting the MetHumi instrument was shocked in the X-axis direction and the MetBaro instrument in the Y-axis direction. In the second shooting MetHumi was shocked in the Z-axis direction and MetBaro in the X-axis direction and in the third and final shooting, the MetHumi was shocked in the Y-axis direction and MetBaro in the Z-axis direction. Both instruments survived all three shock test shootings. Shock spectra of all three shock tests were in line with the requirements of the Mars MetNet Mission.