



Mechanics/Machinery

Umbilical Deployment Device

NASA's next-generation Mars rover encompasses this novel landing technique.

NASA's Jet Propulsion Laboratory, Pasadena, California

The landing scheme for NASA's next-generation Mars rover will encompass a novel landing technique (see figure). The rover will be lowered from a rocket-powered descent stage and then placed onto the surface while hanging from three bridles. Communication between the rover and descent stage will be maintained through an electrical umbilical cable, which will be deployed in parallel with structural bridles.

The 1/2-inch (13-mm) umbilical cable contains a Kevlar rope core, around which wires are wrapped to create a cable. This cable is helically coiled between two concentric truncated cones. It is deployed by pulling one end of the cable from the cone. A retractable mechanism maintains tension on the cable after deployment. A break-tie tethers the umbilical end attached to the rover even after the cable is cut after touchdown. This break-tie allows

the descent stage to develop some velocity away from the rover prior to the cable releasing from the rover deck, then breaks away once the cable is fully extended. The descent stage pulls the cable up so that recontact is not made.

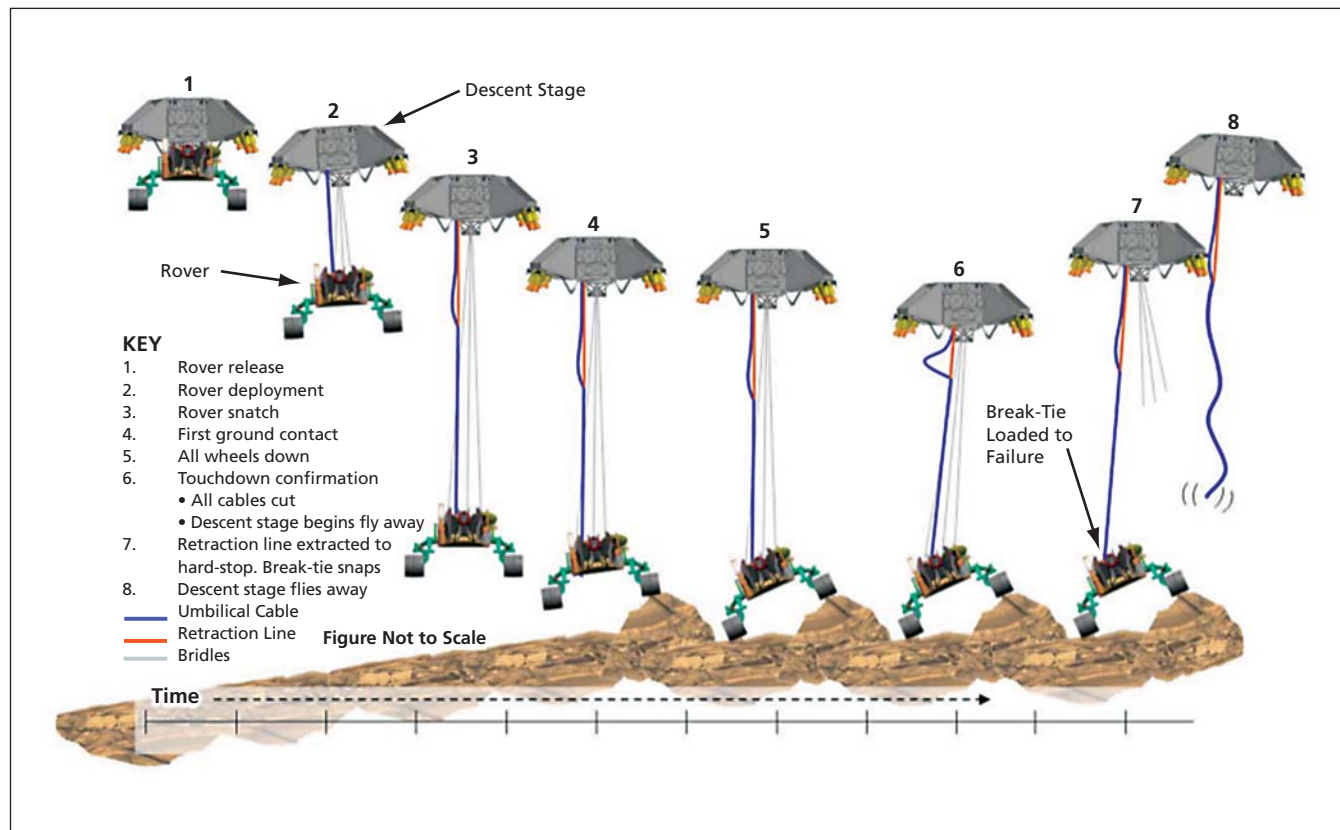
The packaging and deployment technique can store a long length of cable in a relatively small volume while maintaining compliance with the minimum bend radius requirement for the cable being deployed. While the packaging technique could be implemented without the use of break-ties, they were needed in this design due to the vibratory environment and the retraction required by the cable.

The break-ties used created a series of load-spikes in the deployment signature. The load spikes during the deployment of the initial three coils of umbilical showed no increase between the different temperature trials. The cold deploy-

ment did show an increased load requirement for cable extraction in the region where no break-ties were used. This increase in cable drag was superimposed on the loads required to rupture the last set of break-ties, and as such, these loads saw significant increase when compared to their ambient counterparts.

While the loads showed spikes of high magnitude, they were of short duration. Because of this, neither the deployment of the rover, nor the motion of the descent stage, would be adversely affected. In addition, the umbilical was found to have a maximum of 1.2 percent chance for recontact with the ultra-high frequency antenna due to the large margin of safety built in.

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Touchdown Sequence for Mars Science Laboratory.