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The ExoMars Entry & Descent system: an enabler for European planetary science

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Abstract

After HUYGENS and thanks to the ExoMars Entry and Descent System, Europe will confirm the capacity to land on planetary bodies. This presentation reports the development status of ExoMars EDM Entry & Descent system. All development tests are performed, and the subsystems flight models manufacturing are in progress.

1. Introduction

ExoMars is the second planetary entry probe vehicle directly developed by ESA, after HUYGENS. Some technologies used on HUYGENS are reused for ExoMars, but specific development and extension of qualification range were necessary to fulfill the objectives of this mission.

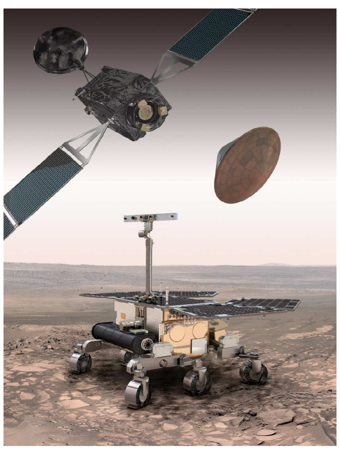

Figure 1: ExoMars modules (Copyright ESA)

This presentation reports the technologies selected for ExoMars Entry & Descent System, and their development status, leading to Flight Model manufacturing in 2013.

2. Aeroshell

During Entry and Descent, mechanical and thermal environment history leads to specific constraints for EDM aeroshell structure. Both Frontshield and Back Cover are composite sandwiches, with carbon fibers embedded in epoxy resin. The operating temperature induced by Entry aerothermal environment combined with the significant mechanical loads generated by aerodynamic deceleration and parachute deployment have led to qualify the classical structure in an unusual operational range. The manufacturing of the Aeroshell structural model has started in 2012. It has been tested in specific static test configurations, in order to stress the structures in a representative way. The flight model is now almost completed.

Figure 1: ExoMars EDM Structural Module modules (Copyright ESA)

The light ablative TPS material selected to protect ExoMars Descent Module from aerothermal flux is derived from launcher application.

The material TRL has been increased for Entry vehicle application via ARD, BEAGLE2 and NetLander project, but a significant step was necessary for ExoMars. The impact of sterilization process, the convective heat flux up to 2 MW/m^2, and the new inter-tile joint material, have led to follow a specific development plan to improve TPS qualification range.

3. Parachute System

The Parachute subsystem is based on a classical Disc Gap Band single stage parachute, using the successful HUYGENS specific shape. However, the very significant deployment load, combined with an extension of operating Mach range has induced both to extend this DGB performance at higher Mach and to qualify all parachute materials for ExoMars. Scaled parachute was also tested during a high altitude drop test. The Parachute Deployment Device takes advantage of NASA Mars mission developments, the parachute mass to be ejected being significantly higher than HUYGENS one. The final Parachute System qualification will be reached during a High Altitude Drop Test on a fully representative Qualification Model in fall 2013.

4. Reaction Control System

ExoMars terminal deceleration is performed via the Pulse Modulation of three clusters of three 400N engines. During the 30s continuous operation of the Reaction Control Subsystem, about 39kg of hydrazine will feed the nine engines in their proper inlet pressure range. The physical phenomena acting in the RCS are unusual compared to both Satellite or Launcher designs. Specific development models are under test to verify architecture in a comprehensive way. A first development model was successfully used in 2011 to qualify fluidic simulator which allows to predict RCS performances.

5. Summary and Conclusions

Manufacturing of ExoMars Entry and Descent Subsystems flight models are in progress, and all subsystems will be delivered to Industrial Prime level between end 2013 and beginning 2014 for integration, in time for a launch in January 2016.

After HUYGENS and thanks to the ExoMars Entry and Descent System, Europe will confirm the capacity to land on planetary bodies.

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