A LAUNCHER EMULATION SYSTEM FOR THE VALIDATION OF LIQUID HYDROGEN NETWORK FOR THE ARIANE 6 LAUNCH BASE

A. Provasi,[1] A. Gorla,[2] E. Veruari,[3] and M. Moretti[4]

[1]*Telematic Solutions, Milan, Italy*
[2]*Telematic Solutions, Milan, Italy*
[3]*Telematic Solutions, Milan, Italy*
[4]*Telematic Solutions, Milan, Italy*
Alberto.provasi@telematicsolutions.it, www.telematicsolutions.it

The creation of a launcher emulation system got a special interest within the scope of the test infrastructure development project for the ground segment of the new base of the European ARIANE 6 launcher. In the absence of the launcher, some bridges (in French *pontets*) were produced to connect the fuel supply and return lines. Their development has allowed the testing of the ground network dedicated to the transport of liquid hydrogen, especially in the delicate phases of cool down, nominal circulation and simulation of leaks through the MANG anti-return valve. Specifically, the emulation of the launcher motor was obtained by means of a calibrated orifice, while the filling of the upper and lower stages, by means of regulating valves. To simulate the leak of gaseous hydrogen, two secondary *pontets* were designed, with the aim of verifying the behavior of the system.

The numerous constraints, mainly related to the overall dimensions due to the test environment, as well as to the problems related to the interfaces, for which a minimum margin was required, were solved already in the design phase through a system flexibility analysis. This also had to be compatible with the structural constraints related to the thermal impact of liquid hydrogen on the pipes. At the same time, a process analysis was carried out to be "compliant" with the flow rate requirements and thermal losses dictated by the launcher needs.

The result was that of a complex system with different degrees of freedom from the mechanical point of view, with an independent system of adjustment in height, and in the horizontal plane, and two additional degrees of freedom for each interface. From a thermal point of view, a vacuum technology has been opted for, with pressure and temperature intakes designed ad hoc, to ensure helium sealing through dedicated fittings. The analysis of the characteristics of the valves, as well as their flow coefficients, gave the possibility to carry out the calibrated leak test. Finally, the test results were compared with the design results, demonstrating the ability to simulate relatively complex cryogenic processes with good reliability.