ASSEMBLY, INTEGRATION AND VERIFICATION OF THE RAMAN LASER SPECTROMETER FOR THE EXOMARS 2020 MISSION.

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Abstract

The Raman Laser Spectrometer (RLS) is one of the three instruments located within the Rover ALD (Analytical Laboratory Drawer) of the ExoMars 2020 mission. RLS is mainly composed by SPU (Spectrometer Unit), iOH (Internal Optical Head), and ICEU (Instrument Control and Excitation Unit), and provides a powerful tool to analyze Mars surface and sub-surface crushed samples by Raman spectroscopy [1].

An overview of all activities carried out during the RLS AIV (Assembly, Integration and Verification) campaign are depicted in this paper.

In the end, the RLS FM in compliance with packaging and transport requirements, was successfully delivered to ESA's subcontractor TAS-I, (Thales Alenia Space Italy), where it was integrated in the ALD (Analytical Laboratory Drawer) of the Rover, and passed the subsequent higher level tests campaigns.

1. Introduction

All along the RLS project, several instrument models, following ECSS (European Cooperation for Space Standardization) policy, have been delivered to ESA's subcontractor (TAS-I, Thales Alenia Space Italy), after the assembly, integration and verification of all different instrument units, for performing the formal qualification/acceptance processes at instrument level by the RLS Team from INTA (Instituto Nacional de Técnica Aeroespacial).

A complete set of integration and testing activities, at both unit and system level were carried out at INTA facilities (testing laboratories and cleanrooms), including an extensive set of tests (Functional, Performance, Mechanical, Thermal, Electromagnetic Compatibility and Software) used to demonstrate the functionality of the complete system.

The RLS Instrument performance and characteristics as well its capability for fulfilling the mission was demonstrated by successive tests and checkouts starting from the manufacturing of the Units and ending at the level of the functional Integrated Instrument.

The tests were shared among the different models, according to the model philosophy in order to get the most efficient and cost effective development program.

During the assembly, integration and testing activities several test facilities were used with the following classification with regard to the verification environment:

- ISO 8 Cleanroom
- ISO 6 Cleanroom
- ISO 5 and ISO 4 flow chamber
- ISO 4, Biological Class 2, flow chamber

2. Functional and Performance Tests

RLS has been tested to verify that the electrical and mechanical functions and the performance of the equipment conform the equipment specification.

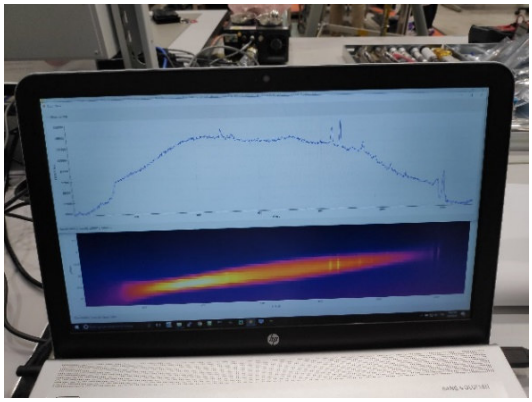

Figure 1. *Raman spectrum of the RLS Calibration Target FM.*

For these verification a set of the following tests was performed at INTA facilities:

- Functional Tests
- Performance Tests
- Electrical characteristics & I/F
- Alignment
- Lifetime tests

Figure 2. *IOH FM alignment tasks in a ISO 5 laminar flow cabinet*.

3. Mechanical Tests

RLS was tested to demonstrate that will support the loads during the different phases of the mission, using the Institute Mechanical Environmental Laboratories, to do the following tests:

- Mechanical I/F check
- Physical Properties (Mass, Center of Gravity, Moment of Inertia)
- Vibration Tests (First resonance search, Sine vibration and Random vibration).
- Shock Tests

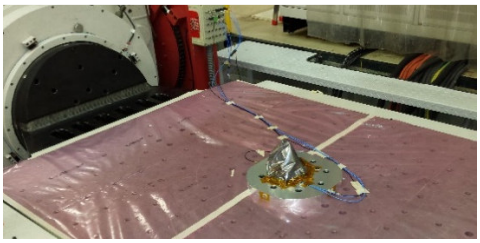

Figure 3. *RLS IOH FM vibration test.*

4. Thermal Tests

RLS was tested both thermal vacuum and Mars thermal ambient (RLS EQM) at INTA facilities. INTA has complete installations equipped with the most advanced instrumentation for the realization of the following thermal tests:

- Thermal Vacuum Tests
- Thermal Mars Environment Tests
    - Temperature and pressure
- Thermal Balance Tests

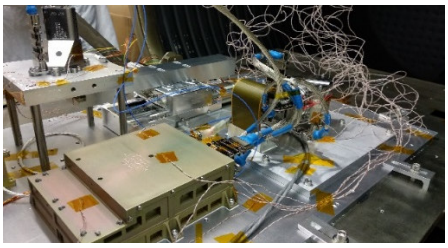

Figure 4. *RLS FM, thermal vacuum test*

5. Electromagnetic Compatibility Tests

The whole instrument was subjected to the following EMC tests:

- Power Quality
- Grounding, Bonding and Isolation
- Conducted emission
- Conducted susceptibility
- Radiated emission
- Radiated susceptibility
- Electrostatic Discharge (ESD)

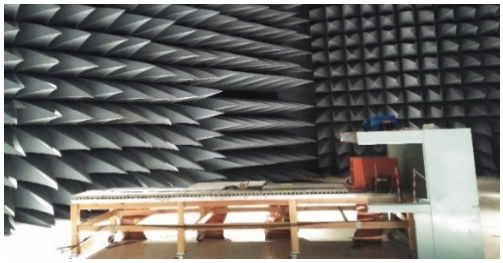

Figure 5. *RLS EQM EMC campaign. Radiated tests.*

6. Conclusions

The activities carried out during the RLS AIV campaign, value the capacity of INTA to develop complex aerospace projects, included those programs of planetary exploration, which need to implement specific Cleanliness, Contamination and Planetary Protection requirements.

7. Acknowledgements

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8. References

[1] Rull, F., Maurice, S., Hutchinson, I., Moral, A., Perez, C., Diaz, C., ... & Forni, O. (2017). The Raman laser spectrometer for the ExoMars Rover mission to Mars. *Astrobiology*, 17(6-7), 627-654.