

Organic Contamination Control for ExoMars 2018

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Contamination control tiger team established to respond to the very demanding planetary protection and organic contamination control requirements for the ExoMars mission

The tiger team was chaired by the planetary protection lead of the prime contractor, membership included ESA and prime contractor project personnel, representatives from affected sub-contractors (“sample acquisition and delivery”) and instrument teams (“sample analysis”)

Major output: acceptable terrestrial organic contamination per gram of sample delivered to the instrument: 50 ng range for organics of biological sources but allows up to μg for tested engineering sources (already presented in April 2013)

| Substance class | Contamination level per gram of martian sample delivered for life detection |
|------------------------------------|---|
| Material from biological sources | $\leq 50 \times 10^{-9}$ gram |
| Monomers of Kapton, Mylar and PTFE | $\leq 500 \times 10^{-9}$ gram |
| Fluorinated technical lubricants | $\leq 500 \times 10^{-9}$ gram |
| Any other organic compound | $\leq 50 \times 10^{-9}$ gram |

Applicability of requirements on “subsystems involved in the acquisition, delivery, and analysis of martian samples for life detection”

Material control based on elimination, conditioning, isolation or characterization (pre-flight and use of blanks during operation)

Design to protect the sensitive surfaces based on segregation (sealed sample path) and overpressure

Aseptic, ISO 3, ISO AMC-9 cleaning and assembly environment for sample path

Cleaning approach:

- Start cleaning at the lowest level, i.e. parts level
- Start bake-outs at the lowest integration level, i.e. sub-assemblies
- Perform sterilisation at the highest integration level possible

Cleaning based on sequence of solvent cleaning (sonication), bake-out, CO₂ snow cleaning, hot gas purge

Pre-launch verification of primary requirement (terrestrial contamination of the sample) with end-to-end test (“subsystems involved in the acquisition, delivery, and analysis of martian samples”) with qualification model approach

- **Cannot verify everything on flight model → impact on model philosophy**
- **Interfaces are critical**

Design it first and think about the cleaning later is usually not compatible with stringent contamination control requirements

Requirements on the type of contamination and the contamination levels depend on the scientific investigations (→ ensure the link between acceptable contamination on the samples and achievable contamination on the flight hardware)

Establish cleaning procedures, including bake-out, early in the hardware design phase

Material selection and characterization is of critical importance to ensure that the flight hardware can be cleaned (→ watch out for surface finish!) and does not produce excessive contamination

Verification of requirements by test (routine and final) and analysis has an impact on hardware design (enable verification, use of blanks), model philosophy (split verification across different models), environmental test chambers (enable verification)

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