MOTIVATION

Cleanliness is crucial for space hardware: the presence of contaminants, either organic residues or particles, on sensitive parts such as optics, mechanisms, detectors, electronics or thermal control coatings may alter significantly their properties and their nominal operating mode. Even if the AIT activities take place in controlled environments, it is highly recommended to protect the equipment during long-term storage and sometimes during short-term periods as well and of course during the numerous shipments in containers. Special care has to be taken to the packaging constraints that are dependent on the cleanliness specifications of the sensitive surfaces to be protected. Further to several anomalies and some alerts coming to the user community, the cross contamination due to materials and/or packaging methods is a real concern. Despite the guidelines described in standards, it still happens that some packaging materials are poorly known and therefore misused.

The purpose of this benchmark study was to develop a methodology and measurement protocols to assess the risk of molecular and/or particulate contamination on different substrates from a wide variety of flexible and rigid packaging materials, in stress conditions or not, in order to the user to select the most appropriate one for his dedicated applications.

METHODOLOGY

3 modes
- Shaking via tank-end-forth table (120 strokes/min, 30 min)
- Heating in oven (60°C, 2 days)
- Long term exposure (room temperature, 2 months)

MAIN RESULTS

particulate contamination tests

Benchmark of witness packaging samples

Amount of ppm added on silica substrates, after exposure in the various packaging samples

molecular contamination tests

Surface molecular contamination from the packaging samples

Volatile molecular contamination from the packaging samples

Volatile molecular contamination from the substrates, after heated exposure in the various packaging samples

RANKING

Concentrations in ppm

<table>
<thead>
<tr>
<th>Concentrations in ppm</th>
<th>HDPE</th>
<th>JPL nylon</th>
<th>UL0-poly</th>
<th>Polyalu</th>
<th>Polyb</th>
<th>Blank</th>
<th>Water box</th>
<th>LDPE</th>
<th>EAE</th>
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<td>Particulate contamination of witness packaging samples</td>
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<td>1</td>
<td>6</td>
<td>3</td>
<td>31</td>
<td>10</td>
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<td>6</td>
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<td>10</td>
<td>39</td>
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<td>75</td>
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<tr>
<td>Particulate contamination after exposure by shaking</td>
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<td>3</td>
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<td>10</td>
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REFERENCES

1. ECSIS-D ST-09-09C, Storage, handling and transportation of spacecraft hardware, 2014