Debris Environment Overview

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Debris Approach

• Debris is an environment generated by the shuttle as it flies and the shuttle must be engineered to successfully fly through that environment

• Our approach to the debris environment has four levels

• First - Eliminate sources of debris by design

• Second - Understand the transport mechanism for any remaining debris that is generated

• Third - Understand the impact tolerance for any debris that can be generated and can reach the shuttle

• Fourth – Contingency plans
RTF actions map into our strategy

• First - Eliminate sources of debris by design
  – ET Bipod redesign, ET TPS revalidation, SRB Bolt Catcher Redesign
  – Non destructive Evaluation (NDE) of TPS
  – Inflight video and photographic coverage
• Second - Understand the transport mechanism for any remaining debris that is generated
  – Tests of debris generation
  – Modeling of debris transport
  – Inflight video and photographic coverage
• Third - Understand the impact tolerance for any debris that can still be generated and can reach the shuttle
  – Coupon and full impact tests as well as analytical models
  – NDE of RCC to verify the effect of age on strength
  – TPS hardening
• Fourth, Contingency Plans
  – On orbit inspection and repair capability
  – Contingency Shuttle Crew Support (CSCS)
Debris Strategy

Eliminate Debris Generation

Eliminate Debris By Transport Mechanism

Eliminate Debris by Impact Tolerance

Contingency Plans
The application of TPS materials includes computer controlled automatic spray cells and manual application.
Picture of ET Flange Foam Transport Cases
### Impact Kinetic Energy

<table>
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<tr>
<th>Weight (lbs)</th>
<th>Velocity (fps)</th>
<th>Energy (ft-lbf)</th>
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<tbody>
<tr>
<td>1.5</td>
<td>777</td>
<td>14,062</td>
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<td>1874</td>
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<td>.1</td>
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<td>760</td>
</tr>
<tr>
<td>.02</td>
<td>1000</td>
<td>310</td>
</tr>
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Purposes of Inflight Imagery

• Verify Design Changes to Eliminate Debris
• Understand transport mechanisms of any remaining debris
• Observe integrated performance to find unknown phenomena