General Disclaimer

One or more of the Following Statements may affect this Document

- This document has been reproduced from the best copy furnished by the organizational source. It is being released in the interest of making available as much information as possible.

- This document may contain data, which exceeds the sheet parameters. It was furnished in this condition by the organizational source and is the best copy available.

- This document may contain tone-on-tone or color graphs, charts and/or pictures, which have been reproduced in black and white.

- This document is paginated as submitted by the original source.

- Portions of this document are not fully legible due to the historical nature of some of the material. However, it is the best reproduction available from the original submission.

Produced by the NASA Center for Aerospace Information (CASI)
Space Shuttle Stiffener Ring foam failure analysis, a non-conventional approach.

The Space Shuttle makes use of the excellent properties of rigid polyurethane foam for cryogenic tank insulation and as structural protection on the solid rocket boosters. When foam applications debond, classical methods of analysis do not always provide root cause of the failure of the foam. Realizing that foam is the ideal media to document and preserve its own mode of failure, thin sectioning was seen as a logical approach for foam failure analysis. Thin sectioning in two directions, both horizontal and vertical to the application, was chosen to observe the three dimensional morphology of the foam cells. The cell foam morphology provided a much greater understanding of the failure modes than previously achieved.
Space Shuttle Stiffener Ring foam failure, a non-conventional approach.

The Space Shuttle makes use of the excellent properties of rigid polyurethane foam for cryogenic tank insulation and as structural protection on the solid rocket boosters. When foam applications debond, classical methods of analysis do not always provide root cause of the failure of the foam. Realizing that foam is the ideal media to document and preserve its own mode of failure, thin sectioning was seen as a logical approach for foam failure analysis. Thin sectioning in two directions, both horizontal and vertical to the application, was chosen to observe the three dimensional morphology of the foam cells. The cell foam morphology provided a much greater understanding of the failure modes than previously achieved.
Foam Failures fall into two categories:

- Adhesive
- Cohesive
- Mixture of both

ATK define the foam failures qualitatively by visual inspection of the presence or absence of foam residue on the de-bonded surface.
The foam bond coat displayed two modes of failure:

> Cohesive failure was observed next to the SRB substrate due to severely deformed foam cells in the bond coat.
> Adhesive failure was observed at the RT-455 Epoxy interface.
> 78% surface of the foam application failed.

The observed morphology of the fracture surfaces indicates that the bond coat was not fully cured before the foam cells were applied, e.g., the expansion forces of the second coat disturbed the bonding cells.

Work is ongoing; possible contributing causes under consideration include:

> Inadequate curing time of the bond coat
> Substrate temperature

This cross section method is applicable to any foam de-bonding incidents.

> SRB, External Tank and Atlas V