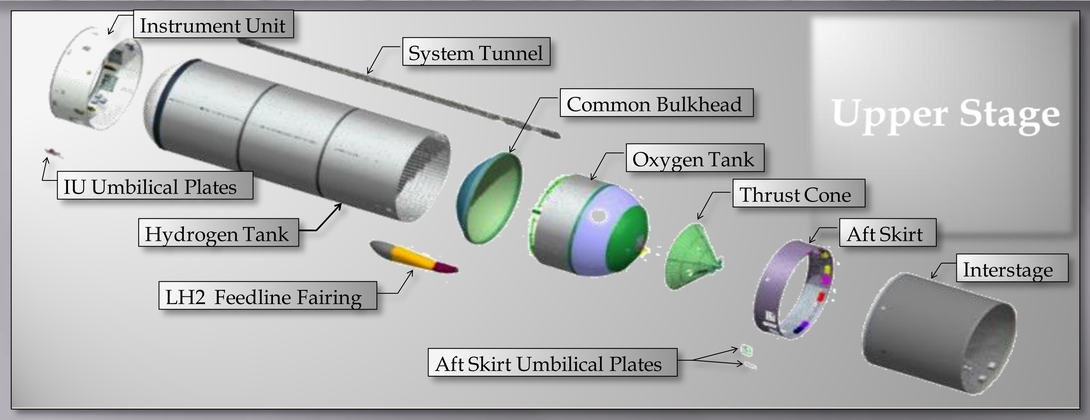
Random Vibrations

Seena Nasseri
Mentor: Philip M. Harrison, Parvin K. Aggarwal
New Century Technology High School

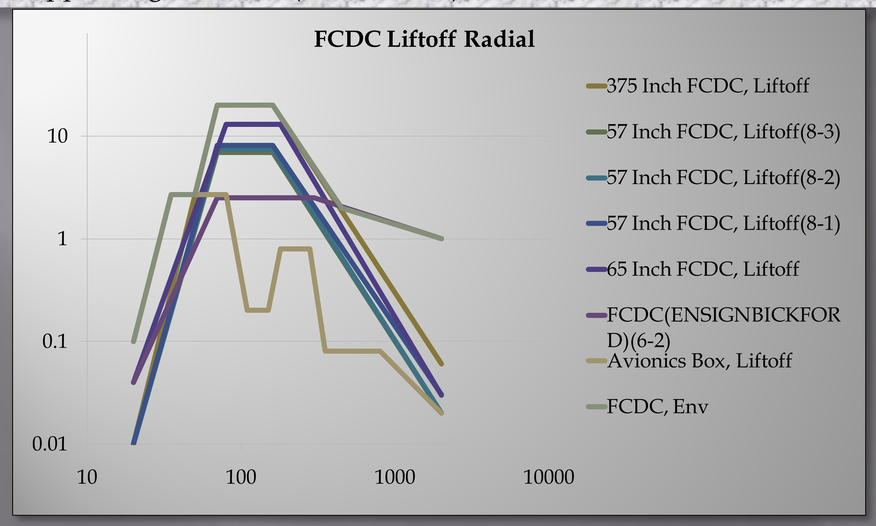
Background:

• Random Vibration test criteria for Ares I Upper Stage pyrotechnic components are developed by enveloping the applicable environments where the component is located.
• For example, the FCDC's are a pyrotechnic component routed through the Upper Stage Instrument Unit, System Tunnel , Aft Skirt, and, Interstage.
• FCDC's are energetic explosive transfer lines used to detonate pyrotechnic devices for the Ares 1 Upper Stage US/ Interstage Separation System, Ullage Settling Motor Ignition & Jettison Systems, and Flight Termination Systems.
• The Design is a Hexanitrostilbene (HNS) internal cord & end tip charges with layered Kevlar and CRES outer braid (0.210" OD).



Data:

• Random vibration design & test criteria were developed by enveloping the applicable data (based on component locations and mounting configurations) from the following documents.
• Predicted Flight Random Vibration for the Ares I Upper Stage (ER41-09-010) .
• Updates to the Flight Random Vibration Environment Predictions for the Ares I Upper Stage Aft Skirt and Aft Quarter of the Interstage (ER41-010-010).
• Predicted Ground Test Random Vibration Environments Predictions for the Ares I Upper Stage (ER41-10-002).
• Ares I Upper Stage Component Random and Sine Response Predictions from J-2X Self-Induced Loads (ESTSG-FY10-01522) and Random Vibration Environments for the Isolated Avionics Boxes in Ares I Upper Stage Aft Skirt (ER41-10-014).



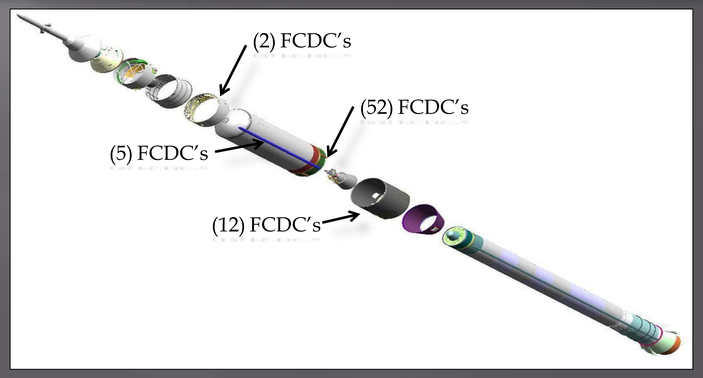
Abstract:

Ares I Zonal Random vibration environments due to acoustic impingement and combustion processes are develop for liftoff, ascent and reentry. Random Vibration test criteria for Ares I Upper Stage pyrotechnic components are developed by enveloping the applicable zonal environments where each component is located. Random vibration tests will be conducted to assure that these components will survive and function appropriately after exposure to the expected vibration environments.

FCDC (Flexible Confined Detonating Cord)

Methodology:

• Random Vibration test criteria for Ares I Upper Stage pyrotechnic components were desired that would envelope all the applicable environments where each component was located.
• Applicable Ares I Vehicle drawings and design information needed to be assessed to determine the location(s) for each component on the Ares I Upper Stage.
• Design and test criteria needed to be developed by plotting and enveloping the applicable environments using Microsoft Excel Spreadsheet Software and documenting them in a report Using Microsoft Word Processing Software.



FCDC Locations & amount

Conclusion:

Random vibration liftoff, ascent, and green run design & test criteria for the Upper Stage Pyrotechnic Components were developed by using Microsoft Excel to envelope zonal environments applicable to each component. Results were transferred from Excel into a report using Microsoft Word. After the report is reviewed and edited by my mentor it will be submitted for publication as an attachment to a memorandum. Pyrotechnic component designers will extract criteria from my report for incorporation into the design and test specifications for components. Eventually the hardware will be tested to the environments I developed to assure that the components will survive and function appropriately after exposure to the expected vibration environments.