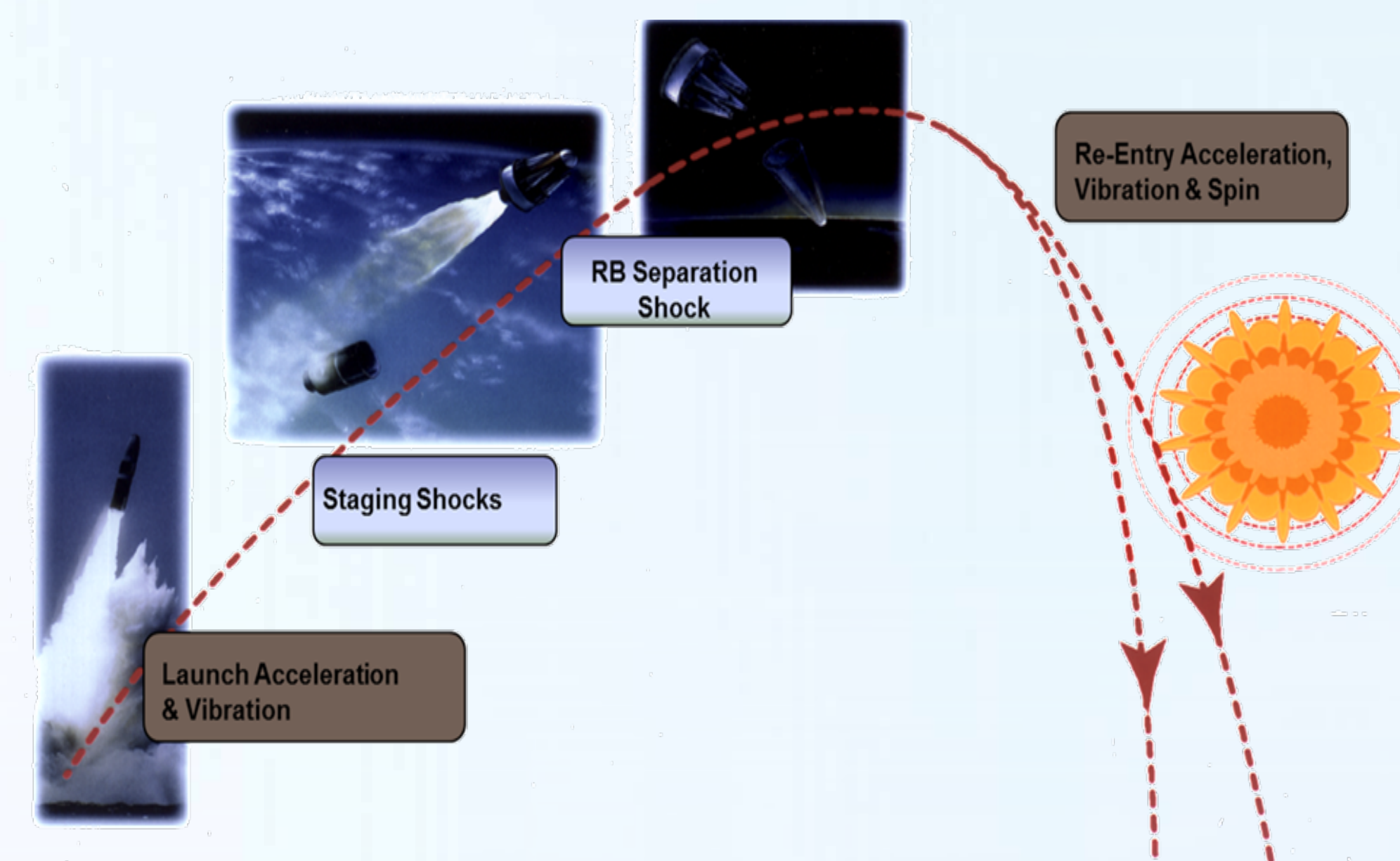


# Capability Development for Combined Shock and Inertial Environment Testing

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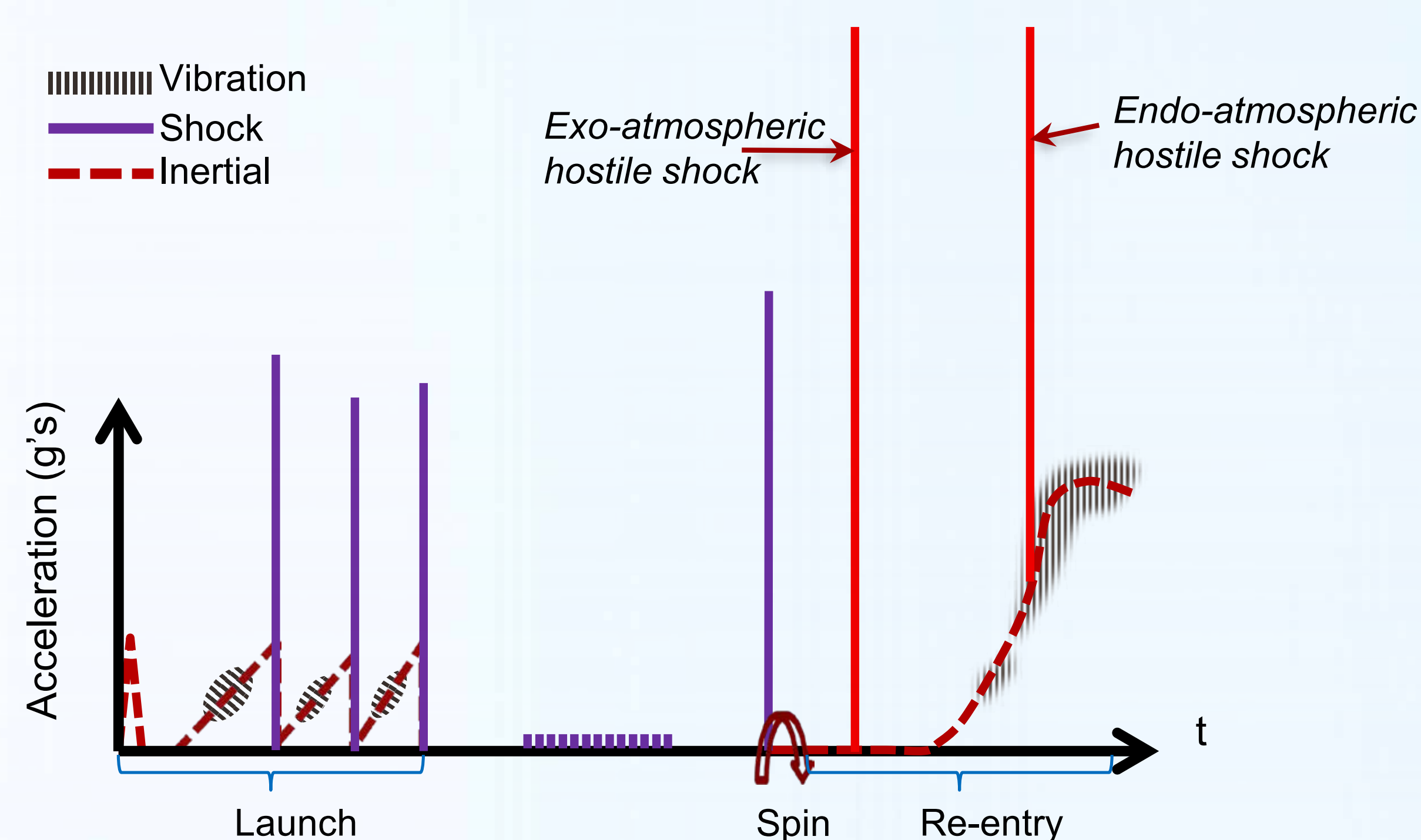
## Problem Definition

- Goal is to more accurately simulate flight environments in ground based testing.
- Recent development work has successfully combined vibration and inertial loads (Vibrafuge). Testing in combined environments with the Vibrafuge has demonstrated compelling evidence for utilizing more realistic ground-based testing.
- Inclusion of additional combined environments, such as shock, will further Sandia's commitment to testing systems to the most realistic environments possible while lowering the cost (potential for less flight tests) and strengthening the confidence and reliability of our systems.



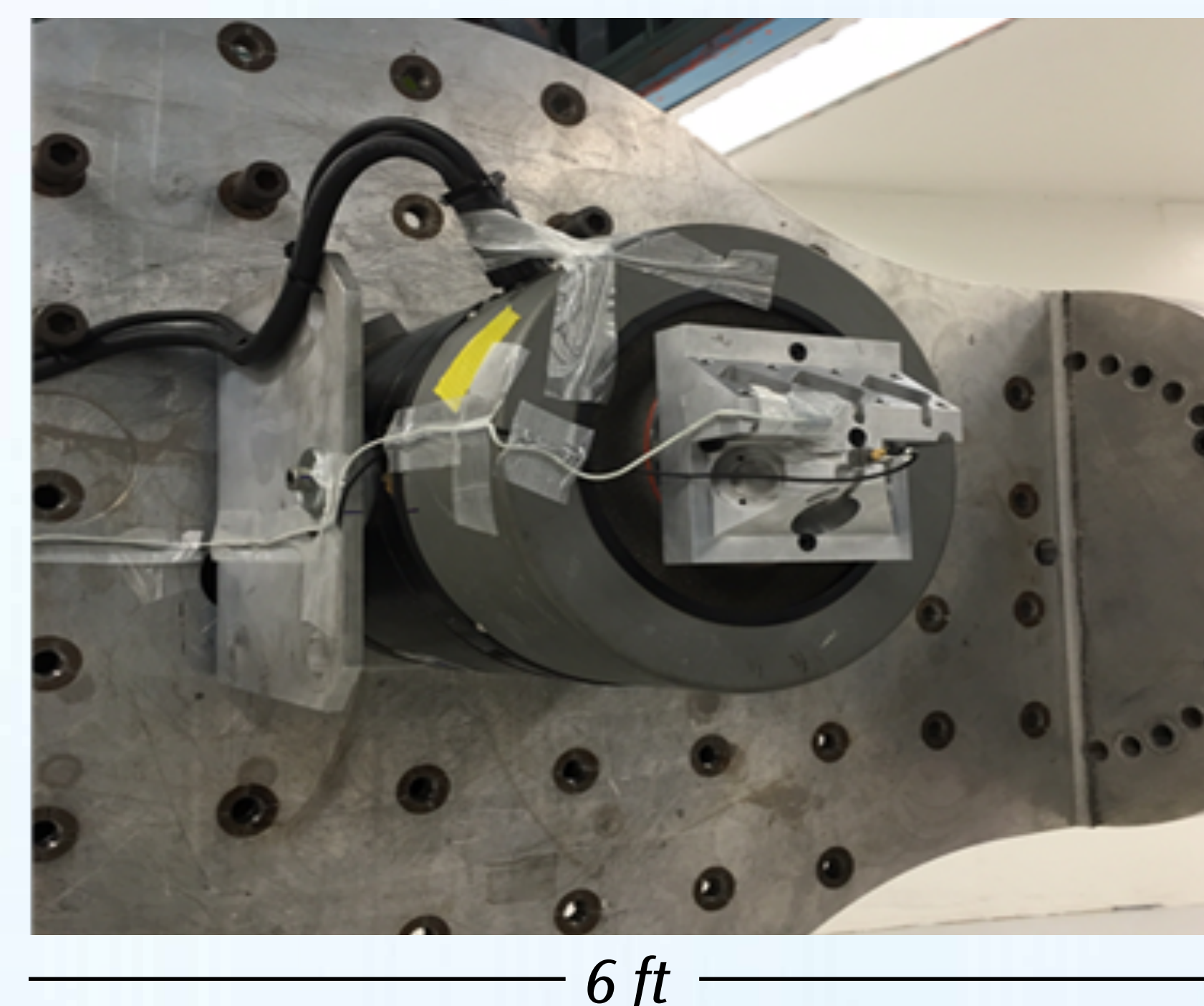
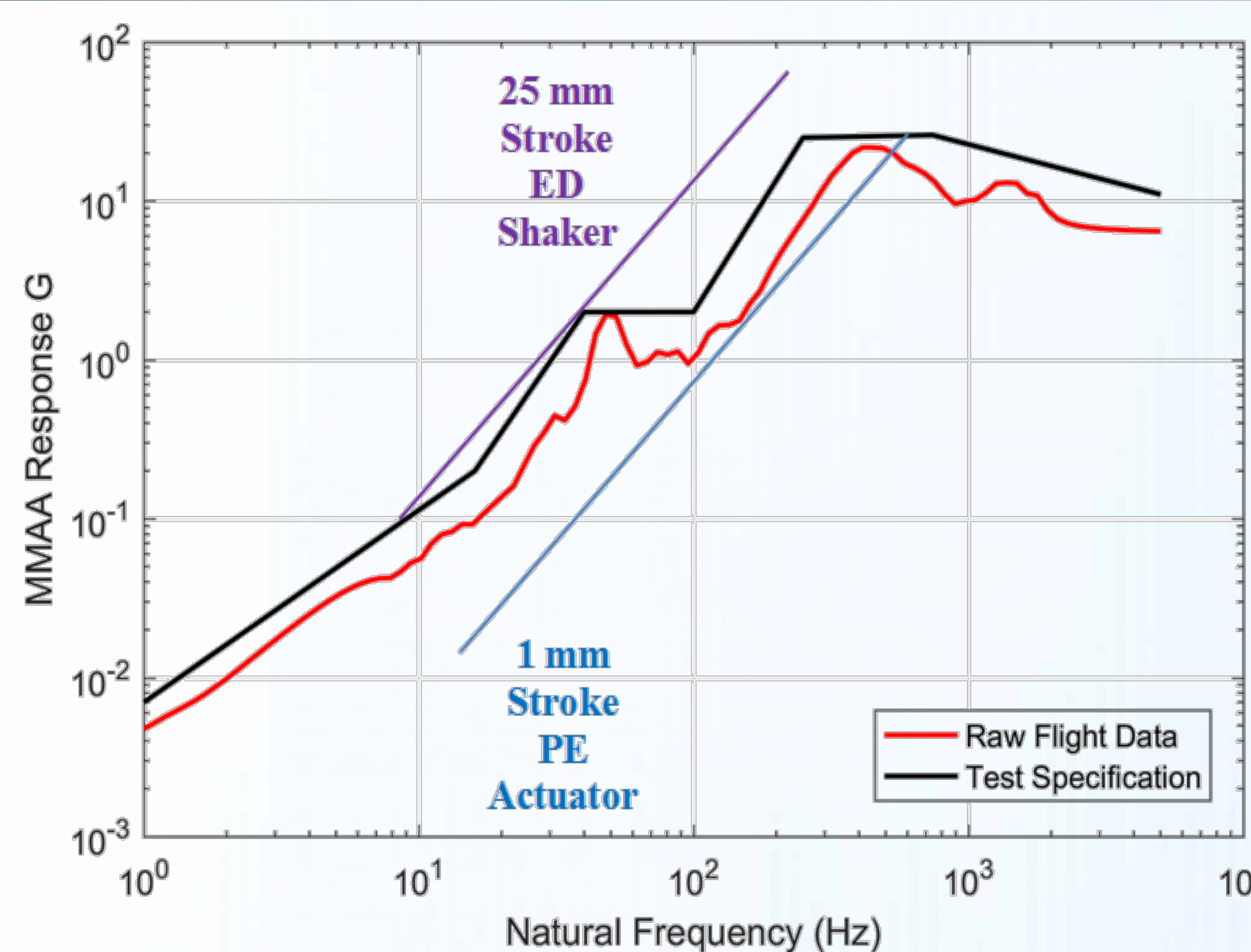
## Approach – Determine Test Requirement

The existing Stockpile-to-Target Sequence (STS) requirements generally provide the test environments that simulate flight events independently. Many times, there is significant conservatism in establishing test specifications using this method which can make the test environment less realistic and performance results potentially misleading. The first step was to determine the simultaneous environments for Normal shock and inertial loads from flight data and develop a test specification from that data.



## Approach – Determine Design Concept

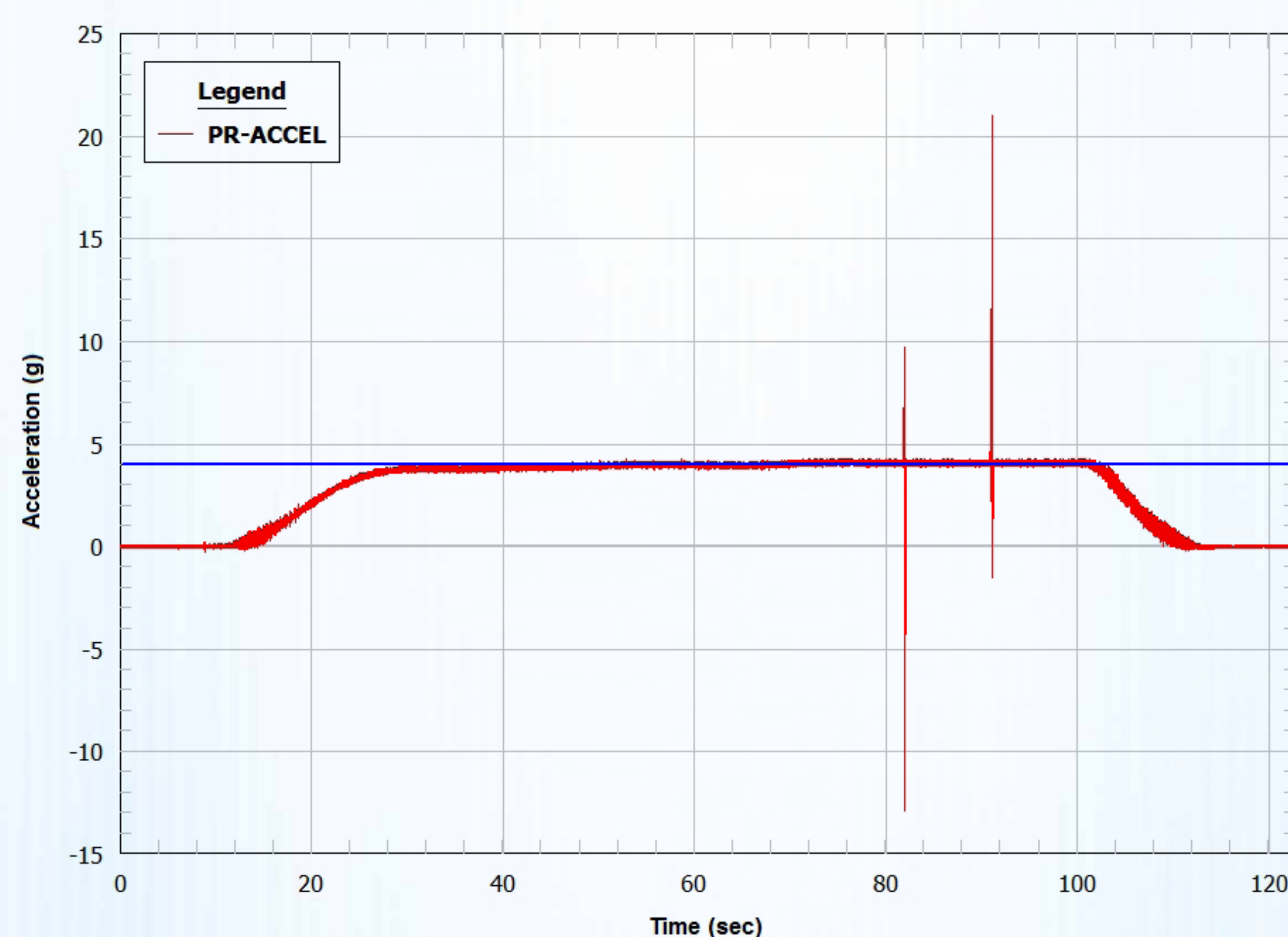
Develop a design concept to meet this combined environment requirement with a proof-test. Since the shock environments require high stroke (~1 inch) and occur at low inertial loads, the design for the test used an electrodynamic (ED) shaker. A small ED shaker was used for the proof-of-concept test, but larger ones are also possible.



## Results & Conclusions

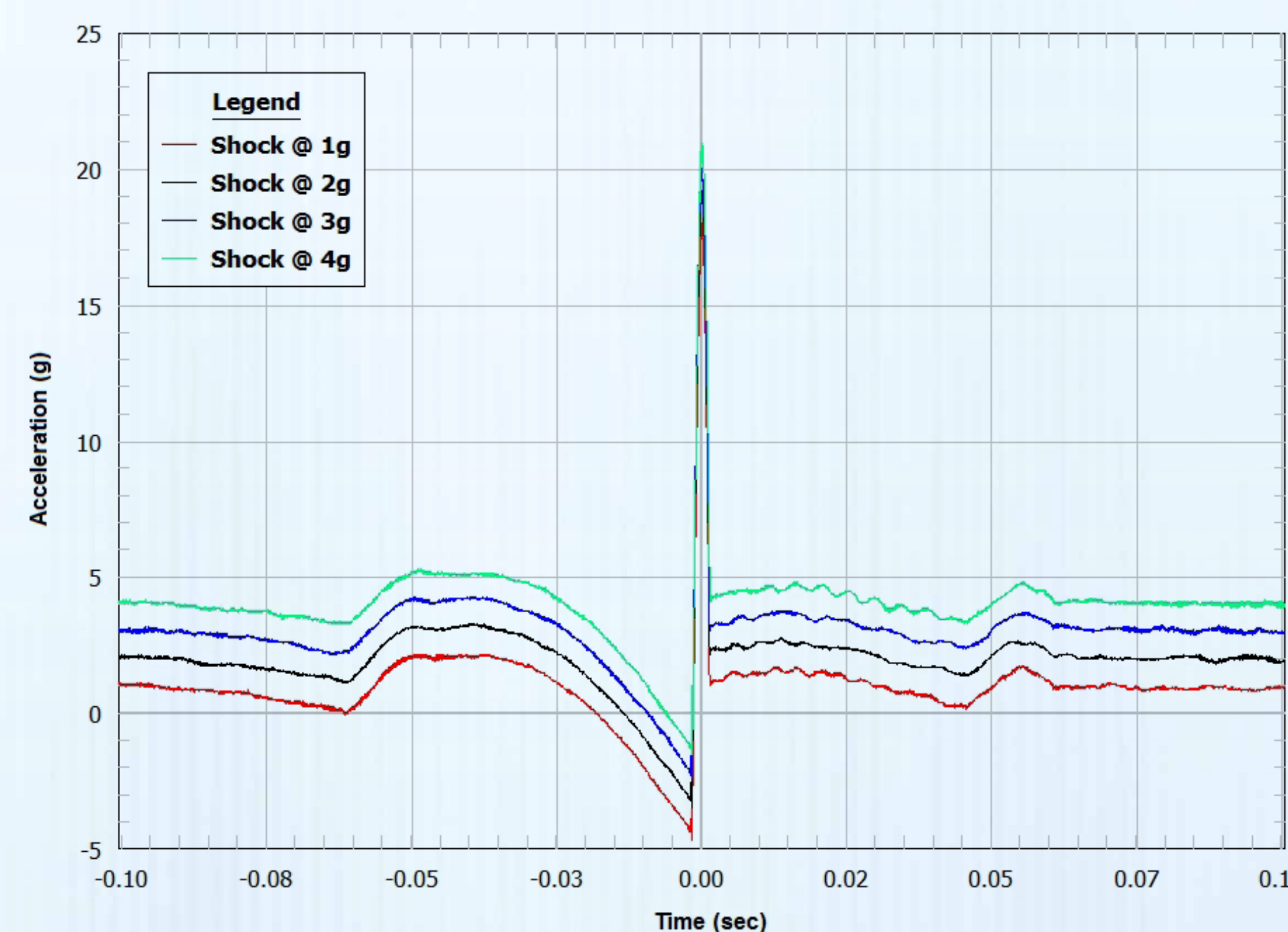
### Combined Shock and Inertial Test:

Positive and Negative Pulse at 4 Gs



### Combined Shock and Inertial Test:

from 0 to 4 Gs



- The outcome of this work demonstrates the ability of an ED shaker for the flight shock in combination with the inertial loads.
- In addition to a new stand alone capability, this work allowed for further concepts to be explored such that multiple environments (inertial, vibration and shock) could be tested simultaneously.
- Ultimate Goal: Ground test data that is indistinguishable from flight data

References  
SAND2016-11416. Capability Development for Combined Shock and Inertial Environment Testing