

# Shock & Vibration – Test, Design and Design Assurance

by Dr. Alec Feinberg

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June 23-24 .....at Cincinnati Sub-Zero, Cincinnati OH

Understanding of vibration and shock: stresses is important for the design of reliable products for diverse applications, ranging from consumer portable devices to safety critical equipment operating in extreme environments. The initial section of the course covers vibration and shock: concept, test methods and test equipment in detail. How to use vibration and shock: equipment as design aids is also covered. Practical examples are used to illustrate the concepts and the attendees will perform the calculations themselves to help reinforce learning.

Design methods for vibration and shock: are covered in the next part. We start by looking at the typical design maturity stages and how these will relate to different activities for the design process. For the actual design, we look at material selection relative to shock: and vibration stress environmental conditions (issues for material modulus, yield strength, hardness, creep requirements, wear issues, fatigue, etc). We then detail isolation and damping design methods to protect against vibration and shock: environments. We then look at design margins to assure robustness. A Monte Carlo method is introduced for stack: up issues. A key to a successful design program and managing a project is the FMEA tool. We will overview both a top down and bottoms up approach to assure product success.



We then look at design assurance some of which was initially covered with the stage gate approach in design. We discuss reliability and quality analysis so the engineer has an understanding on their importance for design. We then go over some visual inspection methods that help in final product release. The course includes physics of failure and analysis methods so the engineer also has a chance to look at potential historical failure modes in manufactured products, how they occur and what failure analysis tools are needed to help determine root cause issues.

The course targets designers, engineers, test engineers and management. However, different sections vary in engineering level. We provide software to help in test and analysis to make the math easier. Students will be given a trial version of the DiRSoft software (30 day activation) for this course which is not mandatory but helps to accelerate learning. DiRSoft software is a multi-level program with different tools that includes shock: and vibration module which greatly helps in teaching this course.

## Section 1

### Understanding Shock & Vibration

#### Section 1.1 Shock

##### • Overview of Shock & Vibration

##### • What is a G, g, Grms, G-force

##### • Shock

- What is shock?
- Shock: testing; electrodynamic (ED), drop shock:
- Shock: Equipment; ED, Air Shock:, Incline, Drop Shock:, Tower Test
- Common types of shock: pulses
- How does 1G free fall create large G shocks?

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# Shock Vibration Test Design And Design Assurance In Oh

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*Scientific and Technical Aerospace Reports* ,1990      **SV. Sound and Vibration** ,1995      Materials Evaluation ,2006

**Thomas Register of American Manufacturers** ,2002 This basic source for identification of U S manufacturers is arranged by product in a large multi volume set Includes Products services Company profiles and Catalog file      Sound & Vibration ,1995      **Aerospace America** ,1992      Thomas Register ,2004      *Mechanical Engineering* ,1987      *Thomas Register of American Manufacturers and Thomas Register Catalog File* ,2002 Vols for 1970 71 includes manufacturers catalogs      **Test** ,1980      **Electronic Design** ,1965      **Transportation, Storage, and Disposal of Radioactive Materials** ,1997      *International Aerospace Abstracts* ,1990      **Instrumentation Technology** ,1969      NASA SP. ,1991

**Aeronautical Engineering** ,1991 A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in Scientific and technical aerospace reports STAR and International aerospace abstracts IAA      Government Reports Announcements & Index ,1988

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