STDI—Structural Test Design and Interpretation
for Aerospace Programs

Course Overview: This 3-day course provides a rigorous look at structural testing and its roles in product development and verification for aerospace programs. The course starts with a broad view of structural verification throughout product development and the roles of testing. The course then covers planning, designing, performing, interpreting, and documenting a test.

The course emphasizes static loads testing and vibration testing on a shaker, including notching and force limiting. Modal survey testing, centrifuge testing, and acoustic testing are touched on as well. Several case studies are presented after first allowing the class to brainstorm ideas relevant to those studies.

The objectives of this course are to improve your understanding of how to

- identify and clearly state test objectives
- design (or recognize) a test that satisfies the identified objectives while minimizing risk
- establish pass/fail criteria
- design the instrumentation
- interpret test data
- write a good test plan and a good test report

Target Audience: All engineers and managers involved in ensuring that flight vehicles and their payloads can withstand mission environments.

Course Developer and Teacher:

Tom Sarafin is President and founder of Instar Engineering and Consulting, Inc. He has worked in the space industry since 1979 as a structural engineer, a mechanical systems engineer, a project manager, and a consultant. Since founding Instar in 1993, he's consulted for NASA, DARPA, the DOD Space Test Program, Lockheed Martin, DigitalGlobe (Maxar), Sierra Nevada Corp (Sierra Space), and many other organizations. He was a key member of the team that developed NASA-STD-5020, "Requirements for Threaded Fastening Systems in Spaceflight Hardware" (March 2012). He is the editor and principal author of *Spacecraft Structures and Mechanisms: From Concept to Launch* and is a contributing author to *Space Mission Analysis and Design*. Since 1995, he has taught well over 300 courses to more than 6000 engineers and managers in the aerospace industry. He teaches the following courses: Space Mission Structures, from Concept to Launch (SMS), Design and Analysis of Bolted Joints (DABJ), Structural Design and Analysis for Aerospace Engineers (SDA), Structural Test Design and Interpretation (STDI), Vibration Testing of Small Satellites (VTSS), Notching and Force Limiting Workshop (NFLW), and Ten Principles for Successful Space Programs (TenP).

Testimonials

"The entire course was useful to me." "This is a great course."

"Good job, Tom. These courses are a big help and give us a lot of great fundamental information."

"Great (instructor) with courses where you can take the information learned and material presented and directly apply it to your everyday work."

"Tom Sarafin's courses never disappoint. This class offers a well-balanced blend of fundamentals, examples, and lessons learned that any aerospace engineer involved in structural test design and interpretation would benefit from."

"Incredibly useful course for anyone concerned with product testing, vibe or otherwise."

"Very good course for practical design of structural tests. Tom's breadth of experience and excellent communication skills only add to the value."

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Course Outline

Introduction

1. **Overview of Structural Testing**
   - Reasons for doing a structural test
   - Structural requirements
   - The building-blocks verification process
   - Verification logic flows
   - Categories and types of structural tests
   - Selecting the right type of strength test
   - Pass/fail and success criteria
   - Test management: documents, reviews, and controls
2. **Designing and Documenting a Test**
   - Designing a test
   - Suggested contents of a test plan
   - Test-article configuration
   - Boundary conditions
   - Ensuring adequacy of a strength test
   - A key difference between a qualification test and a proof test
   - Instrumentation
   - Preparing to interpret test data
   - Documenting with a test report
3. **Loads Testing of Small Specimens**
   - Applications and objectives
   - Common loading systems
   - Test standards
   - Case history: designing a test to substantiate NASA criteria for bolt analysis
4. **Static Loads Testing of Large Assemblies**
   - Introduction to static loads testing
   - Test factors per DOD and NASA standards
   - Special considerations
   - Introducing and controlling loads
   - Developing the load cases
   - Be sure to design the right test!
5. **Testing on an Electrodynamic Shaker**
   - Introduction and typical configuration
   - Limitations of testing on a shaker
   - Fixture design
   - Deriving loads from measured accelerations
   - Sine sweep testing
   - Sine burst testing
   - Random vibration testing
6. **Notching and Force Limiting**
   - Introduction to notching and its technical justification
   - Methods of notching
   - STEP-4 case history: how notching without technical rationale led to mission failure
   - Refereces for force limiting
   - Using force gages to measure base force
   - NASA's semi-empirical method of force limiting; examples
   - Adjusting the force limit during test
   - Response limiting
   - Manual notching
7. **Overview of Other Types of Structural Tests**
   - Centrifuge testing
   - Modal survey testing and correlation of the finite element model
   - Acoustic testing
   - Shock testing
8. **Case History: Vibration Testing of a Large Spacecraft Telescope**
   - Overview
   - Initially planned structural test program
   - Problem statement
   - Revised approach
   - Telescope testing details
   - Test anomalies
   - Lessons learned and conclusions

Summary

Combine this course with the 1-day computer workshop, Notching and Force Limiting Workshop (NFLW), using tools and examples that we provide!

Download a PDF file containing all the course materials at no charge, along with PDF files for Tom's other courses, at https://instarengineering.com/resources.html.