

Fatigue, Damage Tolerance, and Risk Assessment of Aircraft Structures

Course Syllabus

Description

The life of an aircraft is no longer governed by its original design life. To a great extent, it is determined by the capability, maintenance costs, and economic considerations required for the fleet to meet its operational goals. With the requirement to keep aging aircraft in service beyond initially-established service lives, total life – including crack growth – has to be considered with associated risks.

Structural risk and reliability analysis will help operators make decisions regarding operation, material replacement, and inspection time of fleet aircraft. In general, risk analysis will provide answers to the question "what is the probability of failure if an aircraft at a given life index value flies for certain duration without inspection?"

Risk assessment & analysis involves initial and repair crack length distributions, stress exceedance probabilities and specific crack growth characteristics for a given spectrum, in addition to material property variability. The risk analysis tools defined in this course will provide the user risk values as applied to aircraft structural integrity in terms of single flight probability-of-failure, accounting for all fleet actions such as inspections, repair and replacements.

Attendees will learn the skills necessary to perform fatigue and damage tolerance analysis of aircraft structures – using modern, proven analysis and computation techniques – all within the context of structural risk and reliability analysis.

Who Should Attend

Engineers and engineering managers who need to learn more about fatigue, damage tolerance, structural risk and reliability analysis of aircraft structures and their role in aircraft design and life management.

Course Duration

1 week (40 hrs).

Cost

\$1595.00 (USD) per attendee. 15% discount for 3 or more attendees from the same organization.



Course Dates

Please contact us at training@tda-i.com for course scheduling and availability.

Course Authors

Technical Data Analysis, Inc. (TDA).

Course Location

Based on the number of attendees, the course may be hosted onsite at your location, at an offsite location, or at TDA's Falls Church, VA, Lexington Park, MD, or Marietta, GA offices.

Technical Data Analysis, Inc. (TDA)

Falls Church:

7600 Leesburg Pike
West Building, Suite 204
Falls Church, VA 22043
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www.tda-i.com

Lexington Park:

22289 Exploration Drive, Suite 304
Lexington Park, MD 20653
301.866.9400 (tel); 301.866.9411 (fax)

Marietta:

3750 Palladian Village Drive, Suite 500
Marietta, GA 30066
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Course Topics

- I. Introduction and Overview
 - a. Historical Perspective
 - b. Survey of Engineering Materials
- II. Elastic and Inelastic Deformation of Metals
 - a. Tensile, Compressive and Cyclic Characteristics
 - b. Failure Types and Criteria
 - c. Analytical Models and Metallurgy
- III. Selection of Materials and Design Strategies of Aircraft Components
- IV. Fatigue of materials – Crack Initiation
 - a. Cyclic Stress-Strain Response
 - b. Fatigue Life Curves
 - c. Notched Behavior
 - d. Stress-based Fatigue Analysis Techniques
 - e. Strain-based Fatigue Analysis Techniques
 - f. External and Internal Factors Influencing Fatigue Life
 - g. Fatigue life Indexing of Aircraft Components
- V. Fracture Mechanics and Fatigue Crack Growth
 - a. Linear Elastic Fracture Mechanics
 - b. Elastic Plastic Fracture Mechanics
 - c. Stress Intensity Factor Calculation Methods
 - d. Fatigue Crack Growth – Test and Analysis Techniques
 - e. Crack Growth under Constant and Variable Amplitude Loading
 - f. Fatigue Cracks in Aircraft Structures and Analysis
 - g. Damage Tolerance Principles and Applications
- VI. Fatigue Spectra Development
 - a. Full Scale Fatigue Test Spectra Development
 - b. Usage Spectra Development for Aircraft Components
 - c. Spectrum Editing Techniques -Truncation, Clipping, Rainflow Counting
- VII. Fatigue testing and Analysis
 - a. Data Acquisition Techniques
 - b. Coupon, component testing
 - c. Full-scale testing
 - d. Statistical Analysis of Fatigue Test Results
 - e. Aircraft Life Assessment using Full Scale Fatigue Test
- VIII. Risk Analysis and Assessment of Aircraft Components
 - a. Identification of Risk Elements
 - b. Risk Analysis Techniques, Probability of Failure
 - c. Risk Assessment and Management
- IX. Aircraft Life Management and Structural Integrity
 - a. Lessons Learned from “Real world” examples
 - b. Industry Best Practices and Fatigue Life Enhancement Methods
 - c. Structural Maintenance Program Development

Course Materials

The following materials will be provided to each attendee:

1. Course notebook, documenting all covered topics as well as “real world” example problems.
2. N. E. Dowling; “Mechanical Behavior of Materials (3rd Ed.);” Prentice Hall; 2007.
3. S. Suresh; “Fatigue of Materials” (2nd Ed); Cambridge University Press 2003.
4. T. L. Anderson; “Fracture Mechanics”; CRC Press; 2005.

Instructors

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Dr. Nagaraja Iyyer is Director of Engineering at Technical Data Analysis, Inc. (TDA) Falls Church, VA office. He has over 25 years of experience in aircraft structures engineering and application program development. The majority of his experience has been supporting the US Navy in its aircraft structural life surveillance and service life assessment and extension programs of various aircraft. His strengths are in solving fleet problems related to structural integrity issues and has been heavily involved in the development of aircraft mission profiles, ground and flight loads tests, aircraft usage surveys, and numerous fatigue tests including full-scale, component and coupon tests. Dr. Iyyer has conducted numerous risk assessment studies to support safety of flight decisions for various aircraft components. In addition to structural integrity issues, he has also worked in developing algorithms for distributed interactive fire mission systems for the US Army. His current interests are in developing reliable life prediction models for engineers and management, identifying and mitigating age-related problems, and developing new damage detection techniques. Dr. Iyyer has won numerous awards during his career, including the 2006 Naval Air Warfare Center Division’s Area Commander’s Award for his ground breaking development of a probabilistic risk assessment methodology and metrics to quantify the risk of continued US Navy P-3 flight operations. Dr. Iyyer is very proficient at computer programming and fluent in multiple computer systems and software applications.

Other experts in industry may be involved in instruction as well.