

Boeing Simulates Thermal Expansion in Composites with Expanded Metal Foil for Lightning Protection of Aircraft Structures

Modern aircraft such as the Boeing 787 Dreamliner are comprised of more than fifty percent carbon fiber composite requiring the addition of expanded metal foil for lightning strike protection. Researchers at Boeing are using simulation to verify that protective coatings on the metal foil will not fail due to thermal stress arising from a typical flight cycle.

BY JENNIFER A. SEGUI

The Boeing 787 Dreamliner is innovative in that it is comprised of more than fifty percent carbon fiber reinforced plastic (CFRP) due to the material's light weight and exceptional strength. Figure 1 shows the extensive use of composite materials throughout the aircraft. Although CFRP composites

inherently have many advantages, they cannot mitigate the potentially damaging electromagnetic effects from a lightning strike. To solve this problem, electrically conductive expanded metal foil (EMF) can be added to the composite structure layout to rapidly dissipate excessive current

and heat for lightning protection of CFRP in aircraft.

Engineers at Boeing Research and Technology (BR&T) are using multiphysics simulation and physical measurements to investigate the effect of the EMF design parameters on thermal stress and displacement



FIGURE 1. Advanced composites used throughout the Boeing 787 account for more than fifty percent of the aircraft body¹.

Boeing Composites Design Manual

S. Oken



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Scientific and Technical Aerospace Reports ,1995 Lists citations with abstracts for aerospace related reports obtained from world wide sources and announces documents that have recently been entered into the NASA Scientific and Technical Information Database

Handbook of Aluminum Bonding Technology and Data J. D. Minford,1993-06-16 A reference that offers comprehensive discussions on every important aspect of aluminum bonding for each level of manufacturing from mill finished to deoxidized conversion coated anodized and painted surfaces and provides an extensive up to date review of adhesion science covering all significant

Reinforced Plastics Handbook Donald V Rosato,Dominick V Rosato,2004-12-15 In this 3rd Edition of the Reinforced Plastics Handbook the authors have continued the approach of the late John Murphy author of the first and second editions The book provides a compendium of information on every aspect of materials processes designs and construction Fiber reinforced plastics are a class of materials in which the basic properties of plastics are given mechanical reinforcement by the addition of fibrous materials The wide choice of plastics resin matrices and the correspondingly wide choice of reinforcing materials mean that the permutations are virtually unlimited But the optimum properties of resin and reinforcement cannot be obtained unless there is an effective bond between the two and this is the continuing objective of reinforced plastics production design and processing New 3rd edition of this comprehensive practical manual This is a bible for all those involved in the reinforced plastics industry whether manufacturers specifiers designers or end users Has been completely revised and updated to reflect all the latest developments in the industry

Third NASA Advanced Composites Technology Conference, Volume 1, Part 2 ,1992

MFPG Mechanical Failures Prevention Group. Meeting,1982

Fundamentals of Composites and Their Methods of Fabrications Bahram Farahmand,2025-04-03 This book provides readers with essential insights into composite materials encompassing methods for fabricating composite parts PMCs MMCs CMCs determining their mechanical properties via coupon testing and rule of mixtures and exploring their industrial applications Additionally the book covers topics of interest for engineers including damage tolerance analysis nondestructive inspections repairing damaged composite and metallic parts and fabricating composite parts using additive manufacturing processes Drawing on his years of experience in the aerospace industry the author believes the topics presented will be valuable to readers and that engineers in industries students in academia and university instructors will find this book beneficial Introduces progressive failure analysis fatigue and fracture of composite molecular dynamics virtual testing with several practical example problems Explores additive manufacturing methods and their application in fabricating PMCs and assessing mechanical properties Introduces nanocomposites and their fabrication methods detailing advantages and disadvantages of the parts produced

Analytical and Experimental Investigation of Aircraft Metal Structures Reinforced with Filamentary Composites. Phase 3: Major Component Development L. L. Bryson,1973

Analytical and Experimental Investigation of Aircraft Metal Structures Reinforced with

Filamentary Composites S. Oken,1973 *New Materials for Next-Generation Commercial Transports* Committee on New Materials for Advanced Civil Aircraft, Commission on Engineering and Technical Systems, National Materials Advisory Board, Division on Engineering and Physical Sciences, National Research Council, 1996-03-29 The major objective of this book was to identify issues related to the introduction of new materials and the effects that advanced materials will have on the durability and technical risk of future civil aircraft throughout their service life The committee investigated the new materials and structural concepts that are likely to be incorporated into next generation commercial aircraft and the factors influencing application decisions Based on these predictions the committee attempted to identify the design characterization monitoring and maintenance issues that are critical for the introduction of advanced materials and structural concepts into future aircraft Space Benefits: the Secondary Application of Aerospace Technology in Other Sectors of the Economy ,

Handbook of Sustainable Polymers for Additive Manufacturing Antonio Paesano, 2022-05-24 This book provides the latest technical information on sustainable materials that are feedstocks for additive manufacturing AM Topics covered include an up to date and extensive overview of raw materials their chemistry and functional properties of their commercial versions a description of the relevant AM processes products applications advantages and limitations prices and market data and a forecast of sustainable materials used in AM their properties and applications in the near future Data included are relative to current commercial products and are presented in easy to read tables and charts Features Highlights up to date information and data of actual commercial materials Offers a broad survey of state of the art information Forecasts future materials applications and areas of R D Contains simple language explains technical terms and minimizes technical lingo Includes over 200 tables nearly 200 figures and more than 1 700 references to technical publications mostly very recent **Handbook of Sustainable Polymers for Additive Manufacturing** appeals to a diverse audience of students and academic technical and business professionals in the fields of materials science and mechanical chemical and manufacturing engineering

Revolutionizing Aircraft Materials and Processes Spiros Pantelakis, Konstantinos Tserpes, 2020-03-11 This book addresses the emerging needs of the aerospace industry by discussing recent developments and future trends of aeronautic materials It is aimed at advancing existing materials and fostering the ability to develop novel materials with less weight increased mechanical properties more functionality diverse manufacturing methods and recyclability The development of novel materials and multifunctional materials has helped to increase efficiency and safety reduce costs and decrease the environmental foot print of the aeronautical industry In this book integral metallic structures designed by disruptive concepts including topology optimization and additive manufacturing are highlighted

Astronautics & Aeronautics ,1980 **Limited Scientific and Technical Aerospace Reports** ,1980 **Aeronautical Engineering** ,1971 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 **Advances in Composite Materials** A. R. Bunsell, 2013-10-02 Advances in Composite Materials is a collection of papers that discusses fiber reinforced composite materials pertaining to their mechanical and failure properties One paper explains the design and fabrication of a GrFRP concept car by the Ford Motor Company which uses as much as possible graphite fiber in the body chassis and powertrain Another paper discusses the sorption behavior of glass fiber reinforced composites as well as the influence of diffusing media on the deformation and failure behaviors One paper examines the physical elastic viscoelastic and inelastic properties of multiphase short fiber composite materials using the fiber aspect ratio fiber volume fraction and properties of the constituent phases as several variables Another paper describes a procedure to measure the changes in stiffness properties of a unidirectional fibrous composite such as glass fiber reinforced polyester caused by fatigue damage One application of carbon fiber reinforced thermoplastics is in a sleeve bush molded from nylon 66 containing 30 percent fiber reinforcement with PTFE and silicone oil The material has low frictional high wear performance characteristics The Penny and Giles Potentiometers Ltd use this component on a joystick for gun directional control The collection can prove useful for design engineers materials engineers scientists involved with composite materials and industrial researchers in the fields of materials science *Foreign Object Debris and Damage in Aviation* Ahmed F. El-Sayed, 2022-04-27 Foreign Object Debris and Damage in Aviation discusses both biological and non biological Foreign Object Debris FOD and associated Foreign Object Damage FOD in aviation The book provides a comprehensive treatment of the wide spectrum of FOD with numerous cost management and wildlife considerations Management control for the debris begins at the aircraft design phase and the book includes numerical analyses for estimating damage caused by strikes The book explores aircraft operation in adverse weather conditions and inanimate FOD management programs for airports airlines airframe and engine manufacturers It focuses on the sources of FOD the categories of damage caused by FOD and both the direct and indirect costs caused by FOD In addition the book provides management plans for wildlife including positive and passive methods The book will interest aviation industry personnel aircraft transport and ground operators aircraft pilots and aerospace or aviation engineers Readers will learn to manage FOD to guarantee air traffic safety with minimum costs to airlines and airports **Advanced Materials & Processes** ,2001 **Government Reports Annual Index** ,1975 *A Collection of Technical Papers* ,1993

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