

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

RC Schank



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Scientific and Technical Aerospace Reports ,1989 **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 **Analytical and**

Experimental Investigation of Aircraft Metal Structures Reinforced with Filamentary Composites S. Oken,1973

Analytical and Experimental Investigation of Aircraft Metal Structures Reinforced with Filamentary

Composites. Phase 3: Major Component Development L. L. Bryson,1973 *Third NASA Advanced Composites Technology Conference, Volume 1, Part 2* ,1992 *Astronautics & Aeronautics* ,1980 *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 *AIAA Student Journal* American Institute of Aeronautics and Astronautics,1983 *A Collection of Technical Papers* ,1993 *Assembly Engineering* ,1983 **The 34th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, Adaptive Structures**

Forum: 93-1520 - 93-1587 ,1993 Advanced Materials & Processes ,2001 **AGARD Conference Proceedings** North Atlantic Treaty Organization. Advisory Group for Aerospace Research and Development,1976 Composites James A. Quinn,1999-09-22 From properties and processes to design and construction analysis this book collects the information data and equations that are needed to design simply and economically on a day to day basis Composites Design Manual presents the information necessary to facilitate the design and procurement of FRP Graphite and Aramid Composites It describes mechanical physical and environmental properties of composites and materials such as resins catalysts reinforcements multi axials and release agents Over 100 tables figures data sheets and examples simplify the practicalities of composites The Composite Materials Handbook-MIL 17 American Society for Testing and Materials,2002 A government publication that contains extensive information on the design fabrication and use of composite materials It provides guidelines and material properties for polymer organic metal and ceramic matrix composite materials The first three volumes focus on but are not limited to polymeric composites intended for aircraft and aerospace vehicles Metal matrix composites MMC and ceramic matrix composites CMC are covered in volumes 4 and 5 **AIAA Fourth International Aerospace Planes Conference: 92-5000 - 92-5035** ,1992 *Aeronautical Engineering* ,1993 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 NASA SP. ,1990

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