SETEC 11 Conference & Table Top Exhibition

Leiden, Netherlands
14-16 September 2011

Editors:

Mark A. Erath

ISBN: 978-1-61839-657-0
# TABLE OF CONTENTS

## KEY-NOTE 1

**Use of Composites for Space Vehicles**  
Speaker: Mr. C. Stavrinidis ................................................................. 2

## SESSION 1

**SESSION 1A: SPACE 1**  
Chairman H. Cruijssen

**Paper 35**

**Damage Detection in Composite Sub-Reflector Antenna based on Fibre Optic Sensor Technology**  
Speaker: A. Panopoulou, NPI, ESA/ESTEC, University of Patras, Greece ........................................... 23

**Paper 55**

**Electrical Tomography as a Tool for the Damage Assessment of Composite Structures**  
Speaker: A. Baltopoulos, ESA / ESTEC, Noordwijk, The Netherlands ............................................. 31

**Paper 61**

**Nano Composite meeting the Demands of Space Applications**  
Speaker: M. Klebor, ESA / ESTEC, Noordwijk, The Netherlands .................................................... 40

**Paper 69**

**Fiber Steering for Space Sandwich Structures**  
Speaker: W.J. Paalberends, AIRBORNE Technology Centre, NL-2497 GB Den Haag ................ 50

## SESSION 1B: MODELLING & TESTING

Chairman R. Akkerman

**Paper 06**

**Damage Initiation Thresholds in Textile Composites and Fatigue Life Limits**  
Speaker: S.V. Lomov, KU Leuven University, MTM Department ...................................................... 59

**Paper 07**

**Simulating Composites Crush**  
Speaker: A. Prior, SIMULIA Dassault Systems, Providence, R.I., USA ............................................. 67

**Paper 27**

**Virtual Testing of Composites**  
Speaker: W. Wilson, FOKKER Landing Gear B.V., Helmond, The Netherlands ............................. 74

**Paper 67**

**Structural Validation of FEM Simulations on a Safety-critical CFRP Aircraft Component**  
Speaker: A. Verhuizen, ASCO Industries, Belgium ................................................................. 83
SESSION 2

SESSION 2A: TAPAS

Paper 29
The TAPAS project: Introduction by Ingrid Houthuysen, Agentschap NL (Dutch government agency of the ministry of Economic Affairs, Agriculture and Innovation)
Speaker: A. Offringa, FOKKER Aerostructures BV Hoogeveen, The Netherlands .........................92

Paper 30
TAPAS: Induction Welding of Thermoplastic Stiffeners on large Fuselage Panels
Speaker: M. van Wijngaarden., KVE BV., NL-2497GB - Den Haag, The Netherlands....................93

Paper 36
TAPAS: Thermoplastic stiffened Panels for Fuselage Application
Speaker: B. Beral, AIRBUS France SAS F-31707 Biagnc Cedex ..............................................101

Paper 63
AFP for Thermoplastic tailored Blanks and Stringers
Speaker: M. Verkade, AIRBORNE Technology Centre BV, Den Haag, The Netherlands ..............105

SESSION 2B: REPAIR

Paper 58
Design and Manufacture of Bonded Composite Repairs
Speaker: R.J.C. Creemers, National Aerospace Laboratory, NLR, NL-8316 PR Marknesse ............114

Paper 62
Repair of Primary Aircraft Structures with Advanced Hybrid Materials
Speaker: J.W. Gunnink, GTM Advanced Products - & Delft University of Technology ................122

Paper 73
Low Cost Tools for Large Repairs Structures, Prototypes or One-Off Productions
Speaker: F. Collombet, Toulouse University Institut Clément Ader, F-31077 Toulouse ............123

Paper 84
Composite Repairs – Regulation (Bonded Structure/Repair/Extended Repairs)
Speaker: S. Waite, EASA European Aviation Safety Agency, D-50452 Köln, Germany .............131

SESSION 3

SESSION 3A: AUTOMATION 1

Paper 16
Laser assisted Processing of Thermoplastic Composite Structures
Speaker: C. Kok, AFPT BV., Sprang-Capelle, The Netherlands ..................................................162

Paper 23
A New Fibre Placement Technology for flexible 2D and 3D Hybrid Preforms
Speaker: L. Friedrich, Faserinstitut Bremen e.V., D-28359 Bremen, Germany .......................163

Paper 32
Thermoforming Process with new Tempered Tooling Design
Speaker: C. Peters, Faserinstitut Bremen e.V., D-28359 Bremen, Germany ..........................177
Paper 52
Press Forming of tailored CFRTP Products
Speaker: S. Hooning, Dutch Thermoplastic Components BV., Almere, The Netherlands .......... 185

Paper 89
Fiber Placement for AP-PLY Composite Components
Speaker: M. Nagelsmit, National Aerospace Laboratory NLR., NL-8316 PR Marknesse The Netherlands ................................................................. 195

SESSION 3B: DESIGN Chairman L. Cohen

Paper 13
Nondestructive Characterization of the Elastic Properties of Orthotropic Composites with Ultrasound
Speaker: J. Degrieck, University of Gent, Material Science & Engineering Dept. B-9052 Zwijnaarde, Belgium ......................................................................................... 204

Paper 14
Low-Cost Composite Structures: Pitfalls and How to avoid them
Speaker: G. Ghilai, Israel Aerospace Industries LTD., Ben Gurion Internat. Airport ................. 212

Paper 34
Flexible Matrix Composites for use in Pneumatic Actuation Tubes for Morphing Aero-Structures
Speaker: J. Kirn, EADS Innovation Works Aeromechanic Systems, D-85221 Ottobrunn .......... 220

Paper 40
Towards Structural Fatigue Evaluation in Composite Structures
Speaker: R.C. Alderliesten, Delft University of Technology, Delft, The Netherlands .............. 228

Paper 41
Application of Bonded Metal and Hybrid Straps for improving the Damage Tolerance of Thin Metallic Skins
Speaker: R. Rodi, Delft University of Technology Delft, The Netherland ................................ 238

KEY-NOTE 2

KBW, Knowledge Based Engineering, the missing Link in Design Evolution
Speaker: Mr. M.J.L. van Tooren ................................................................................. 249

SESSION 4

SESSION 4A: INFUSION & RTM Chairman A. Mills

Paper 08
Fast Impregnation of Complex Shapes for the Manufacturing of High Performance Composites and its associated Tooling
Speaker: C. Dransfeld, Fachhochschule Nordwest-Schweiz, CH-5210 Windisch ............... 251

Paper 10
Quality Assurance System for Aircraft Structural Profile Preforms
Speaker: A. Miene, Faserinstitut Bremen e.V. D-28359 Bremen ......................................... 259

Paper 37
Application of Composite Material for the Manufacturing of Large Transport Aircraft Slats
Speaker: B. Poularen, SONACA SA., B-6041 Gosselies, Belgium ...................................... 267
Why Preforming can be kept simple: A Comparison of RTM and SQRTM Out-of-Autoclave Processes for the Manufacturing & Qualification of Integrated Structures
Speaker: A. Bertin, COEXPAIR SA., B-5190 SPY

SESSION 4B: THERMOPLASTIC
Chairman H. Bersee

Paper 12
Macro-Mechanical and Microscopic Study of the fatigue Damage Behaviour of a Carbon Fabric/PPS Thermoplastic Composite
Speaker: W. Van Paepegem, University of Gent, Materials Science Dept., B-9052 Gent

Paper 39
Thermoforming of Sandwiches into Complex Shapes
Speaker: J. Krena, LETOV Letecka Vyroba Ltd., Latecoere Group, CZ-199 02 Praha 9 - Letnany

Paper 43
AFP Technologies for High Performance Thermoplastics: Characterization of Mechanical Performance and Output Rate
Speaker: H.P.J. de Vries, National Aerospace Laboratory, NLR, Amsterdam, The Netherlands

Paper 48
Thermoplastic Compound Compression Molding
Speaker: A. Jongbloed, Kok & Van Engelen NL-2497GB Den Haag, The Netherlands

SESSION 5
Chairman M. Van Tooren

Paper 25
Test-Analysis Correlation Environment for Composite Aerostructures
Speaker: B. Peeters, LMS International, B-3001 Leuven, Belgium

Paper 51
Design and Analysis of Modified Support Structure for a Star Sensor of a Satellite
Speaker: S. Shreyas, R.V. College of Engineering., Bangalore – 560059, Karnataka, India

Paper 85
Multidisciplinary Design Optimization and Knowledge-based Engineering for Integrated Wing Design
Speaker: R. d'Ippolito, NOESIS Solutions B-3001 Leuven, Belgium

SESSION 5B: TOOLING
Chairman E. Shahidi

Paper 53
Carbon Foam for Aerospace Composite Tooling: Analysis of Stress in Foam
Speaker: K. Alam, Ohio University, Dept. of Mechanical Engineering, Athenes, OH 45701

Paper 79
New Molding Technology for Carbon Fiber Applications using Induction Heating
Speaker: J. Fritsch, ROCTOOL, F-73375 Le Bourget-du-Lac, Cedex, France

Paper 81
Out of Autoclave Composite Tooling for in Autoclave use
Speaker: E. Shahidi, Umeco Composites, ACG Group
### SESSION 6

#### SESSION 6A: AUTOMATION 2

**Chairman C. Weimer**

**Paper 21**

**Modelling of Automated Layup Processes for Improved Efficiency and Sustainability**

Speaker: D. Lukaszewicz, Bristol University Bristol, UK ................................................................. 403

**Paper 46**

**Novel Automation Technologies for an efficient Production of Fiber Reinforced Plastics (FRP) Structures at a Glance**

Speaker: J. Schilp, Technische Universität München, IWB Anwenderzentrum Augsburg D-86153 Augsburg ......................................................................................................................... 411

**Paper 76**

**Automated high Rate Manufacture of Automotive Composites Structures via Compression Moulding (ARMATURE)**

Speaker: A. Ryder, Umeco Composites Structural Materials, Heanor, Derbyshire, UK ............... 419

**Paper 28**

**Prospective Strategies for Composite Production**

Speaker: A. Schnabel, RWTH Aachen University Institut für Textiltechnologie, Aachen, Germany .......................................................................................................................... 443

### SESSION 6B: NEW MATERIALS

**Chairman I. Verpoest**

**Paper 11**

**All-aromatic Liquid Crystal Polymers for Cryogenic and High-Temperature Composite Applications**

Speaker: T.J. Dingemans, Delft University of Technology Faculty of Aerospace Engineering, Delft, The Netherlands ............................................................................................................. 457

**Paper 18**

**Processing and Characterization of PETI Composites Fabricated by High Temperature VARTM**

Speaker: S. Ghose, National Institute of Aerospace Hampton, VA 23666, USA ......................... 465

**Paper 47**

**Thin Ply Technology for High Performance Composite Structures**

Speaker: G. Rocher & T. Ricard, North Thin Ply Technology, CH-1305 Penthalaz-Cossonay, Switzerland .......................................................................................................................... 473

**Paper 80**

**Suppression of Damage Development in Carbon Fiber/Epoxy Composites with Carbon Nanotubes**

Speaker: L. Gorbatikh, KU University Leuven, MTM Department, B-3001 Heverlee, Belgium ..... 481

### SESSION 7

#### SESSION 7A: SPACE 2

**Chairman R. Bureau Dacal**

**Paper 45**

**Composite Structures Developments in ESA for the Future Launcher Preparatory Programme**

Speaker: D. Jaredson, European Space Agency ESA, Noordwijk, The Netherlands ............... 490
Development of a CFRP Base-Plate for the future ARIANE Launchers’ Engine Thrust Frame
Speaker: J. Fatemi, Dutch Space BV., NL-2303 DB Leiden, The Netherlands

Out-of-Oven Manufacturing of Large Integrated Structures using Thermoplastic Composite Materials
Speaker: C.M. Ó Brádaigh, Eire Composites Teo., Indreabhán, Co. Galway, Ireland

SESSION 7B: JOINING & ASSEMBLY
Chairman K. Muijs

Optimizing Ultrasonic Welding of Carbon Fiber Reinforced Polyetherimide (CF/PEI)
Speaker: M. Barroso Romero, Technical University of Delft, Faculty of Aerospace Engineering, NL-2629 HS Delft

Newest 3-D Sandwich Panel Manufacturing, Design & Application Technology - Focus on Weight, Strength and Thermal Expansion
Speaker: J. Kustermans, ACROSOMA NV., B-9160 Lokeren, Belgium

Investigation of the Properties and Failure Mechanisms of a Damage Tolerant 3D-Reinforced Joint for Lightweight Structures
Speaker: A.C. Nogueira, Fraunhofer Institut, Projektgrupper Funktionsintegrierter Leichtbau D-86159 Augsburg, Germany