



Introduction of Liquid Resin Molding Project





Scope of Project



- Create an initial control criteria philosophy
- Develop criteria for procurement and processing
- Create draft documents for procurement and processing
- Solicit industry input on draft criteria
- Revise the criteria based on industry input
- Release through the FAA Technical Center



The LRM Team



- Industry Team

- Drafters

- Gregg Bogucki
- Larry Gintert
- John Bayldon

- Reviewers

- Stephen Ward
- Will McCarvill
- John Tomblin

- FAA Team

- Lester Cheng
- David Ostrodka
- Evangelia Kostopoulos
- Peter Shyprykevich
- Curtis Davies
- Larry Ilcewicz



Liquid Resin Molding (LRM) Processes



- Types of Processes covered
 - RTM
 - VARTM
 - RFI
 - Can apply to traditional wet lay-up processes
- Materials
 - Constituents – resin, fiber, tackifiers, cores, stitches/pins, special forms;
 - Consumable materials)
- Processes
 - Fiber processing, ply cutting, lay-up, pre-forming, de-molding, post-mold operations



LRM Material Procurement



- Procurement considerations similar to that of the prepreg material producer
- All constituent materials (including fiber sizing, tackifiers, additives, pins, stitching, etc.) need to be controlled via material specs. with out time, packaging, & other critical parameters properly controlled & documented.



LRM Material Procurement



- Cores, fly-away mandrels (density and stability), consumable/wash-out tooling
- Tooling and consumable materials including release agents, cleaning techniques, sealing techniques, bagging materials/bleeders, bagging techniques, and flow media



LRM Material Procurement



- Neat resin controls are numerous and dependant on material forms
 - Hot melt, heat-activated ingredients, degassed liquid resin, viscosity, visual/color, cure parameters, other parameters
- Tackifiers
 - Liquid/aqueous and powder
 - Physical parameters (powder size, viscosity), cure parameters, ingredients/chemistry, other
 - Resin compatibility



LRM Processing



- Fiber processing
 - Braiding, specialty weaving, stitching, pinning, hybrids, special forms (T's, H's, etc.), automation, consumables
- Lay-up and Preforming
 - Special tooling/fixturing for complex shapes
 - Special details (braids, cores, T's, noodles, etc.)
 - Ply cutting and handling – multi-ply packs/kits
 - Preform locating techniques (tooling pins, features)
 - Tackifiers, pins, stitches, etc.
 - Special tooling/fixtures and processes



LRM Processing



- Tool Closure, Injection and Cure
 - Gap measurement, vacuum check, bag check
 - Resin injection/infusion sequence/cycle
 - Critical heating areas, heat-activated ingredients/cure agents (pre-form=filter)
 - Heat-up
 - Vacuum (hard)
 - Inject/infuse resin
 - Bleed technique/sequence, bag check
 - Ramp-up, back pressure
 - Plumbing diagram (consumable plumbing, preheater)



LRM Processing



- Demolding
 - Mandrel extraction - critical sequences
 - Wash-out mandrels
 - Tooling holes/fixturing features
 - Neat resin sample or witness laminate
 - Tool cleaning and prep
- Post-molding Operations
 - Typical but usually more complex



Material Qualification & Equivalency of Polymer Matrix Composite Material Systems




DOT/FAA/AR-00/47
Office of Aviation Research
Washington, D.C. 20591

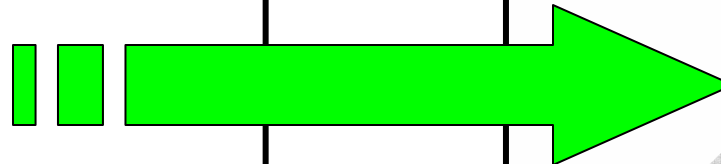
Material Qualification and Equivalency for Polymer Matrix Composite Material Systems

April 2001
Final Report

This document is available to the U.S. public through the National Technical Information Service (NTIS), Springfield, Virginia 22161.



U.S. Department of Transportation
Federal Aviation Administration




DOT/FAA/AR-03/19
Office of Aviation Research
Washington, D.C. 20591

Material Qualification and Equivalency for Polymer Matrix Composite Material Systems: Updated Procedure

September 2003
Final Report

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U.S. Department of Transportation
Federal Aviation Administration

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Update Material Qualification & Equivalency Documents



- Original MQ&E
 - DOT/FAA/AR-00/47
 - Reduced sampling on certain properties
 - Original AGATE methodology
- Updated MQ&E
 - DOT/FAA/AR-03/19
 - Full sampling on all Properties(3 Batches)
 - Add statistical check for pooling
 - Additional statistical methodology based on MIL-HDBK-17 and user input
 - Corrected errata

Updated document due to be released in September 2003



Small Group Discussion

Group A

Group B

Group C

<p>Group A Discussion of Current Practice, Needs and Further Actions for LRM Procurement Specifications</p>	<p>Group B Discussion of Current Practice, Needs and Further Actions for LRM Processing Specifications</p>	<p>Group C Discussion of Current Practice, Needs and Further Actions for Fabric Procurement Specifications</p>
<p>Group A Discussion of Current Practice, Needs and Further Actions for Fabric Procurement Specifications</p>	<p>Group B Discussion of Current Practice, Needs and Further Actions for LRM Procurement Specifications</p>	<p>Group C Discussion of Current Practice, Needs and Further Actions for LRM Processing Specifications</p>
<p>Group A Discussion of Current Practice, Needs and Further Actions for LRM Processing Specifications</p>	<p>Group B Discussion of Current Practice, Needs and Further Actions for Fabric Procurement Specifications</p>	<p>Group C Discussion of Current Practice, Needs and Further Actions for LRM Procurement Specifications</p>



Division of Workshop for Group Discussions



- Group A

- Shun-Ichi Bandoh
- Geoffrey Wood
- Lester Cheng
- Mark James
- Richard Monschke
- Cheol-Won Kong
- Cheryl Bowman
- Laura Petrescue
- Pierre Harter
- Mark Chris
- Mary Pacher
- Atsushi Harada
- Richard Fields
- Gregory Dishian
- Mike Braley
- Dennis Cicci
- Philip Chung
- Scott Lindsay
- Chris Ridgard
- Michael Stuart
- Steven Peake
- Laura A. Fournier
- John Bayldon
- Emmanuel Pons
- Scott Reeve
- Jim Krone
- Bob Stratton
- John Bayldon
- Kousuke Yoshimura
- Dusty Penn

- Group B

- Kim Hyonny
- Dave McClenahan
- John Ayorinde
- Mark Freisthler
- Kennedy Jones
- David Ostrodka
- Ho-Sung Lee
- Gary Roberts
- Alain Douchant
- Peter Shyprykevich
- ULF Breuer
- Dan Ruffner
- Paul Brey
- Hiroshige Kikukawa
- Melanie Violette
- Cynthia Cole
- Leigh Sargent
- Mei Tian
- Rex Kay
- Paul Myslinski
- Roger Francombe
- Shreeram Raj
- George Lallas

- Group C

- John Tomblin
- Sailen Chatterjee
- Bob Stratton
- Fred Guerin
- Angie Kostopoulos
- Henry Offermann
- Roderick Martin
- Andrew Johnston
- Carl Matson
- Phillip Larson
- Werner Henkel
- Matthew Baxter
- Molly Stone
- Carl Rousseau
- John Adelman
- James Paulson
- Craig Schiffman
- Alan Norwid
- Dave Stresing
- Barry Meyers
- Halvar Y. Loken
- Tom Jonas



Small Group Discussion



- Intended to allow better interaction between the criteria drafters and workshop participants
- Group A will be in Executive Forum, Group B in Burton (Lower Level) and Group C in Banks (Lower Level)
- Provides informal meeting atmosphere for honest discussion of comments and concerns
- Drafters will record all comments for later review and action



FAA Bonded Structure Projects



- After last discussion group meeting all will return to the Executive Forum at 4:00 PM
- Results of the discussion groups will be consolidated this evening and be presented tomorrow
- At 4:00 PM will review FAA projects on bonded structures
- This will give you background for the subject to be discussed Thursday morning on FAA plans in bonded structure