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
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
<table>
<thead>
<tr>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
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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
  - Sainen 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 Adelmann
  - 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