

# Update on CMH-17 Volume 5 Ceramic Matrix Composites

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# Overview

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- CMH-17 Mission and Vision
- Format / Content / History Summary
- Volume 5
- Linking CMH-17 to FAA
- Publication
- Working Groups

# Composite Materials Handbook-17



## CMH-17 Mission

The Composite Materials Handbook (CMH) organization creates, publishes and maintains proven, reliable engineering information and standards, subjected to thorough technical review, to support the development and use of composite materials and structures.

## CMH-17 Vision

The Composite Materials Handbook will be the authoritative worldwide focal point for technical information on composite materials and structures.

- Volunteer organization that creates, publishes, and maintains engineering information and standards to support the use of composite materials and structures
- Statistically analyzed composite data and guidance

# Structure of Handbook

- Volume 1 Polymer Matrix Composites: *Guidelines for Characterization of Structural Materials*
- Volume 2 Polymer Matrix Composites: *Material Properties*
- Volume 3 Polymer Matrix Composites: *Materials Usage, Design and Analysis*
- Volume 4 Metal Matrix Composites
- Volume 5 Ceramic Matrix Composites
- Volume 6 Structural Sandwich Composites (Initial Release)

# Handbook History



- 2017** Release of Vol. 5A – CMH-17 Handbooks
- 2013** Release of Vol. 6, 4B – CMH-17 Handbooks
- 2012** Release of Volumes 1-3 Rev G – CMH-17 Handbooks
- 2006** Transition from Army to FAA as Primary Sponsor  
Established Roadmap to New Composite Materials Handbook “Release G”
- 2004** Joint Meetings with CACRC, SAE-P17
- 2002** MIL-HDBK-17 Vol. 1F, 2F, 3F, 4A, 5  
Commercial Publication through ASTM
- 1999** MIL-HDBK-17 Vol. 2E, Vol. 4
- 1998** Joint Meetings with ASTM D-30
- 1997** MIL-HDBK-17 Vol. 1E, 3E
- 1996** CMC Coordination Group Formed
- 1993** MMC Coordination Group Formed
- 1990** First PMC Data Set Approved
- 1988** MIL-HDBK-17B Vol. 1 Release
- 1986** Secretariat Added
- 1978** Coordination Group Formed
- 1971** MIL-HDBK-17A Plastics for Aerospace Vehicles
- 1959** MIL-HDBK-17 Plastics for Air Vehicles
- 1943** ANC Bulletin 17 Plastics for Aircraft

Last CMC  
handbook issued  
~15 years ago

PMC: Polymer Matrix Composites  
MMC: Metal Matrix Composites  
CMC: Ceramic matrix Composites

# What is the Importance of CMH-17 Volume 5— Ceramic Matrix Composites ?

**CMH-17**  
COMPOSITE MATERIALS HANDBOOK

## *Ceramic Matrix Composite (CMC) Components For Commercial Aircraft Require Certification*

- CMC components have begun to enter service in commercial aircraft.
- A wide range of issues must be addressed prior to certification of this hardware.
- The FAA (Federal Aviation Administration) is working with the CMC Community to identify the tasks required to support these components and to establish a timeframe for certification.



**Federal Aviation  
Administration**

# What is the Importance of CMH-17 Volume 5— Ceramic Matrix Composites? *(continued)*



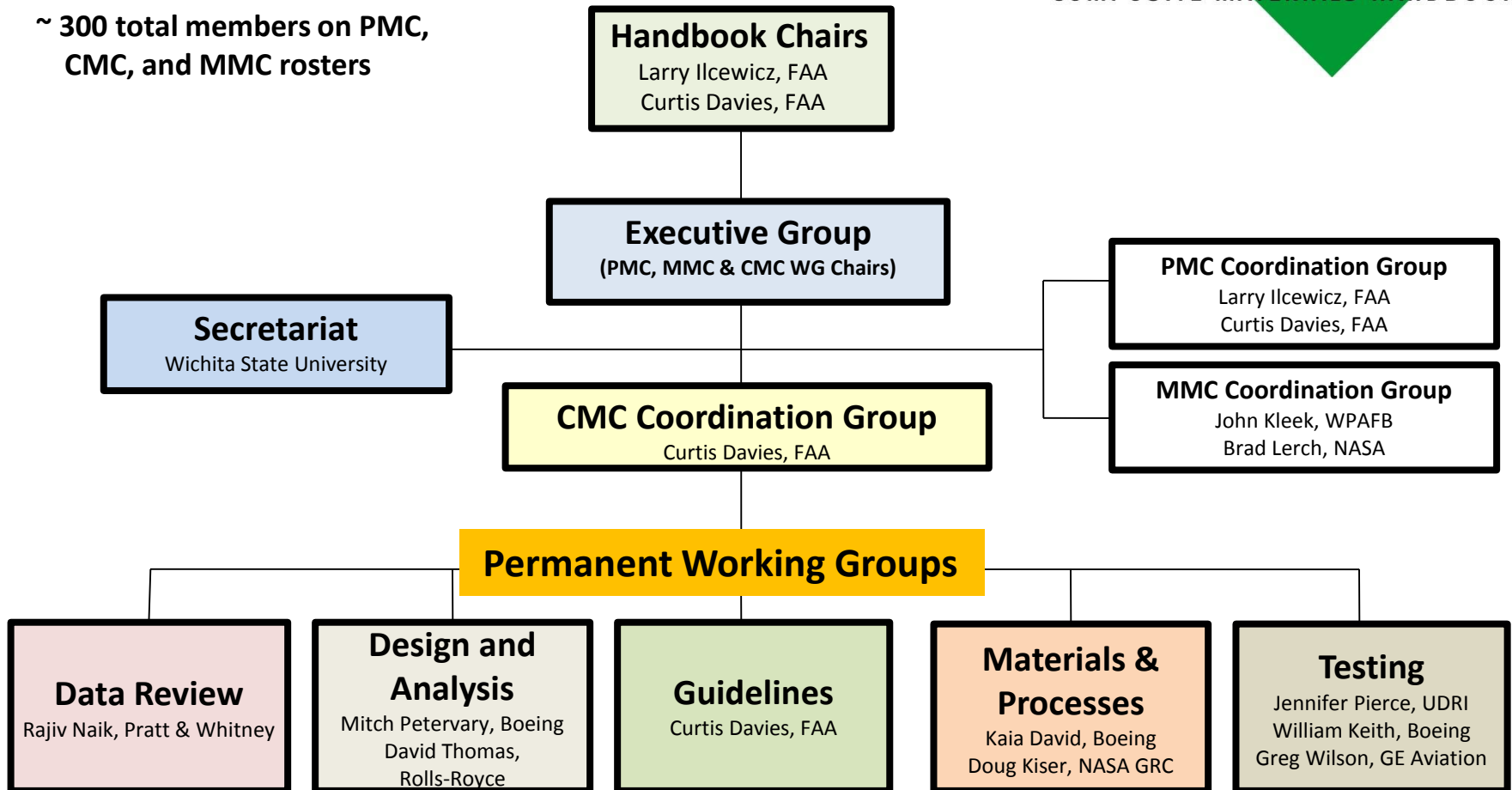
## **Ceramic Matrix Composite (CMC) Components For Commercial Aircraft Require Certification**

- The Composite Materials Handbook-17, Volume 5 on ceramic matrix composites is being revised to support FAA certification of CMCs for hot structure and other elevated temperature applications.
- The handbook supports the development and use of CMCs through publishing and maintaining proven, reliable engineering information and standards that have been thoroughly reviewed.
- Volume 5 will contain detailed sections describing:
  - CMC Materials / Processing
  - Design / Analysis Guidelines
  - Testing Procedures
  - Data Analysis and Acceptance

# The CMH-17 Organization



~ 300 total members on PMC,  
CMC, and MMC rosters



**Working groups are meeting at this conference on Wed. from 5 - 6:30 pm and on Thurs. from 12-1:30 pm (pizza lunch available)**



# Volume 5 Handbook Outline

- Handbook grouped into 4 sections – each linked to specific working groups
  - *Part A: Introduction and Guidelines*
    - Materials and Processes WG
  - *Part B: Design Supportability*
    - Design & Analysis WG
  - *Part C: Testing*
    - Testing WG
  - *Part D: Data Requirements and Data Sets*
    - Data Review WG

# Linking CMH-17 to FAA Certification

Provide standardized data and information for acceptance by authorities by:

- Establishing Active CMC Working Groups
  - Sessions for each WG
  - Regular WG Telecons
  - Continually review WG charters and make necessary changes/edits
  - Work on key tasks identified and review periodically
- Periodically holding coordination meetings to discuss critical issues
  - CLEEN consortium/Cocoa Beach meetings
  - Working group meetings in conjunction with other CMC events

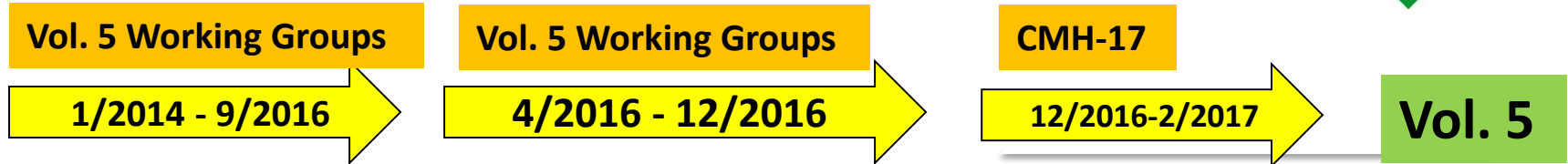
# FAA References / Publications



- The most comprehensive means of compliance for composite structure is in Advisory Circular (AC) 20-107 “Composite Aircraft Structure”
  - Additional guidance in other ACs and Policy Statements
  - Published guidance is “one means, but not the only means” to meet the regulations; however it is typically the fastest and easiest
- FAA guidance relies heavily upon industry publications such as CMH-17
  - May build upon information in CMH-17 or reference it, as shown below

(2) Existing references (e.g., The Composite Materials Handbook (CMH-17) Volumes 1 and 3, FAA Technical Report DOT/FAA/AR-03/19), addressing composite qualification and equivalence and the building block approach, provide more detailed guidance regarding batch and test numbers and the appropriate statistical analysis up to laminate level. Changes at higher

# CMH-17 Vol. 5 Publication Timeline



- Initial drafts created
- Circulate within Working Groups
- Approved at the Working Group level
- Yellow Pages – multiple review cycles (~6 weeks each)
- Update sections based on Coordination Group feedback
- Working draft updated and posted on website

- Testing and Design YPs are currently out for review - deadline is 12/16
- Final M&P Sections to be sent out this month.

- Final review
  - Copyright releases
  - Consistency review
  - Technical review
- DoC Review
- PUBLICATION

# Working Group Progress

- Materials and Processes
- Design and Analysis
- Testing
- Data Review

# Materials & Processes Working Group



## Goals:

- To provide information on the composition, fabrication, quality control, and characterization of CMC engineering materials and structures.
- To provide a comprehensive overview of ceramic matrix composite (CMC) technology, outlining the types of CMCs, commercial aircraft applications, benefits, methods of fabrication, quality control, and supportability.
- To define the essential elements of information on composition, structure, and processing of CMCs necessary to support design, selection, fabrication, certification, and utilization of CMC structures
- To specify the methods and procedures to be used in the characterization of ceramic matrix composites, their coatings, and their constituents. Efforts will be coordinated with the Testing Working Group.

# Design and Analysis Working Group



## Goals:

- To provide information on design and analysis methods and options, the level of substantiation required, and presentation formats required in validation and certification processes
- To ensure future relevancy of the handbook by maintaining an up to date survey of the current state of the art capabilities within the design, analysis and lifing communities for CMCs

## Challenges:

- Creating a document that contains meaningful and valuable content for both industry and government entities while honoring the highly proprietary nature of corporate design practices

# Testing Working Group

## Vision Statement:

- To be the primary and authoritative source for recommended/required methods for testing characterization of CMCs & their constituents

## Goals:

- To identify appropriate existing consensus standard test methods for CMCs and their constituent materials
- To assist in the identification/development of appropriate standard test methods for CMCs and their constituent materials, where no such standards exist



# Data Review Working Group

## Vision Statement:

- Formulate guidelines & requirements for submission (batch size, etc.), documentation, analysis, and review for all CMC data that are submitted for inclusion in the handbook.
- Review the data and the analysis of data sets that are submitted for inclusion in the handbook.
- Develop formats for presentation of data in the handbook and for its storage in electronic databases.
- Develop and document statistical methods for pooling and analysis of CMC data.

## Key Issues:

- Export classification of data that is submitted to the handbook
- Storage and dissemination of ITAR data
- Appropriate electronic Database choice for data storage and dissemination (with export restricted access as needed)
- Sources of new CMC data

# CMC Property Database

*Currently not ITAR restricted*

Composite Name	Composite Description	Producer
9/99 EPM SiC/SiC	Sylramic™/BN-Si/MI SiC	<b>Ceramic Composite Products</b>
Enhanced SiC/SiC	CG Nicalon™/Carbon/CVI SiC	
Carbon/SiC	T300/Carbon/CVI SiC	
Hi-Nicalon/MI SiC	Hi-Nicalon™/BN/MI SiC	
AS-N720-1	Nextel 720/alumino-silicate	<b>COI Ceramics</b>
Sylramic S-200	CG Nicalon™/BN/PIP Si <sub>3</sub> N <sub>4</sub> -SiC	

- New CMC data to be included in future revisions
- Currently working with organizations to obtain data

# Summary

- The Composite Materials Handbook-17, Volume 5 on ceramic matrix composites is being revised to support FAA certification of CMCs for hot structure and other elevated temperature applications
  - CMC Materials / Processing
  - Design / Analysis Guidelines
  - Testing Procedures
  - Data Analysis and Acceptance
- WGs are currently seeking volunteers / input for future revisions
- **Publication Spring 2017 through SAE International**

# Summary



Individuals interested in contributing to these groups should please forward their contact information to

[Rachael Andrulonis \(rachael@cmh17.org\)](mailto:rachael@cmh17.org)

and/or talk to any Working Group member

*Working groups are meeting at this conference on Wed. from 5 - 6:30 pm and on Thurs. from 12-1:30 pm (pizza lunch available)*