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Composite Initiatives involving EASA

Introduction to CMH17 updates

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Introduction to CMH-17 Updates
Advances in CMH-17 content for PMC

Presentation by:

Simon Waite, Senior Expert Materials, EASA
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EASA Webinar
26 March 2025

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Agenda – Part 2

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Introduction to CMH-17 Handbooks — 10’

- Historical Overview
- Overview of CMH-17 rev H

CMH-17 rev H – Volume 3 Chapter 3 — 5’

- Aircraft Structure Certification and Compliance - Overview

CMH-17 rev H – Volume 3 Chapter 12 — 35’

- Damage Resistance, Durability and Damage Tolerance - Overview
- Focus on some technical contents:
  - Damage Threat Assessment
  - Categories of Damage & SDC
  - Hybrid Issues & Thermal Loads
  - Application Case Studies
  - Fatigue and Aging

CMH-17 rev H – Volume 6 (Provisional) — Shifted to a dedicated session

- Structural Sandwich Composites – Vol 6 Rev A Overview

Q&A Session — 10’

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Advances in CMH-17 Content for Polymer Matrix Composites

Introduction to CMH-17 Handbooks

Authors:
Dr Larry Ilcewicz, Chief Scientist and Technical Advisor for Composites, FAA
Cindy Ashforth, Senior Technical Specialist for Composites, FAA

Presented during IRCWG Warsaw, August 2024

Historical Overview – IRCWG Meeting, Initiatives and Outcomes

Shared Matl. Data/Equiv.
Structural Substantiation
RC F&DT ARAC
Matl./Process Spec. Control
Bonded Structure
Workforce Educational Standards Certification Tutorial and Maintenance
AC 20-107B
AMC 20-29

2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010

Initial Meeting (Sept., 2005/ Toulouse, France)

2nd Meeting (March 2006/ Seattle, WA, US)

1st Damage Tolerance & Maintenance Workshop
August, 2006, CMH-17, Chicago, US

2nd Damage Tolerance & Maintenance Workshop
July 2007, SAE CACRC, Amsterdam, Netherlands

3rd Damage Tolerance & Maintenance Workshop
June 2009, SAE CACRC, Tokyo, Japan

AIRBUS

Federal Aviation Administration

BOEING

EASA
European Union Aviation Safety Agency

Workforce Educational Standards
Structures and Manufacturing

CMH-17, Vol. 3, Chap. 12 – 14, Rev G
Bonded Repair
HEWABI
Main Final Report §25.571 ARAC
Extension Final Report §25.571 ARAC
2021 Bonded Repair ARAC Report
CMH-17, Vol. 3, Rev H
2025 Structural Mod SAE ARP

2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025

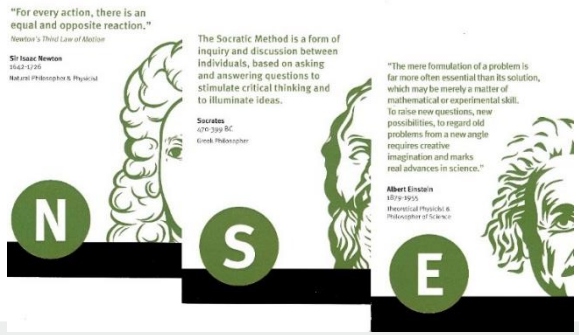
3rd Meeting (Feb. 2011/Seattle)
6th Meeting (Sept. 2012/Toulouse)
6th Meeting (July 2013/Wash DC)
8th Meeting (April 2015/SC, US)
10th Meeting (July 2017/Ottawa)
12th Meeting (Feb. 2020/Seattle)
13th Meeting (May 2023/Toulouse)
14th Meeting (June 2024/Charleston)

4th Damage Tolerance & Maintenance Workshop
May 2011, Atlanta, GA

4th Meeting (Sept., 2011/Koln)
5th Meeting (April 2012/Tukwila)
7th Meeting (May 2014/Koln)
9th Meeting (Sept. 2016/Toulouse)
11th Meeting (June 2018/Belfast)
CMH-17, Design TG
CACRC Alternate Repair M&P Initiative Started
Sandwich Disbond (2023 Workshop)

5th Damage Tolerance & Maintenance Workshop
Sept. 2015 §25.571 ARAC, Montreal, Canada

NIAR WICHITA STATE UNIVERSITY
NATIONAL INSTITUTE FOR AVIATION RESEARCH



Transport Canada

BOMBARDIER

SPIRIT AEROSYSTEMS

Future Thoughts

- We need high-rate manufacturing
  - Stringent material & process controls
  - Manufacturing-induced performance benefits?
- Advanced structural scaling knowledge
- Combined building block awareness
  - How to advance efficiency, without penalties?
- How to ensure knowledge transfer?

Other Items in Work

- CMH-17, Vol. 3, Post-Rev. H
- CMH-17, Vol. 6, Rev. A
- CACRC Alternate Repair Material
- Future of CMH-17 (expanded reach-outs)
- AC 20-107C

What is CMH-17?

About CMH-17

The Composite Materials Handbook (CMH-17) provides information and guidance necessary to design and fabricate end items from composite and non-metallic additively manufactured (AM) materials. Its primary purpose is the standardization of engineering methodologies related to testing, data development, reduction, and reporting of current and emerging composite and non-metallic AM materials. In support of this objective, the handbook includes material properties that meet specific data requirements. In addition to providing material data and instructions on how to develop it, the Handbook provides industry best practices for design, manufacture, substantiation, and sustainability. The Handbook therefore constitutes an overview of composites and non-metallic AM technology and engineering, an area which is advancing and changing rapidly. As a result, the document is constantly being updated as sections are added or modified to reflect advances in the state-of-the-art.

Mission

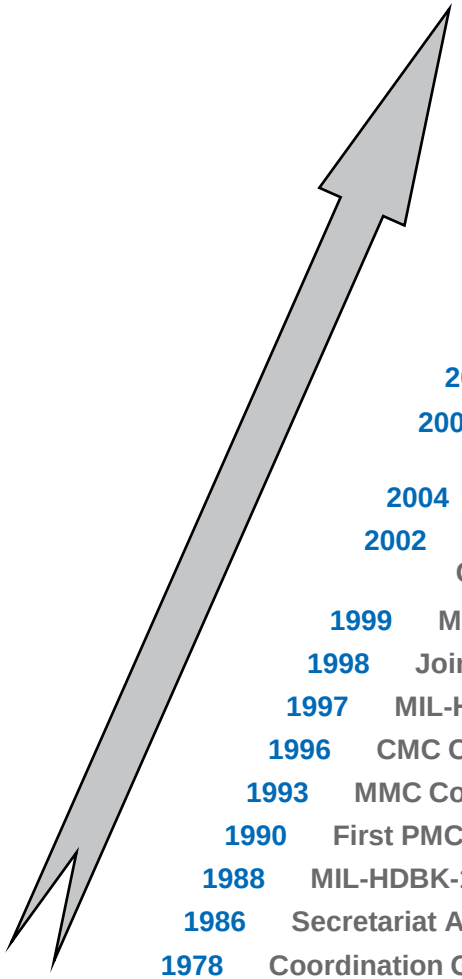
The Composite Materials Handbook organization creates, publishes and maintains proven, reliable engineering information and standards, subjected to thorough technical review, to support the development and use of composite and non-metallic additively manufactured materials and structures.

Vision

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

This summary does not match what you will currently find on cmh17.org, but reflects current practices. It is being discussed in 2024 coordination meetings for member acceptance in the ***Future of CMH-17***.

Handbook History



2024 and Beyond Release of Vol. 5 Rev B (CMC), Vol 6 Rev A (Sandwich), and Vol 7 Initial Release (Non-Metallic AM)

2024 Release of Vol. 3H – CMH-17 Handbook PMC: Materials Usage, Design, and Analysis

2022 Release of Vol. 1H – CMH-17 Handbook Guidelines for Characterization of Structural Materials

2018 AM Coordination Group Formed

2018 Release of Vol. 2H – CMH-17 Handbook PMC: Material Properties

2017 Release of Vol. 5A – CMH-17 Handbook for CMC

2013 Release of Vol. 6, 4B – CMH-17 Handbooks for sandwich structure and MMC, respectively

2012 Release of Volumes 1-3 Rev G – CMH-17 Handbooks for PMC

2005 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

PMC: Polymer Matrix Composites
MMC: Metal Matrix Composites
CMC: Ceramic Matrix Composites
AM: Additive Manufactured Materials

What is CMH-17?

- CMH-17 stands for the Composite Material Handbook, which is supported by a Composite Material Handbook Organization
- The Handbook itself consists of 6 volumes (with a 7th planned on non-metallic additive manufacturing)
- The Handbook content was originally in Mil-Hdbk-17 (Vol 1-5) and Mil-Hdbk-23 (Vol 6) but the military stopped supporting content
- The FAA took over management of the Organization and Handbook and adopted the new name
  - The Handbook is directly referenced in regulation (§ 2x.613) and guidance, such as AC20-107B
    - The handbook provides significant details and background information on the ***What, Why and How*** of composite materials to support succinct MOC in FAA guidance and elsewhere
  - The FAA provides annual funding to the Secretariat, together with revenues from handbook sales
  - FAA personnel can attend CMH-17 meetings for free (participation must be coordinated with your manager and AIR-645, per Order 8000.376)
  - Handbook volumes are published by SAE (available to FAA employees through the Consensus Standards KSN)
  - Actively working in PMC (includes sandwich structure), CMC, and Non-Metallic AM Materials; MMC is currently Inactive

Vol 7 Non Metallic AM in preparation

VOLUME 1
1 GENERAL INFORMATION
2 GUIDELINES FOR PROPERTY TESTING OF COMPOSITES
3 EVALUATION OF REINFORCEMENT FIBERS
4 MATRIX CHARACTERIZATION
5 PREPREG MATERIALS CHARACTERIZATION
6 LAMINA, LAMINATE, AND SPECIAL FORM CHARACTERIZATION
7 STRUCTURAL ELEMENT CHARACTERIZATION
8 STATISTICAL METHODS

VOLUME 2
1 GENERAL INFORMATION
2 CARBON FIBER COMPOSITES
3 BORON FIBER COMPOSITES
4 GLASS FIBER COMPOSITES
5 QUARTZ FIBER COMPOSITES
APPENDIX A1 CMH-17A DATA

VOLUME 3
1 GENERAL INFORMATION
2 INTRODUCTION TO COMPOSITE STRUCTURE DEVELOPMENT
3 AIRCRAFT STRUCTURE CERTIFICATION AND COMPLIANCE
4 BUILDING BLOCK APPROACH FOR COMPOSITE STRUCTURES
5 MATERIALS AND PROCESSES - THE EFFECT OF VARIABILITY ON COMPOSITE PROPERTIES
6 QUALITY CONTROL OF PRODUCTION MATERIALS AND PROCESSES
7 DESIGN OF COMPOSITES
8 ANALYSIS OF LAMINATES
9 STRUCTURAL STABILITY ANALYSES
10 DESIGN AND ANALYSIS OF BONDED JOINTS
11 DESIGN AND ANALYSIS OF BOLTED JOINTS
12 DAMAGE RESISTANCE, DURABILITY, AND DAMAGE TOLERANCE
13 DEFECTS, DAMAGE, AND INSPECTION
14 SUPPORTABILITY, MAINTENANCE, AND REPAIR
15 THICK-SECTION COMPOSITES
16 CRASHWORTHINESS AND ENERGY MANAGEMENT
17 STRUCTURAL SAFETY MANAGEMENT
18 ENVIRONMENTAL MANAGEMENT
19 SPACE APPLICATIONS
20 ENGINE APPLICATIONS

VOLUME 4
1 GUIDELINES
2 DESIGN GUIDELINES FOR METAL MATRIX MATERIALS
3 MATERIALS PROPERTIES DATA
APPENDIX A TYPICAL PUSHOUT TEST DATA
APPENDIX B RAW DATA TABLES FOR MATRIX MATERIALS
APPENDIX C RAW DATA TABLES FOR METAL MATRIX COMPOSITE MATERIALS

VOLUME 5
1 CMH-17 GUIDELINES AND PROCEDURES
2 INTRODUCTION, HISTORY AND OVERVIEW
3 PROCESSING, CHARACTERIZATION AND MANUFACTURING
4 QUALITY CONTROL
5 APPLICATIONS, CASE HISTORIES AND LESSONS LEARNS
6 DESIGN AND ANALYSIS
7 A REVIEW OF TEST METHODS FOR CERAMIC MATRIX COMPOSITES
8 DATA SUBMISSION, FORMAT AND REQUIREMENTS
9 STATISTICAL METHODS
10 CMC PROPERTY DATA
11 ENGINE APPLICATIONS
APPENDIX A DERIVATION OF THE RESIDUAL STRENGTH REDUCTION EXPRESSIONS FOR LCF AND RUPTURE LOADINGS

VOLUME 6
1 GENERAL INFORMATION
2 GUIDELINES FOR PROPERTY TESTING
3 MATERIAL DATA
4 FABRICATION OF SANDWICH STRUCTURES
5 QUALITY CONTROL
6 DESIGN AND SUBSTANTIATION FOR SANDWICH STRUCTURES
7 INTERNAL LOADS AND STRESSES
8 ANALYSIS AND STRUCTURAL DESIGN
9 DAMAGE ASSESSMENT OF SANDWICH STRUCTURES
10 SUPPORTABILITY
11 SANDWICH DESIGN CASE STUDIES
12 SUPPORTING DATA AND DISCUSSIONS

VOLUME 7
1 CMH-17 AM INTRODUCTION AND GUIDELINES
2 CHARACTERIZATION CONSIDERATIONS
3 EVALUATION OF FEEDSTOCK
4 PROCESSING AND MANUFACTURING
5 QUALITY CONTROL OF PRODUCTION MATERIALS AND PROCESSES
6 MATERIAL TESTING & CHARACTERIZATION FOR SUBMISSION OF DATA TO CMH-17
7 PROPERTY TESTING OF ADDITIVELY MANUFACTURED MATERIALS
8 STATISTICAL METHODS
9 EVALUATION OF AM PARTS
10 ELEMENT LEVEL TESTING
11 DESIGN AND ANALYSIS
12 MAINTAINABILITY AND SUPPORTABILITY
13 APPLICATIONS, CASE HISTORIES, AND LESSONS LEARNED
14 AM PROPERTY DATA

Current Working Outlines

PMC Volume Updates

- **Current PMC Content Handbook**

  Volume 1 Rev H (2022) Polymer Matrix Composites: Guidelines for Characterization of Structural Materials

  Rev H: Numerous test method updates, supporting procedures and updated test matrix recommendations

  Volume 2 Rev H (2018) Polymer Matrix Composites: Material Properties

  Rev H: Numerous test method updates, supporting procedures and updated test matrix recommendations

  Volume 3 Rev G (2012) Polymer Matrix Composites: Materials Usage, Design and Analysis

  Volume 6 IR (2013) Structural Sandwich Composites

- **Major PMC Revisions Planned**

  Volume 3 Rev H (2025)

  Rev H:
  - *Bond process, design, analysis and cert content*
  - *Certification chapter re-write*
  - *Bolted design and analysis updates*
  - *Many new durability & damage tolerance sections*
  - *Supportability (bonded/bolted repair substantiation)*
  - *IPD & technology readiness guidelines*
  - *Crashworthiness (energy management for certification)*
  - *Structural engineering technology course definition*
  - *New chapter on Spacecraft*
  - *New chapter on Engines*

V3 Rev H has ~1500 pages of updated content and is the focus of today's opening presentation

Volume 6 Rev A (2025-2026)

Rev A:
- *Sandwich disbond engineering methods*
- *Sandwich core data*
- *Many other chapter updates (Design, NDI, M&P control, and repair)*

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Volume 3 Chapter 3

Aircraft Structure Certification and Compliance

Author: Simon Waite, Senior Expert Materials, EASA

Presented during IRCWG Warsaw, August 2024

CMH-17 Volume 3 Chapter 3 (V3C3)
AIRCRAFT STRUCTURE CERTIFICATION AND COMPLIANCE

Volume 3 Chapter 3 (V3C3) - AIRCRAFT STRUCTURE CERTIFICATION AND COMPLIANCE

Co-chairs:

Cindy Ashforth, FAA/ANM

Simon Waite, European Aviation Safety Agency (EASA)

A new CMH-17 Chapter to present certification guidance and identify issues of concern when using composite materials and showing compliance with Design, Production, and Continued Airworthiness Requirements. This recognizes the integrated link between all activities in accordance with Safety Management principles.

Supported by significant and evolving CMH-17 Tutorial

'Aircraft Certification with Composite or AM Parts'

CMH-17 Volume 3 Chapter 3 (V3C3)
AIRCRAFT STRUCTURE CERTIFICATION AND COMPLIANCE

Where does V3C3 fit into CMH-17?

V3 Rev. H Content:

1. GENERAL INFORMATION
2. INTRODUCTION TO COMPOSITE STRUCTURE DEVELOPMENT
3. AIRCRAFT STRUCTURE CERTIFICATION AND COMPLIANCE
4. BUILDING BLOCK APPROACH FOR COMPOSITE STRUCTURES
5. MATERIALS AND PROCESSES
6. QUALITY CONTROL OF PRODUCTION MATERIALS AND PROCESSES
7. DESIGN OF COMPOSITES
8. ANALYSIS OF LAMINATES
9. STRUCTURAL STABILITY ANALYSES
10. DESIGN AND ANALYSIS OF BONDED JOINTS
11. DESIGN AND ANALYSIS OF BOLTED JOINTS
12. DAMAGE RESISTANCE, DURABILITY, AND DAMAGE TOLERANCE
13. DEFECTS, DAMAGE, AND INSPECTION
14. SUPPORTABILITY, MAINTENANCE, AND REPAIR
15. THICK-SECTION COMPOSITES
16. CRASHWORTHINESS AND ENERGY MANAGEMENT
17. STRUCTURAL SAFETY MANAGEMENT
18. ENVIRONMENTAL MANAGEMENT
19. LAUNCH VEHICLES AND SPACECRAFT

Note: V3C3 close link to Safety Management WG V3C17

CMH-17 Volume 3 Chapter 3 (V3C3)
AIRCRAFT STRUCTURE CERTIFICATION AND COMPLIANCE

Brief History:

developed new chapter for rev. G in order to:

- provide a focus for the many diverse contributors to CMH-17
  …. the objective is usable safe certified product!
- provide a global industry/regulator interface
- increase awareness of regulatory interests regarding composite issues
- help to standardise the subject
- help identify content for harmonised FAA AC 20-107B/ AMC 20-29 (previous AMC to 2x.603 in EASA)

CMH-17 Volume 3 Chapter 3 (V3C3)
AIRCRAFT STRUCTURE CERTIFICATION AND COMPLIANCE

Brief History continued…

Why there is a need for revision ?

- V3C3 Rev.G has done its job in its current form… much of the content is now redundant

- Harmonised FAA AC 20-107B/ AMC 20-29 published 2009/2010

- significant progress with supporting content development for CMH-17 V3 Rev.H

Purpose and scope - unchanged

AMC 20-29 Effective: 26/07/2010
Annex II to ED Decision 2010/003/R of 19/07/2010

AMC 20-29
Composite Aircraft Structure

0. TABLE OF CONTENTS

CMH-17 Volume 3 Chapter 3 (V3C3)
AIRCRAFT STRUCTURE CERTIFICATION AND COMPLIANCE

V3C3 Rev.H Outline:

3.1 INTRODUCTION

3.1.1 Purpose and scope

3.1.2 Types of Certification

- 3.1.2.1 Design Approval
- 3.1.2.2 Production Approval
- 3.1.2.3 Airworthiness Approval

3.1.3 Civil Aviation Certification Terms

3.2 REGULATIONS AND GUIDANCE

3.2.1 Certification and the Regulators

- 3.2.1.1 Regulatory Organizations
- 3.2.1.2 Regulatory Structure

3.2.2 Regulations

3.2.3 Primary Composite Guidance – AC20-107B and AMC 20-29

3.2.4 Other Guidance (e.g. related to PS, CMs, standards)

- 3.2.4.1 Structural Bonding
- 3.2.4.2 High Energy Wide Area Blunt Impact (HEWABI)
- 3.2.4.3 Glass Transition Temperature
- 3.2.4.4 Shared Databases – NCAMP
- 3.2.4.5 Sandwich Structures
- 3.2.4.6 Certification of Light Sport Aircraft
- 3.2.4.7 Repairs and Alterations
- 3.2.4.8 Composite Seats

Note: emerging priority themes for Policy Statements/Certification Memos… some of GA, Rotorcraft, eVTOL interest…

3.3 APPLICANT CONSIDERATIONS

3.3.1 Design approval

3.3.2 Production approval

3.3.3 Continued airworthiness

3.3.4 Product modification approval

3.3.5 Workforce knowledge, training, and teamwork

3.4 References

CMH-17 Volume 3 Chapter 3 (V3C3)
AIRCRAFT STRUCTURE CERTIFICATION AND COMPLIANCE

CMH-17 V3C3 - Conclusions

- V3C3 revision (EASA/FAA/TCCA harmonized) ready for release at V3 rev.H, following significant re-write
- V3C3 large pax bias continues in this revision, but with intent to expand scope to include other products
- emerging Policy Statement and Certification Memo subjects included in V3C3, some of particular relevance to GA, Rotorcraft, eVTOL, ref. Section. 3.2.4, e.g. Bonding, Shared Databases, Sandwich Structure, Light Sport Aircraft, Repairs and Alterations
- future broader CMH-17 content development supported by input and leadership from the GA, Rotorcraft, eVTOL communities (icw Regulatory Guidelines, ASTM F44 etc?)

Nota: Note: For more extensive guidance regarding composite design, beyond regulator certification considerations, see also Volume 3, Chapter 7, “Design of Composites”

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Volume 3 Chapter 12

Damage Resistance, Durability and Damage Tolerance

Authors:
DM Hoyt, NSE Composites
Allen Fawcett, NSE Composites

Agenda

- CMH-17 Spring Joint Coordination Meeting
- May 12-16, 2025
- Hosted at Wichita State University - Wichita, KS, USA
- Joint Spring 2025 Coordination Meeting: www.cmh17.org for registration

Monday May 12	Tuesday May 13	Wednesday May 14	Thursday May 15	Thursday May 16
Tutorials/ New Member Orientation	Opening coordination/ Working Group Meeting/ Social	Forum/Mini-Tutorial/ Working Group Meetings/	Panel Session/ Working Group Meetings/ Closing Coordination	Exec Meeting/ Optional Tours

Agenda

- SAE AMS CACRC Meeting
- March 31 – April 4, 2025
- Wichita, KS, USA
- Meeting Focus: Material Obsolescence and Bond Compatibility in Composite Repairs
- Registration: https://standardsworks.sae.org/standards-committees/ams-cacrc-commercial-aircraft-composite-repair-committee#
- The CACRC meeting will be hybrid, so if you can not attend in person you can participate via TEAMs meeting. Please email Jeff.Adkins@sae.org with your contact info and request to join CACRC as a Mailing list member to access the links

Call for Volunteers !

CMH-17
COMPOSITE MATERIALS HANDBOOK

- Any interest to support CMH-17 or other initiative?
  - To bring new content on design, materials, product types & analyses?
  - Share positive experience, good design practices?
  - Propose case studies for testing, repairs, manufacturing?
  - Develop reference standards in manufacturing, design or testing?

- Please contact CMH-17 to offer your support: info@cmh17.org

- Your help is more than welcome !
- An opportunity for you to get your practices as **a reference**

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