



IACMI Fall 2020 Members Meeting

October 7-8, 2020

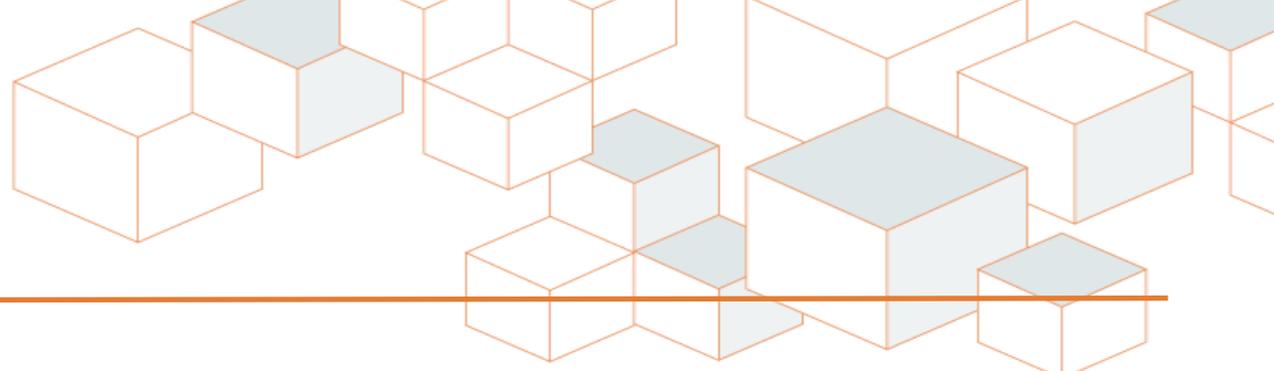
Status of Development of Automotive Grade Carbon Fiber Composite Performance Standards Project 6.21

Working Group Best Practices

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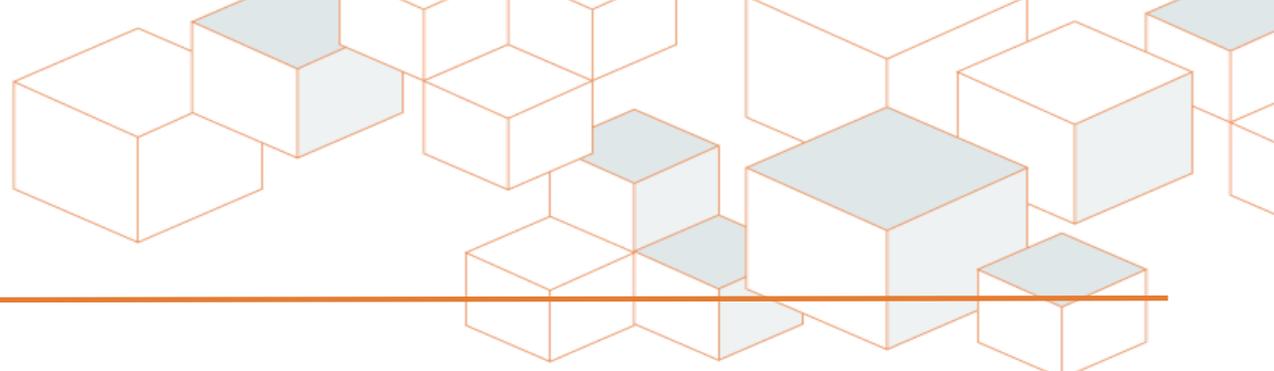


Presentation Outline



- ***CFRP Performance Project***
 - Purpose
 - Overview and status of Stages
 - Accomplishments
 - Future Steps
- ***Working Group Best Practices***
 - Project 6.21 Working Group Team
 - Best practices
- **Questions**

IACMI Program Goal

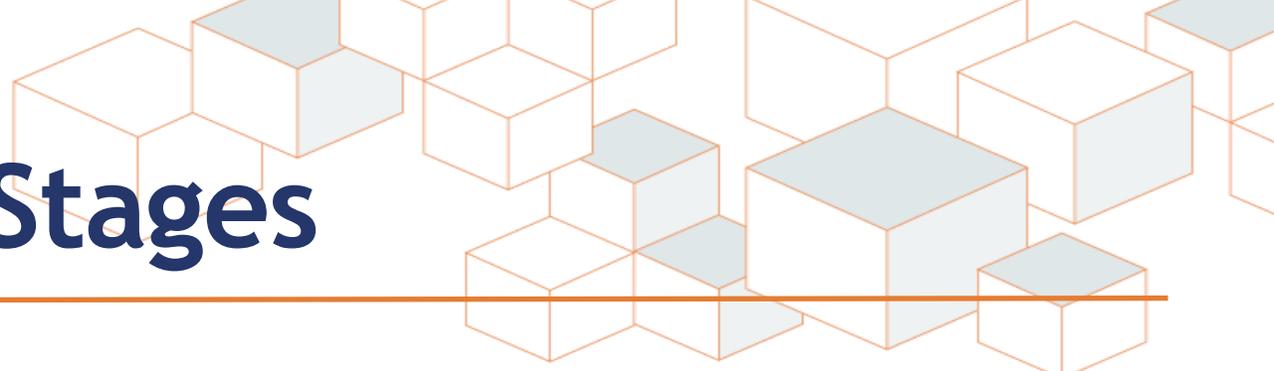


Facilitate the use of fiber reinforced polymer matrix composites in automotive applications

Supporting steps:

- Identify the key material properties that OEMs need for material selection;
- Provide recommended test methods and conduct tests for generating these properties
- Define and populate a database with the test data and key properties for which IACMI/ACC members and OEMs will have access.

Overview of Project Stages



Stage 1 (Completed):

- Identified performance specification needs and associated technical gaps,
- Identified test methods by which key material properties may be measured,
- Identified gaps that exist in the application of that data with respect to computational models.
- Developed work plan for Stage 2

Stage 2 (Ongoing):

- Concentrate on overcoming the gaps by identifying key material performance parameters
- Select test procedures from which the performance parameters can be derived. Conduct testing with the selected test procedures
- Develop database requirements and upload test data and material performance parameters into database.

Stage 1 Milestones

Milestone 6.21.2.1 *Conduct a workshop* with automotive industry OEM's and Suppliers to formulate a list of needed performance specifications and identify the associated technology gaps. (May 2018) **Completed**

Go/No Go Milestones 6.21.2.2 *Issue a workshop report* containing a comprehensive list of technology gaps for each performance standard in 6.21.2.1 and brief those performance specification list and technology gaps to DOE (July 2018) **Completed**

Milestone 6.21.3.1 *Identify at least 4 of the major performance functionalities* for material performance standards and *organize team* to address each of those. Provide the team list to DOE. (September 2018) **Completed**

Milestone 6.21.4.1: *Develop detailed work plan for Stage 2* to overcome technology gaps in four performance standards areas will be developed and briefed to DOE by each of the working teams. Those plans will include: (1) performance standards; (2) material testing protocol; (3) reporting format and databases; and (4) computational modeling. The detailed work plan will include a prioritized listing of test method deficiencies and serve to prioritize development efforts. (July 2019) **Completed**

Stage 2 Work Plan Tasks

Task 6.21.5.1 Determination of Key Material Characteristic Parameters

Identify key material characteristic parameters for the **energy absorbing**, **stiffness**, and **strength** functionalities.

- Review input gathered from the workshop and subsequent meetings of the working group
- Review CFRP material cards for finite element analysis codes for identifying key material characteristics parameters.
- Review AVK task force’s findings.

Task 6.21.5.2 Development of Standard Test Methods

– Sub-Task 6.21.5.2a Material Selection:

- Determine materials needed for the test program; and
- Solicit materials from ACC’s Plastics Division Automotive Team members, participating IACMI members, and OEMS.

Stage 2 Work Plan Tasks (continued)

Task 6.21.5.2 Development of Standard Test Methods (cont'd)

– Sub-Task 6.21.5.2b Static Testing (UTK):

- Extract coupons from the material plaques provided
- Run tests to evaluate tensile modulus and strength and the compression modulus and strength along fiber and transverse directions.
- Obtain in-plane shear modulus and strength using increased specimen panel thicknesses
- Document physical properties (composite density, fiber density, resin density, fiber volume fraction, void fraction) along with X-ray computed, micro tomography-based material microstructures for the provided material types

Stage 2 Work Plan Tasks (continued)

Task 6.21.5.2 Development of Standard Test Methods (cont'd)

– Sub-Task 6.21.5.2c Dynamic Testing (UDRI):

- Provide recommended procedures to generate 1/s to 100/s data
- Properties to be generated: Young's modulus in two orthogonal directions (E1, E2), Longitudinal tensile strength (S1), Transverse tensile strength (S2), Maximum strain in shear (es-fail)
- Conduct High Rate Tensile Testing using the SAE J2749 “High Strain Rate Tensile Testing of Polymers” procedure.
 - Constant grip velocity tests - Slack adapter used
 - Strain measured via back-to-back strain gages
 - Rates: Test at 10/s and 100/s measured strain rate
- Options for the high rate tensile specimens include:
 - ASTM D695 modified with longer tabs – try due to success with weaves in past
 - The AVK's TTS specimen scaled down in size – try due to interest by IACMI to match work by European consortium
 - TUM Specimen – try because it combines taper & shorter length



Stage 2 Work Plan Tasks (continued)

Task 6.21.5.3 Data Base Development and Formatting

- Review the CAMPUS and M-Base database formats established via the European AVK project.
- Define additional data fields as required (including those described in Task 6.21.5.4) and collaborate with AVK/M-Base to incorporate the additional fields

Task 6.21.5.4 OEM Material Card Requirements

- Review material cards for modeling CFRP materials in LS-Dyna to ensure that test procedures provide sufficient data to model the material.
- Upload test data into the database (in format defined in Task 6.21.5.3).

Accomplishments



- Assigned working group members to each of the tasks of the work plan
- Sent letter to ACC member companies and automaker involved in the project requesting commercially available materials, additional testing to complement that by UTK and UDRI, and contribute to populating the materials database with their data.
- Evaluated materials available from response to the letter; and with input from OEMs, selected and then requested the material plaques
- Specified key material characterization parameters
- Specified test procedures (static and dynamic) to be utilized for Stage 2 testing.
- Defined coupon specifications to be extracted from material plaques for use in testing



Next steps

- **Receive material plaques. Extract coupons for use in the testing**
- **Commence testing with the selected test procedures.**
 - Evaluate ease and accuracy of test methods
 - Modify test procedures as necessary
 - Document procedures
- **Continue database review for material property card depository**
- **Evaluate test results**
- **Initiate loading data into the materials database**
- **Write final report**

Milestones for Stage 2



Milestone 6.21.5.1 Complete Standard Performance requirements review and provide a detailed listing of quantifiable performance requirements for the Crash Energy Management and Stiffness Critical Composites working groups and DOE. (TBD) 80% Complete

Milestone 6.21.5.2 Complete identification of standard test methods specified for the Stiffness and Strength critical composites and begin development efforts on at least two standard test methods. Provide a list of those test methods in priority order to IACMI and DOE. (TBD) 90% Complete

Go/No Go Milestone 6.21.5.3 Deliver data reporting format to IACMI/DOE and secure a partnership with an appropriate organization to serve as a repository for the generated data. (TBD) 10% Complete

Milestone 6.21.5.4 Complete development of at least 2 material test methods. Deliver data generated using those methods in the agreed upon data format to IACMI and DOE. (TBD) 20% Complete

Best Practices for Working Groups

Membership

Agenda

Document Handling

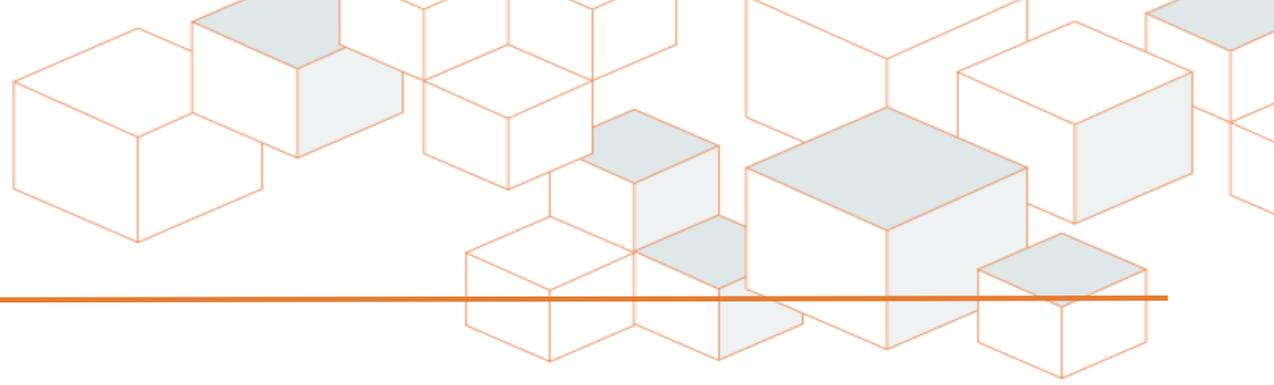
Communications

Frequency of Meetings

Other

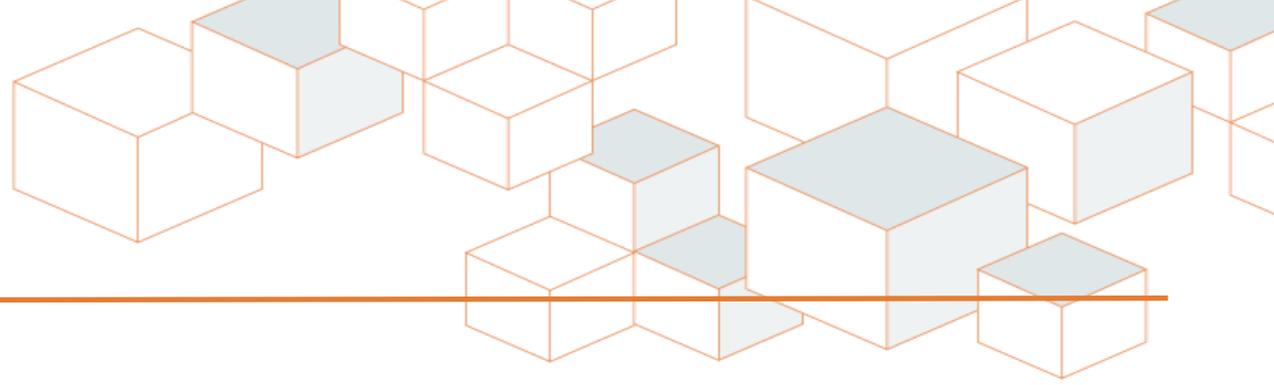
CFRP Performance Working Group Team

Name	Company	Name	Company	Name	Company	Name	Company
Alvarez, Sebastian	Solvay	Haley, Bob	Kuraray	Patchen, Andrew	U of Tenn	Swaminathan, Pal	LANXESS
Bach, Aleksandar	Ford	Heisserer, Ulrich	DSM	Penumadu, Dayakar	U of Tenn	Szendro, Mark	BASF
Bobba, Somasekar	SABIC	Hollowell, Tom	WTH	Robertson, Barbara	ACC	Unser, John	IACMI
Bouguettaya, Mohamed	BASF	Knouff, Brian	ORNL	Rogers, Bradley	GM	Wagner, David	Ford
Bras, Aurele	Solvay	Kondapalli, Prasanna	BASF	Rose, Ron	Kuraray	Zuber, Peter	SABIC
Brooks, Daniel	SABIC	Kuhlman, Sarah	UDRI	Scheliga, David	Institute for Composite Materials (IVW)		
Brophy, Erin	IACMI	Lambi, Marios	BASF	Schell, Chad	DOE		
Brosius, Dale	IACMI	McClelland, Sandra	Solvay	Schijve, Warden	SABIC		
Calzolari, Andrea	Instron	McEnteggart, Ian	Instron	Schmeer, Sebastian	Institute for Composite Materials (IVW)		
Chang, Fred	SABIC	Michaud, Joey	U of Tenn	Shah, Bhavesh	GM		
Chirino, Jose	LANXESS	Moruzi, Paul	DSM	Shahwan, Khaled	FCA		
Deo, Ravi	DOE	Oliver, Gina	ACC	Shakour, Elias	BASF		
Grum, Kipp	BASF	Parkinson, Matthew	BASF	Stirnemann, Duane	Solvay		



Best Practices

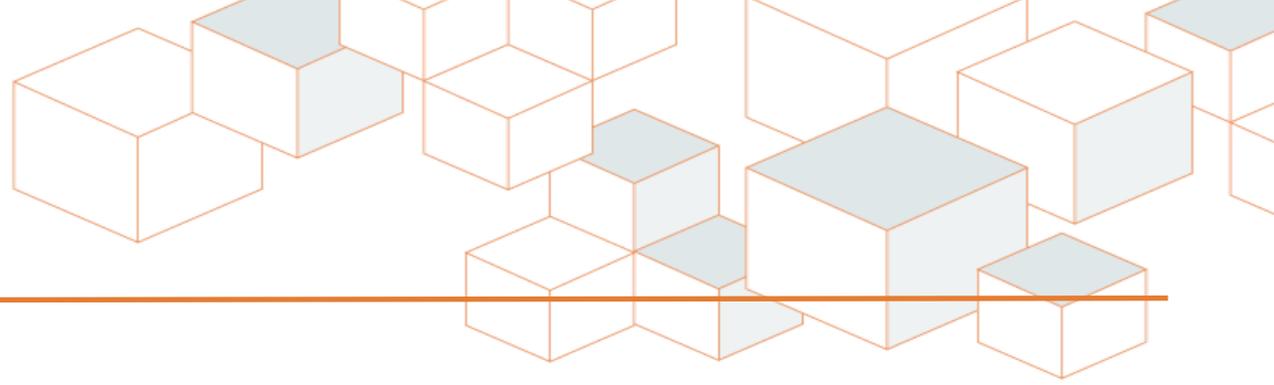
- **Membership**
 - Start small, grow as needed
- **Agenda**
 - Welcoming and Introductory remarks
 - Antitrust statement (multiple companies on working group)
 - Action items from previous meeting
 - New Items to be presented/discussed
 - Review of new action items (what and by whom)
 - Date for next meeting



Best Practices

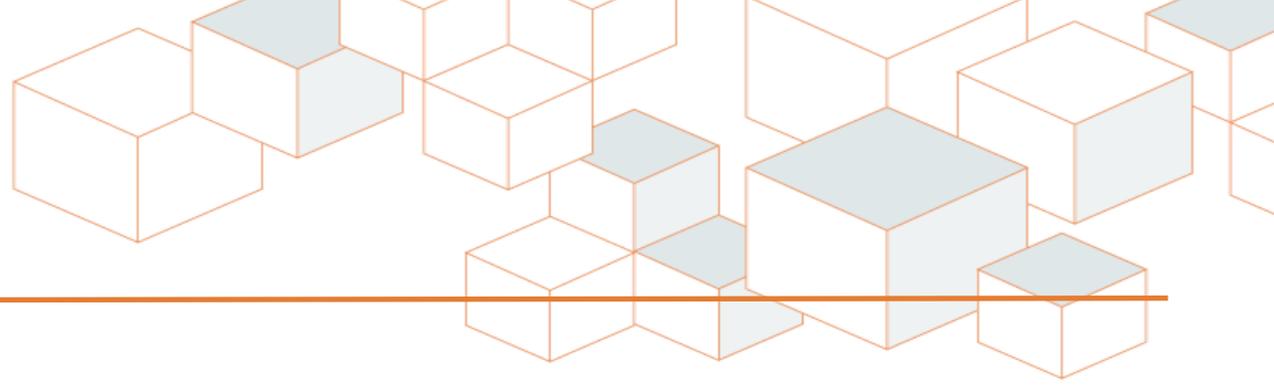
- **Document handling**

- Website portal with folders for meeting minutes/summaries, presentations, working documents, referenced documents, etc.
 - Meeting minutes/summaries
 - Agenda
 - Attendance
 - Minutes or meeting summary
 - Presentations and Documents
 - File names should include document number followed by description and version number (e.g., N047_Work Plan for Stage 2_v4)
 - Read protect with password
 - Edit protect with different password



Best Practices

- **Communications**
 - Email
 - Phone (both office and mobile)
 - Texting (notify recipient of time critical request)
 - Working group website portal (particularly for action items)
- **Frequency of Meetings**
 - Full working group (generally monthly)
 - Sub-group or teams (weekly, bi-weekly)
- **Other comments**



Questions?