

JANNAF INTERAGENCY PROPULSION COMMITTEE

JOINT ARMY-NAVY-NASA-AIR FORCE

Liquid Propulsion Subcommittee (LPS)
Advanced Materials Panel (AMP)
Additive Manufacturing for Propulsion Applications
Technical Interchange Meeting (TIM)



Meeting Invitation

Jackson Center
Huntsville, AL
27-28 August 2018



JANNAF Meeting Invitation and Preliminary Program - August 2018

You are invited to attend The Joint Army-Navy-NASA-Air Force (JANNAF) Liquid Propulsion Subcommittee (LPS) Advanced Materials Panel Additive Manufacturing for Propulsion Applications TIM being held August 27-28, 2018, in Huntsville, Alabama at the Jackson Center.

The Program Co-Chairs for this Meeting are Brian West, NASA Marshall Space Flight Center, Huntsville, AL and Omar Mireles, NASA Marshall Space Flight Center, Huntsville, AL. A complete list of Program Committee Members begins on page 5.

NASA and the propulsion community are committed to overcoming the challenges to widespread adoption of additive manufacturing into new propulsion systems. NASA, other agencies, industry and academia have realized unprecedented advances additive manufacturing research and technology development for materials, design, manufacturing, and certification. This TIM is intended to share the results of these efforts, to encourage organizations with similar interests, and provide insight into the plans for future developments. The journey beyond low earth orbit (LEO) will require the development of highly reliable propulsion systems to fulfill future mission needs. Various in-space propulsion systems are being considered in support of Space Launch System (SLS) Exploration Upper Stage (EUS), Mars Sample Return, Mars architecture studies, Lunar missions, Europa and other deep space missions. The purpose of this workshop is to bring the in-space transportation community together to discuss the in-space chemical propulsion requirements, what has been done, and what needs to be done to support current mission planning, emerging satellite industry and low cost small launch industry. This forum will be conducive to sharing ideas and needs for future in-space chemical propulsion developments.

This Technical Interchange Meeting (TIM) will bring together leading experts from the propulsion community to discuss the most advanced technologies in additive manufacturing that are being applied to propulsion components. This forum will be conducive to collaboration and sharing ideas for recent advances and needs for future development. Additive manufacturing is enabling entirely new design approaches and is vital for reducing manufacturing time and cost. As affordability is becoming increasingly critical for

space launch systems, new and innovative manufacturing techniques are becoming a mainstream approach to manufacturing. As additive manufacturing becomes more widely accepted for general use, it is necessary to comprehensively understand the area in order to proceed with implementation of the technology into spaceflight applications requiring a high level of reliability.

Meeting Site

The overall security classification of this meeting is unclassified. Sessions will be held at the Jackson Center in Huntsville, Alabama. Information about the Jackson Center can be found on its Website at <http://www.jacksoncenter.net/>.

Hotel Information

Room blocks have not been established for the August 2018 LPS AMP Technical Interchange Meeting (TIM). Attendees will be responsible for reserving their own rooms for the meeting.

Click [here](#) for a list of hotels located near the Jackson Center.

Transportation and Parking

Free parking is available at the Jackson Center. Please be aware that the hotels near the Jackson Center do not offer an airport shuttle or a shuttle service to nearby businesses such as the Jackson Center. If you will not have your own car, you will most likely need to rent a car or use a taxi service.

Security/Attendance Requirements

The overall security level of the meeting is Unclassified. All sessions will be held at the Jackson Center in Huntsville, Alabama.

Attendance is restricted to invited U.S. Citizens*

Non-government attendees must have their employment confirmed with an organization certified with the Defense Logistics Agency (DLA) to obtain export-controlled technical data AND be certified by a sponsoring government official from one of the participating JANNAF agencies.

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*Foreign Nationals and Foreign National Representatives are not permitted. U.S. green card holders (permanent residents) may be considered by NASA for attendance and should contact the JHU/WSE-ERG Security Team. Please contact either Mary Gannaway/FSO at (410) 992-7304, ext. 211 or mtg@jhu.edu or Tricia Reider/AFSO, at (410) 992-7300, ext. 222 or treider@erg.jhu.edu for additional information.

ALL non-government attendees (which includes contractors, consultants and universities) attending this meeting **must**:

1. Be certified by a Sponsoring Government Official
2. Provide their organization's DD 2345 Certification Number for receipt of militarily-critical technical data

DD 2345: For additional information, contact the [Joint Certification Program Office \(JCP\)](#) at 1-800-352-3572 or visit their website.

All attendees will be required to register via the JANNAF Secure Portal. Portal accounts are complimentary so if you do not currently have an account, please visit the JANNAF web-site at www.jannaf.org to begin the process. Questions concerning attendance eligibility or establishment of a secure portal account should be directed to the JHU/WSE-ERG Security Team. Please contact either Mary Gannaway/FSO at (410) 992-7304, ext. 211 or mtg@jhu.edu or Tricia Reider/AFSO at (410) 992-7300, ext. 222 or treider@erg.jhu.edu.

Tour of the NASA Marshall Space Flight Center

A bus tour of the NASA Marshall Space Flight Center will be available on Wednesday, August 29, 2018, from 9:00 AM–12:15 PM, for the JANNAF Additive Manufacturing TIM attendees who respond to this invitation. The tour will visit the MSFC additive manufacturing lab, propulsion lab, and test area.

Participants will meet at the Redstone Arsenal Gate 9 Visitor's Center located on South Rideout Road. Please park your cars in the visitor's center parking lot where you will be escorted by bus for the tour.

The tour bus will depart from the Redstone Arsenal Gate 9 Visitor's Center at 9:00 AM.

Please **send a response to Chip Jones**, chip.jones@nasa.gov, by **August 10, 2018**. If you are interested in participating in this bus tour indicate whether or not you have a Government Common Access Card (CAC). If you have a Government CAC, please arrive by 8:45 AM. If you do not have a Government CAC, please arrive by 8:30 AM for processing through security. Chip will ask those who respond to this tour invitation to provide additional information to get approved for entry to the Redstone Arsenal. You will also need to bring a valid government ID with you to the NASA gate in order to get through security. Only people who have pre-registered will be allowed on the bus tour.

Space is **limited to 55 attendees**. Please note that if you sign up for the tour you are making a commitment to attend a limited participation event. If you register for the tour and decide to decline your participation on the day of the event, you are denying another willing participant the opportunity to attend.

Posters

For those attendees who are presenting posters, you may ship your posters to the address below:
Jackson Center/LPS AMP TIM Conference
c/o Jamie Jones
600 Genome Way
Huntsville, AL 35806

Dining / Boxed Lunches

Attendees have the option of pre-ordering a box lunch from the Jackson Center for the Monday-Tuesday sessions. **Orders must be placed by Thursday, 23 August 2018.**

Unfortunately, the Jackson Center will not be able to accept orders after this date. For more information or to place an order, go to the [Site Info & Meal Options page](#) of the meeting website.

Coffee, juice, muffins and danish will be offered at Breakfast for \$1 each. No pre-order necessary for breakfast. Snacks will be available for purchase on-site and will include but not necessarily limited to: sodas, coffee, chips, peanuts, granola bars, candy bars, bottled water (\$1.00 each).

(OUTSIDE FOOD AND BEVERAGE IS NOT ALLOWED TO BE BROUGHT INTO THE JACKSON CENTER)

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Attendees are welcome to go beyond the Jackson Center to purchase a lunch. Nearby restaurants include the Hudson Alpha Cafe. In addition, the Jackson Center is located 1.2 miles from the Bridge Street Town Centre which features 70 upscale shops and restaurants.

Networking Room

The Atrium prefunction area (Jackson Center, 1st floor) will serve as the networking area. This area will be open each meeting day from 7:00 a.m. - 5:00 p.m. Please note that scheduled breaks are included in session agendas where time permits.

Side Meetings

There is one conference room located near the Atrium Lobby in the Jackson Center that is available for side meetings. Please contact Mary Gannaway at (410) 992-7304, ext. 211 or mtg@jhu.edu to reserve this room.

Meeting Proceedings

Proceedings from this meeting will be published by the JHU-WSE-ERG. Presentations will be available at no charge to Government attendees (DoD, DoE and NASA) via the new JANNAF Digital Online Collection (JDOC) Database, accessible through your account on the JANNAF Secure Portal. Industry and academic attendees will be able to access the presentations from the LPS AMP TIM by subscribing to JDOC.

Information about subscriptions or JDOC may be obtained from Tricia Reider at (410) 992-7300, ext. 222 or treider@erg.jhu.edu. Please allow 12 weeks following the conclusion of the LPS AMP TIM for the presentations to be posted on JDOC.

On-Site Electronics Policy

We know how important it is to stay connected. However, as a registered attendee of this ITAR restricted symposium, you have a personal responsibility to help protect the data exchanged at this event. This includes managing your electronic devices (phones, computers, cameras, pads, etc.), as well as your conversations responsibly. Aside from security concerns, prudence and responsible use of these devices extends basic courtesy to other attendees and speakers.

Please follow these basic guides at this meeting:

- Phones should not be used in any technical session. Preferably turn these devices off. If you must have your phone on, it should be on vibrate mode. Calls should not be accepted during the course of a presentation.
- Confine technical discussions to the meeting space, as an open foyer may be available to the general public.
- If using a phone or having a conversation with someone in the general vicinity of the symposium area be mindful of other people or devices that could pick up or transmit your conversation or those going on around you.
- Cameras are strictly prohibited. If you would like a photo of a poster, speaker, or other person or item within the confines of the meeting space, please first see someone at the registration desk. If your computer or other device has a microphone or camera, turn it off while in the meeting space.

Registration

There is no registration fee to attend the August 2018 LPS AMP TIM. All attendance requirements must still be met (see Security/Attendance Requirements on page 2). **Pre-registration is strongly recommended.**

STEP #1

Create a Portal Account (www.jannaf.org)

To register for the LPS AMP TIM, **you must first have a JANNAF Secure Portal account.** Please allow sufficient time for completion of the Portal Account application and approval process. For more information and instructions, please visit the [FAQ page](#) on the meeting website.

STEP #2

Once you have your JANNAF Secure Portal Account:

1. Go to the [Registration page](#) of the meeting website and click on "Register for the LPS AMP TIM".
2. Log in to your Portal account.

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STEP #3

Complete the brief online Registration Questionnaire.

After your response to the Registration Questionnaire has been entered in the meeting database, you will receive an email confirming your registration for the August 2018 LPS AMP TIM.

On Site Registration

The Registration Desk will be located in the lobby of the Jackson Center. Pre-registered attendees must show photo identification before receiving their badge and materials.

Pre-registration is strongly recommended to ensure that all attendance requirements have been met prior to arrival. Registration will be open Monday and Tuesday, 27-28 August, beginning at 7:00 a.m. and closing at the end of sessions each day.

Attire

There is no official dress code for this TIM; however, most attendees wear business or business casual attire. When packing, keep in mind that it can be difficult to regulate the temperature in meeting rooms to everyone's liking, and any changes may not be noticeable quickly, so it is best to bring a light sweater or jacket and dress in layers.

Questions

Questions concerning this program should be directed to Mary Gannaway at (410) 992-7304, ext. 211 or e-mail: mtg@jhu.edu.

Upcoming JANNAF Meeting

45th Structures and Mechanical Behavior (SMBS)/41st Propellant and Explosives Development and Characterization (PEDCS)/32nd Rocket Nozzle Technology (RNTS)/30th Safety and Environmental Protection (SEPS) Subcommittees/Programmatic and Industrial Base meeting (PIB), December 10-14, 2018, Vancouver, WA. *For more information visit the meeting website at: <https://www.jannaf.org/mtgs/2018Dec/pages/index.html>*

Program Committee Members

MEETING CO-CHAIRS

Mr. Brian West
NASA Marshall Space Flight Center
Huntsville, AL

Mr. Omar Mireles
NASA Marshall Space Flight Center
Huntsville, AL

LPS PANEL CHAIRS

Mr. Clyde S. Jones
NASA Marshall Space Center
Huntsville, AL

Mr. Robert Carter
NASA Glenn Research Center
Cleveland, OH

PROGRAM COMMITTEE

(also includes the Meeting Co-Chairs and LPS Panel Chairs)

Mr. James L. Cannon
NASA Marshall Space Flight Center
Huntsville, AL

Ms. Monica Jacinto
Aerojet Rocketdyne
Canoga Park, CA

Ms. Alison Park
Aerojet Rocketdyne
Canoga Park, CA

Mr. John Vickers
NASA Marshall Space Flight Center
Huntsville, AL

AREA CHAIRS

AREA I: DESIGN FOR ADDITIVE MANUFACTURING

Co-Chair: Mr. Will Brandsmeir
NASA Marshall Space Flight Center
Huntsville, AL

Co-Chair: Mr. Alan Fung
Aerojet Rocketdyne
Canoga Park, CA

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AREA II: ADDITIVE MANUFACTURING MODELING AND SIMULATION

Co-Chair: Mr. Edward Glaessgen
NASA Langley Research Center
Newport News, VA

Co-Chair: Ms. Nima Shamsaei
Auburn University
Auburn, AL

AREA III: MATERIAL DEVELOPMENT AND MECHANICAL TESTING

Co Chair: Mr. David L. Ellis
NASA Glenn Research Center
Cleveland, OH

Co-Chair: Mr. Michael Kirka
Oak Ridge National Laboratory
Oak Ridge, TN

AREA IV: ADDITIVE MANUFACTURING TECHNIQUES & IN-SITU MONITORING

Co-Chair: Mr. Nicholas Mule
Aerojet Rocketdyne
Canoga Park, CA

Co-Chair: Mr. John Middendorf
University Technology Corporation
Beavercreek, OH

AREA V: POST-PROCESSING: HEAT TREATMENT, SURFACE FINISH MODIFICATION, NDE

Co-Chair: Mr. Owen Hildreth
Arizona State University
Tempe, AZ

Co-Chair: Ms. Judith Schneider
University of Alabama
Huntsville, AL

Area VI: COMPONENT AND SYSTEM TESTING

Co-Chair: Mr. Paul Gradl
NASA Marshall Space Flight Center
Huntsville, AL

Co-Chair: Mr. Brian Webb
Aerojet Rocketdyne
Canoga Park, CA

AREA VII: PROCESS QUALIFICATION & FLIGHT CERTIFICATION

Co-Chair: Mr. Douglas N. Wells
NASA Marshall Space Flight Center
Huntsville, AL

Co-Chair: Mr. Richard W. Russell
NASA Kennedy Space Center
KSC, FL

ERG TECHNICAL REPRESENTATIVE

Mr. Nicholas Keim
JHU-WSE-Energetics Research Group
Columbia, MD

MEETING PLANNER / PROCEEDINGS EDITOR

Ms. Katie Cochran
JHU-WSE-Energetics Research Group
Columbia, MD

FACILITY SECURITY OFFICER

Ms. Mary T. Gannaway
JHU-WSE-Energetics Research Group
Columbia, MD

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Technical Program

The LPS AMP TIM program currently consists of 7 technical sessions, with 31 presentations. There will also be poster presentations.

Technical Program Agenda - Monday, 27 August	
8:00 a.m. - 8:05 a.m.	Welcome
8:05 a.m. - 8:15 a.m.	Introductory Remarks; NASA MSFC
8:15 a.m. - 10:15 a.m.	Session 1: Design for Additive Manufacturing
10:15 a.m. - 10:30 a.m.	BREAK: View Posters & Network
10:30 a.m. - 12:00 p.m.	Session 2, Part I: Additive Manufacturing Modeling and Simulation
12:00 p.m. - 1:00 p.m.	LUNCH
1:00 p.m. - 2:00 p.m.	Session 2, Part II: Additive Manufacturing Modeling and Simulation
2:00 p.m. - 3:30 p.m.	Session 3, Part I: Material Development and Mechanical Testing
3:30 p.m. - 3:45 p.m.	BREAK: View Posters & Network
3:45 p.m. - 5:15 p.m.	Session 3, Part II: Material Development and Mechanical Testing
5:15 p.m. - 5:45 p.m.	Session 4, Part I: Additive Manufacturing Techniques & In-situ Monitoring

Technical Program Agenda - Tuesday, 28 August	
8:00 a.m. - 8:05 a.m.	Welcome
8:05 a.m. - 10:05 a.m.	Session 4, Part II: Additive Manufacturing Techniques & In-situ Monitoring
10:05 a.m. - 10:20 a.m.	BREAK: View Posters & Network
10:20 a.m. - 11:50 a.m.	Session 5: Post-Processing: Heat Treatment, Surface Finish Modification, NDE
11:50 a.m. - 12:50 p.m.	LUNCH
12:50 p.m. - 3:20 p.m.	Session 6: Component and System Testing
3:20 p.m. - 3:35 p.m.	BREAK: View Posters & Network
3:35 p.m. - 5:05 p.m.	Session 7: Process Qualification and Flight Certification