

# JANNAF

JOINT ARMY-NAVY-NASA-AIR FORCE  
INTERAGENCY PROPULSION COMMITTEE



# NEWS

Volume 9, Issue 2 Released December 1, 2020

## JANNAF Will Meet Virtually in December

In response to the global Covid-19 pandemic, the December 2020 JANNAF Meeting will take place in a virtual format from Dec. 7-17, 2020. The featured keynote speaker at the meeting is Michael E. White, Principal Director for Hypersonics in the Office of the Under Secretary of Defense for Research and Engineering (OUSD(R&E)). The Defense Information Systems Agency's Defense Collaboration Services (DCS) online platform will host all sessions of the meeting, which will feature a joint gathering of the 50th Combustion (CS), 38th Airbreathing Propulsion (APS), 38th Exhaust Plume and Signatures (EPSS), and 32nd Energetic Systems Hazards (ESHS) Subcommittees, as well as a meeting of the Programmatic and Industrial Base (PIB). The meeting will be chaired by Kevin D. Kennedy, Ph.D., of the Army Combat Capabilities Development Command Aviation & Missile Center at Redstone Arsenal, Ala.

White's keynote speech about hypersonic systems will be held on Tuesday, Dec. 8. He will



*Kevin D. Kennedy, Ph.D., CCDC Aviation & Missile Center, Redstone Arsenal, Ala., will chair the JANNAF Meeting.*

focus on the key elements of the Department of Defense's (DoD's) offensive hypersonic systems strategy and defensive strategy for addressing adversary hypersonic systems. He will describe the progress being made by the DoD in dramati-

*(See December 2020 Virtual Meeting on page 3)*

»Sep/Oct Virtual  
JANNAF Meeting  
Review

PAGE 6

»APS Best  
Papers Award

PAGE 9

»In Memoriam

PAGE 12

»JANNAF History  
Highlights

PAGE 13

»ERG Communications  
and Publications Team

PAGE 14



**Editor: Benjamin S.M. Schwantes**  
410-992-7300, ext. 227  
[bschwantes@erg.jhu.edu](mailto:bschwantes@erg.jhu.edu)

**ERG Director: Peter E. Zeender**  
The Johns Hopkins University WSE ERG  
10630 Little Patuxent Parkway, Suite 202  
Columbia, Maryland 21044-3286  
<https://www.erg.jhu.edu>  
Fax: 410-730-4969

The JHU WSE Energetics Research Group (ERG) is the technical support contractor of the Joint Army-Navy-NASA-Air Force (JANNAF) Interagency Propulsion Committee. The purpose of JANNAF is to solve propulsion problems, affect coordination of technical programs, and promote an exchange of technical information in the areas of missile, space, and gun propulsion technology.

*JANNAF News* is available free of charge to the propulsion community. Reproduction of *JANNAF News* articles is permissible, with attribution. Neither the U.S. Government, ERG, nor any person acting on their behalf, assumes any liability resulting from the use or publication of the information contained in this document, or warrants that such use or publication of the information contained in this document will be free from privately owned rights.

Copyright © 2020 The Johns Hopkins University  
No copyright is claimed in works of the  
U.S. Government.

*ERG is the technical support contractor for the JANNAF Interagency Propulsion Committee operated by the Johns Hopkins University Whiting School of Engineering under contract FA9300-19-C-0002.*

## Recent ERG Publications

- Abstract Number: 2019-0003  
Joint PSHS/CS Shock/Impact Induced Reactions Panel Report  
*Investigating the Relationship between Mechanical and Reactive Behavior in Energetic Materials*  
Sep 2018
- Abstract Number: 2020-0004  
*NASA In-Space Chemical Propulsion Technical Interchange Meeting*  
Sep 2020
- Abstract Number: 2020-0005  
*JANNAF LPS AMP Additive Manufacturing for Propulsion Applications Technical Interchange Meeting*  
Sep 2020

## ERG's Technical/Bibliographic Inquiry Service

ERG offers a variety of services to its subscribers, including responses to technical/bibliographic inquiries. Answers are usually provided within three working days, in the form of telephoned, faxed, electronic, or written technical summaries. Customers are provided with copies of JANNAF papers, excerpts from technical reports, bibliographies of pertinent literature, names of recognized experts, propellant/ingredient data sheets, computer programs, and/or theoretical performance calculations. The ERG staff responds to numerous inquiries each year, from over 150 customer organizations. For further information, please contact Nicholas Keim by email at [nkeim@erg.jhu.edu](mailto:nkeim@erg.jhu.edu).

## ERG Subscriptions

ERG recently forwarded GFY 2021 subscription renewal packets to its customer base for continued products and services. We would like to take this opportunity to inform the community that a minimum yearly subscription of \$1,775 entitles subscribers to one complimentary suite of JANNAF databases; one complimentary *JANNAF Journal*; and six hours (prepaid) of technical/bibliographic inquiry hours. For information concerning a yearly ERG subscription and/or products and services, please contact Tricia Frey at 410-992-7300, ext. 222, or email [tfrey@erg.jhu.edu](mailto:tfrey@erg.jhu.edu). You may also visit <https://www.erg.jhu.edu/subscriptions>.

***JANNAF News* is seeking short  
(Dist A) technical articles for  
future editions.**

**If you are interested in submitting an article or  
have any questions,  
please contact  
Managing Editor  
Benjamin Schwantes at  
[bschwantes@erg.jhu.edu](mailto:bschwantes@erg.jhu.edu).**

## December 2020 Virtual Meeting... *continued from page 1*

cally accelerating the delivery of transformational hypersonic capabilities to the warfighter.

has an extensive background in hypersonic weapon systems development. Prior to his current position, he served as the Head of the Air and Missile Defense Sector at the Johns Hopkins University Applied Physics Laboratory where he led more than 1,100 staff members developing advanced concepts to enhance the nation's air and missile defense capability for programs including AEGIS, STANDARD Missile, Ship Self Defense System, Cooperative Engagement Capability, the Surface Electronic Warfare Improvement Program, Aegis Ballistic Missile Defense, and numerous other Missile Defense Agency programs. White earned both his B.S. and M.S. in aerospace engineering from the University of Maryland and has authored more than 30 papers on hypersonic weapon system development and other defense system related topics.

For complete details on all the papers and topics at the December 2020 JANNAF Meeting, please see the meeting program, which is available through the JANNAF portal at <https://www.jannaf.org/mtgs/2020Dec/pages/index.html>.



*Michael E. White, Principal Director for Hypersonics in the Office of the Under Secretary of Defense for Research and Engineering, Washington, DC, will be the keynote speaker at the virtual JANNAF Meeting.*

### A Message from the JANNAF Technical Executive Committee to the JANNAF Community

**W**e would like to thank all of the authors, presenters and participants in our successful first set of JANNAF virtual meetings held 29 September through 9 October 2020. Also thank you to all who submitted abstracts for the December 2020 virtual meetings and those who plan to participate. Projecting past December 2020, due to the continuing uncertainties with COVID-19 and the resulting travel and meeting restrictions, we are planning to conduct the Spring 2021 meetings virtually as well. Please stay healthy and safe and we look forward to hearing from you all in December!

Very respectfully,

Drew O. DeGeorge

Chair

JANNAF Technical Executive Committee



# December 2020 Meeting Subcommittee Highlights

## CS

**T**he JANNAF 50th Combustion Subcommittee (CS) sessions will focus on research around different regimes, materials, and measurements surrounding state-of-the-art combustion sciences in the Department of Defense and NASA. Different topics include hypersonic combustion (injection, fuels, and system design) and associated processes and modelling, interior combustion ballistics, as well as fundamental combustion research, novel green propellant chemistry, reactive materials, and metal combustion studies. Highlights include specialist sessions focusing on enhancing synergy between flowfield diagnostics and computational modelling, in addition to several joint Airbreathing Propulsion Subcommittee/CS sessions on rotating detonating engines and scramjets.

## APS

**T**he JANNAF 38th Airbreathing Propulsion Subcommittee (APS) meeting sessions will discuss topics on turbopropulsion, ramjets, scramjets, pressure gain combustion, advanced materials and measurement and analysis. A strong focus will be on hypersonic vehicles, which include a hypersonic program overview, subsystem and component analysis (inlets and nozzles, isolators, fuel systems, etc.), material development and modeling techniques and tools.

Another main focus will include a four-day session on Aether, a turbine-based combined cycle flight demonstration vehicle. Topics discussed will include a general overview, the propulsion system, configuration performance, and structural, thermal and ground tests.

Additional sessions on rotating detonation engines, high speed flow modeling, high speed aerodynamics, and aerospace structures will be held. Joint sessions with the Combustion Subcommittee on ignition, combustion, flameholding, alternate fuels, and analysis tools for scramjets will also be presented. Two workshops, one on the medium scale critical components Program, and the other on equivalent available pressure measurement techniques will occur.

## EPSS

**T**he JANNAF 38th Exhaust Plume and Signatures Subcommittee (EPSS) sessions include the latest advancements in hypersonics and rocket plume, wake, and flowfield measurements, modeling, and phenomenology. Two tutorials will be provided — the first will be on chemical kinetics, held jointly with the Combustion Subcommittee (CS); the second will be a tutorial on the Spectral and In-Band Radiometric Image of Targets and Scenes Model (SPIRITS) AC3. A session will also be held on the composite scene signatures. Finally, EPSS is hosting an interagency collaboration forum to facilitate identification of challenges and solutions of mutual interest across the Department of Defense and NASA and their respective technology domains.

## ESHS

**T**he JANNAF 32nd Energetic Systems Hazards Subcommittee (ESHS), formerly the Propulsion System Hazards Subcommittee (PSHS) addresses potential hazards associated with missile, space, and gun propulsion systems by examining damage mechanisms, response to heating (cook-off), shock/impact induced reaction, as well as supporting the continued development of insensitive propellants and explosives. In addition to four technical sessions, ESHS will be holding a panel meeting to share current research and advances in shock and impact induced reactions.

**The *JANNAF Journal of Propulsion and Energetics* is seeking reviewers and associate editors with knowledge of rotating detonation engine (RDE) technology.**

**If you are interested in reviewing RDE manuscripts, please contact:**

**Managing Editor Benjamin Schwantes at  
[bschwantes@erg.jhu.edu](mailto:bschwantes@erg.jhu.edu).**

# JANNAF FAQ:

## Suggestions and Tips for Getting the Most out of Your DCS Virtual JANNAF Meeting

*What are the hardware requirements for running DCS?*

- You will need a laptop or desktop computer with speakers, running Windows 10 and a compatible HTML5 web browser. Google Chrome and Microsoft Edge Chromium are supported.
- Presenters will also need a microphone. Telephone dial-in options are available but should only be used as a last resort.
- Windows Users: DoD Root certificates need to be installed if you are using non-DoD equipment.
- Apple Users: DCS does not officially support MacOS. We cannot guarantee that you will be able to successfully participate using an Apple computer.

*What specific hardware do I need as a presenter?*

- You will need a microphone. The best audio arrangement is to use a headset with microphone that has noise cancelling functionality. This prevents background noises from interrupting the virtual meeting.
- Connect and configure your audio device before you start your browser or it may not be recognized by your browser.

*What are some other technical considerations that I should know as a virtual JANNAF Meeting attendee?*

- DCS recommends avoiding wireless or WiFi connections. Use a hardwired connection if possible.
- When joining a DCS virtual meeting, first close all non-essential programs on your computer. Avoid software updates and virus scans while connected to DCS.
- Test your DoD Root certificates by visiting: <https://conference.apps.mil/dashboard>. Accept the U.S. Department of Defense Warning Statement by clicking the *Accept* button. If you are able to see the DCS Dashboard, your DoD Root Certificates are working.

- If you are disconnected from a session, attempt to rejoin. If necessary, dial in to the session using the call-in number and PIN provided.
- Test your web browser and audio in a live DCS test session. JHU WSE Energetic Research Group has scheduled these test sessions in DCS to ensure that your system is ready when the JANNAF meeting begins. You must be registered for the JANNAF December meeting to join a DCS testing/troubleshooting session. Please visit <https://www.jannaf.org/mtgs/2020Dec/pages/virtual.html> for more information and the testing schedule.

### **The Propulsion Systems Hazards Subcommittee is now the Energetic Systems Hazards Subcommittee**

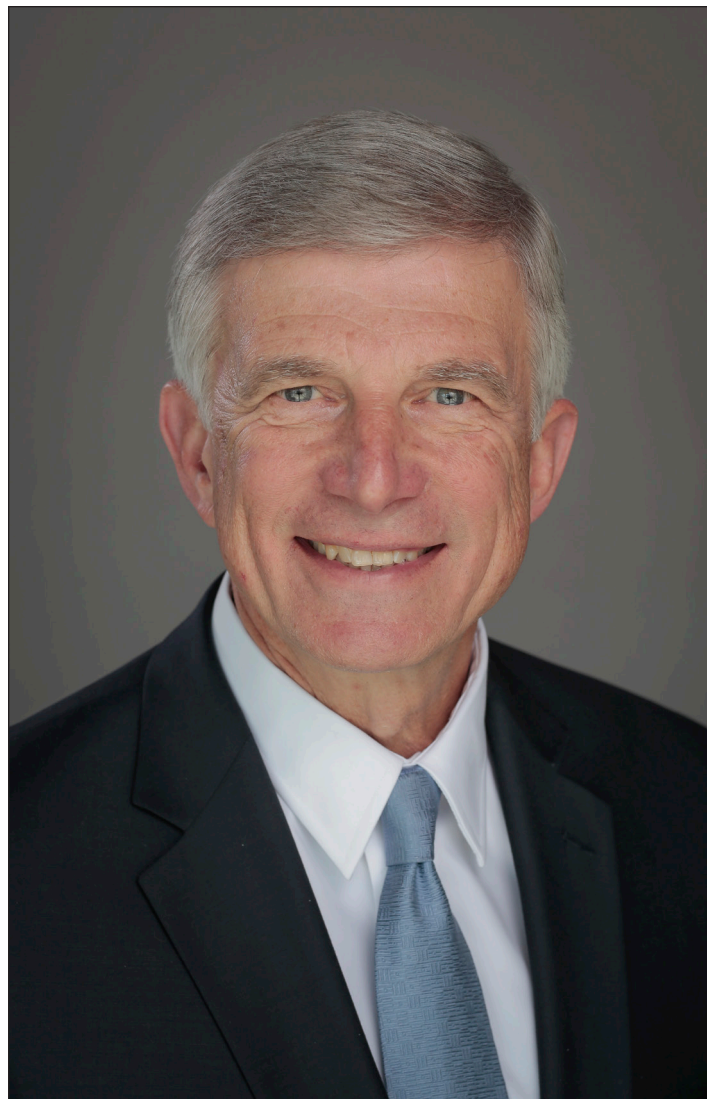
**The Propulsion Systems Hazards Subcommittee (PSHS) Technical Steering Group (TSG) has decided to change the name of the subcommittee to the Energetic Systems Hazards Subcommittee (ESHS). The TSG believes that the new name will better reflect the breadth of papers and discussions typically occurring under the subcommittee and alleviate any misconceptions that the subcommittee is “propellant” oriented when its purpose is to serve the entire energetics community.**

**Please look for the subcommittee name change in the December 2020 JANNAF Meeting Preliminary Program.**

# JANNAF Meets Virtually for the First Time in the Organization's 70-Year History

**T**he JANNAF community broke new ground by meeting virtually in late September and early October for the first time in the organization's nearly 70-year history. Due to the Covid-19 pandemic, participants in the 67th JANNAF Propulsion Meeting and the meeting of the 46th Structures and Mechanical Behavior (SMBS), 42nd Propellant and Explosives Development and Characterization (PEDCS), 33rd Rocket Nozzle Technology (RNTS), 31st Safety and Environmental Protection (SEPS) and 14th Modeling and Simulation (MSS) subcommittees gathered online using the Defense Information Systems Agency's Defense Collaboration Services (DCS) platform for all sessions and panel meetings. Paul J. Conroy of the U.S. Army Combat Capabilities Development Center Army Research Laboratory in Aberdeen Proving Ground, Md., chaired the two-week meeting, which also included a keynote by Ronald M. Sega, Ph.D., Chief Technology Officer of the U.S. Army Futures Command in Austin, Texas, focusing on the past, present, and future of propulsion systems and energetics technologies.

Sega drew on lessons learned from past space-flight activities and discussed how they could be applied to promoting U.S. national security in the present and the future, especially with potential adversaries improving their propulsion and energetics technologies at a rapid pace. As he noted, the "rate of change of technology is increasing. We can say



*Keynote speaker Ronald M. Sega, Ph.D., Chief Technology Officer, U.S. Army Futures Command, Austin, Texas.*

that we want to do better than we did last year... but [that's] not sufficient because we have to look at where the competition is and potential adversaries, of course, in the national security environment. So, as things are going very, very fast we have to... be at that speed or higher. Our metric is [to] learn more about how we are doing with respect to the rest of the world, versus only looking at how we did yesterday." He stressed the importance of working collaboratively across disciplines, especially in light of the technical challenges involved with developing complex propulsion systems such as hypersonic scramjets. Sega cited the significance of the 1957 Sputnik launch by the Soviet Union as a lightweight, easy to orbit, and extremely observable (both visually and through radio) artificial satellite

that achieved broad aims far beyond the scope of its relatively limited technical specifications. He also noted how U.S. rocket scientists quickly adapted ballistic missile warhead reentry vehicle designs to serve as the basis for spacecraft for the first U.S. astronauts of NASA's Mercury program. Sega highlighted parallels between the design and development of vehicles for the Apollo program and present-day concerns about developing hypersonic vehicles and support systems. As he noted, just as with the race to the moon in the 1960s, speed and scale are critical in the present era. In some cases, many vehicles may be needed for testing and development. Some may be lost and others should be recovered, especially those with crews. Expendable designs should also be included in the mix if they are cost effective. Sega argued that these factors influenced the development of the Saturn V rocket for the Apollo program, as well as the space vehicles used for the journey to the Moon and back. Sega

---

***“Our metric is [to] learn more about how we are doing with respect to the rest of the world, versus only looking at how we did yesterday..”***

---

then pivoted to discussing his own experiences in space as an astronaut on two Space Shuttle flights, Discovery in 1994 and Atlantis in 1996, respectively. On the 1994 flight, he served as Co-Principal Investigator for the Wake Shield Facility, which sought to characterize the ultrahigh vacuum created by the device sweeping upper-atmosphere gas molecules from the thermosphere aside as it orbited the Earth. He highlighted some design shortcuts that were implemented in the first Wake Shield Facility. A final configuration test was not completed prior to flight, and orbital deployment of the device revealed electromagnetic interference between components that hindered the success of the experiment in its first iteration. However, the experiment did help NASA to characterize the plumes from the maneuvering jets of the Space Shuttle, data that proved

its value in Sega's second flight during which Atlantis docked with the Russian MIR space station.

After discussing his spaceflight experiences, Sega discussed his work as Director of Defense Research and Engineering at the Department of Defense (DoD). He assumed the role in 2001 and following the September 11 attacks, assembled the national defense technical community to discuss programs that could be fielded rapidly and have an impact on U.S. military power. Within 48 hours,

---

***“The rest of the world has a vote in how fast we need to be delivering new capabilities... We really need to lead.”***

---

three programs were selected including a thermobaric device under development by the Navy that went from laboratory research to a fielded system in 90 days. Sega argued that similar rapid development ideas could be applied to other critical areas for national defense including hypersonic vehicle development, high-energy-density materials for use as propellants and explosives, directed energy technologies, and other related fields. He also highlighted the importance of technical systems reviews and workforce improvements for the rapid development of new propulsion and energetics technologies.

Sega discussed system-based aerospace efforts to develop scramjet vehicles and support systems for weapons and space access. He addressed various roadmaps for joint scramjet development efforts by NASA and the DoD and the necessary technologies to achieve various near-term and long-term project goals. He also touched on space-based technology goals and electrical power generation, storage, and distribution projects for directed energy weapons systems and other needs. Sega addressed efforts to lower the production risks of DoD projects by using more mature technologies upfront and increasing the risk in the science and technology development arena instead. He cited the example of GPS III development and production work, as well as the TacSat-2 and Space Test Program 1 launches. Last-

*(See September/October 2020 JANNAF Meeting on page 8)*



ly, Sega touched on multi-domain (MDO) studies. MDO warfare requires new technologies and conceptualization work through joint development efforts to achieve success against peer adversaries. In the case of JANNAF, he argued that it is important for program officials to pay attention to the high rate of change in technology across the globe and to leverage that change in order to achieve specific advances in domestic technology development. JANNAF should also leverage resources from the DoD, national labs, and other entities in order to develop new propulsion and energetics technologies rapidly and systematically. Finally, JANNAF should take a leadership role in propulsion and energetics technology development. As Sega concluded, “the rest of the world has a vote in how fast we need to be delivering new capabilities,” and in some critical areas, such as artificial intelligence and additive manufacturing, “we really need to lead.”

Following Sega’s keynote address, Paul Conroy introduced JANNAF Technical Executive Committee (TEC) Chair Drew DeGeorge of the Air Force Research Laboratory (AFRL), Edwards, Air Force Base, Calif., who thanked the AFRL contracting staff and Johns Hopkins University Energetics Research Group (JHU ERG) meeting planning staff for their hard work setting up and running the virtual meeting. He also thanked JANNAF Meeting participants on behalf of the TEC and Programmatic and Industrial Base Executive Committee for their willingness to assemble online and join the meeting remotely. He expressed hope that all attendees would find the meeting valuable and would continue to contribute to JANNAF in various ways until in-person meetings resumed. Next, Conroy presented the September 2020 JANNAF Meeting Student Best Paper Award to Jeremy Marcum of Purdue University in West Lafayette, Ind. Finally, *JANNAF Journal* Managing Editor Dr. Benjamin Schwantes of the JHU ERG in Columbia, Md., thanked meeting attendees for their contributions to the *JANNAF Journal*, especially following an

**JANNAF is pleased to announce the  
Modeling and Simulation Subcommittee  
(MSS) and Spacecraft Propulsion  
Subcommittee (SPS) Best Papers  
Awards for 2018 and 2019**

**MSS**

**2018 Long Beach, Calif.  
JANNAF Meeting**

**B. Bornhoft, D.M. Peterson, E. Hassan, M.A.  
Hagenmaier, T. Eymann, and R.A. Baurle**

**2019 Dayton, Ohio, and Tampa, Fla.,  
JANNAF Meetings**

**R.R. Shenoy, T.G. Drozda, R.A. Baurle, and  
P.A. Parker**

**SPS**

**2019 Tampa, Fla., JANNAF Meeting**

**M.S. McDonald and M.W. Nurnberger**

urgent call for papers in the summer. He reminded participants that Volume 11 of the annual publication is scheduled to be released in December 2020 and encouraged submissions for Volume 12, which is scheduled to be published in 2021. He also encouraged participants to volunteer as reviewers and associate editors, particularly those knowledgeable about pressure gain combustion. Schwantes reminded meeting attendees that all past volumes of the *JANNAF Journal* are available electrically on JDOC (the JANNAF Digital Online Collection) on the JANNAF website ([www.jannaf.org](http://www.jannaf.org)) and new volumes and papers will be published electronically exclusively on JDOC until in-person meetings resume. Conroy concluded the keynote event by encouraging JANNAF participants to publish their research in limited-distribution journals such as the *JANNAF Journal* and ensure that all security policies were observed when attending virtual sessions and handling meeting materials.



# Best Paper Award Winners Selected from 37th APS Meeting

**F**ollowing the 37th Airbreathing Propulsion Subcommittee (APS) Meeting held June 3-7, 2019, in Dayton, Ohio, the APS Technical Steering Group chose 17 of the 118 technical papers that were presented as nominations for the Best Paper Award. Two of those papers were chosen as co-winners when the final scores were tabulated and discussed with the APS Awards Review Team. The first paper is by Eric Blades and Azariah Cornish, ATA Engineering, Inc., Huntsville, Ala; and Patrick O'Hara, Mark Hagenmaier, and Dean Eklund, Air Force Research Laboratory/Aerospace Systems Directorate/Human Systems Integration Directorate (RQHP), Wright-Patterson Air Force Base, Ohio. This paper presents the results of fluid-thermal-structure interaction simulations to predict engine deflections for comparison with two successful high-speed powered flight tests. The simulations were performed at a representative flight condition and include the two main sources of heating: aerothermodynamic heating and heating due to combustion. The results of these simulations are consistent with trends observed in the flight test data. "This paper is an example of the analysis tasks that are required to address hypersonic-flight hardware. Additionally, it provides insight into the types of data that need to be collected during flight, and associated ground, tests to ultimately comprehend the net-performance value(s)," wrote one of the reviewers of the paper.

The second winning paper is by Bryan Kubitsek, Analytical Services & Materials, Inc., Hampton, Va.; Andrew Williams and Jacques Cuneo, Southern Research, Birmingham, Ala.; and Wallace Vaughn, David Glass, and Matthew Mahlin, NASA Langley Research Center, Hampton, Va. This paper provides Advanced Carbon-Carbon-6 composites (of interest for hot struc-

ture applications in hypersonic vehicles) material property data which are needed to develop high performance optimized hot structures. In particular, compression property data are desired to understand the strength at elevated temperatures subjected to various thermal and mechanical loading conditions (including monotonic stress, creep, and load-unload-reload compression). As one of the reviewers stated, it is "important data for the design of hypersonic systems, [and] good to see application of uncertainty quantification, something we need to push more as a community."

On behalf of the best paper review committee, as well as the 17 APS members who reviewed papers, I hope you will join me in offering a hearty congratulations to the recipients of this well-deserved honor.

*Larry Huebner*

*Airbreathing Propulsion Subcommittee*

**JANNAF is pleased to announce the  
Best Student Paper from the  
September/October 2020  
JANNAF Meeting**

**Student/Primary Author:**

**Jeremy W. Marcum**

**Authors:**

**Jeremy W. Marcum**

**Jeremy M. Manheim**

**Victoria M. Boulos**

**B.J. Updike**

**Hilkka I. Kenttämä**

**Timothée L. Pourpoint**

# Fall 2020 Virtual Meeting Subcommittee Review

## SMBS

The Structures and Mechanical Behavior Subcommittee (SMBS) met for the 46th time as a JANNAF Subcommittee from 29 Sept. to 9 Oct., 2020. Three technical sessions, four joint sessions, and four panel meetings were held with a total of 19 papers presented, including the joint sessions. Panel meetings discussed each of the technical areas currently in operation within SMBS. Planning was started for a Technical Steering Group meeting, which was held virtually on Oct. 30.

## PEDCS

The 42nd Propellant and Explosives Development and Characterization Subcommittee (PEDCS) opened its meeting on Tuesday morning, Sep. 29, 2020, with four presentations on solid propellant ingredients and followed the next day with two concurrent sessions: the Joint PEDCS/Structures and Mechanical Behavior Subcommittee “Materials Characterization” session had five presentations and “High Performance Propellants” had five presentations with an additional three associated papers to be published in JDOC only. Two liquid propellants sessions had nine papers combined and a panel meeting, and “Processing Technology for Ingredients Preparation” addressed many of the challenges in scale-up and safety in manufacturing of energetic materials. The “Gun Propulsion” session had seven papers including two on additive manufacturing of gun propellant charges, the “Propellant Binders” session reviewed technology suited for solid ramjet fuels, and the “Explosives Development Mission Area” session addressed topics related to modeling, development, and qualification of new explosive formulations and an update from the Critical Energetic Materials Working Group. The Mini-

mum Signature Propellants, Computational Approaches To Solid Propellants, and Detonation Measurements technical sessions had seven papers each, and the Joint Safety and Environmental Protection Subcommittee/PEDCS “Green Energetic Materials” technical session offered six technical presentations summarizing current work towards environmentally friendly energetic formulations followed by a highly collaborative panel meeting.

## SEPS

The 31st Safety and Environmental Protection Subcommittee (SEPS) held its first meeting on Wednesday, Sep. 30, 2020, with an eye towards the future with presentations addressing the national industrial base and international chemical regulations. In contrast, a demilitarization session focused on programs and technology used to address the safety of obsolete weapons systems and propellants. The SEPS Toxicology Mission Area’s technical session presented recent test data on existing and emerging energetic compounds as well as addressing strategy for assessing toxicity of new compounds under development. As always, the Joint SEPS/Propellant and Explosives Development and Characterization Subcommittee “Green Energetic Materials” technical session and associated panel meeting were well attended with six technical presentations addressing the development, evaluation, and system integration of environmentally friendly energetic formulations and a robust panel discussion of future efforts in green energetic technologies.

## RNTS

The Rocket Nozzle Technology Subcommittee (RNTS) met for the 33rd time in JANNAF history, in the first virtual conference held by JANNAF. There

was one session of RNTS papers, one joint session with the Modeling and Simulation Subcommittee (MSS) and one panel meeting on “Nozzle Analysis and Modeling.” While the face-to-face networking typical of past JANNAF meetings was missing, attendees were able to see the names of all attendees in the “room” and use that reminder to engage or re-engage with fellow technologists in the study of the unique problems within solid rocket nozzles, material characterization issues, and the special challenges of modeling the extremely complex and dynamic environment found within nozzles. Nine papers or presentations were released at the meeting.

## MSS

**T**he 14th Modeling and Simulation Subcommittee (MSS) held numerous sessions during the JANNAF Meeting. For the first time, MSS met alongside the Structures and Mechanical Behavior (SMBS), Propellant and Explosives Development and Characterization (PEDCS), Rocket Nozzle Technology (RNTS), and Safety and Environmental Protection (SEPS) subcommittees. The subcommittee's transition to scheduling a meeting every year with the JANNAF Propulsion Meeting proved to be a success and cross-subcommittee collaboration was evident. Half of the MSS sessions were held as joint sessions with either SMBS or RNTS. The main focus of the joint sessions were service life estimation and nozzle thermal, structural, and fluids analysis. MSS also held independent sessions on prognostic health management and advances in modeling and simulation.

Alongside regular sessions, a plenary talk along with two code demonstrations were also presented at the Sep./Oct. virtual meeting. Lee Davis, Ph.D. of Northrop Grumman Innovation Systems presented the plenary talk. Davis is extremely well known for his work in service life estimation through chemical and structural modeling. His presentation addressed condensed matter field theory and included some of the history of how it originated. His talk was well

attended, and on behalf of the JANNAF community, we wish him well in his retirement.

The meeting included a demonstration focused on Finite Element Model Builder (FEM Builder). An example was provided on how to model the temperature of a solid rocket motor that is at a launch site. This example took into account the sun's direction and heating as well as the radiative effects of the motor itself, the buildings surrounding and supporting the motor and the ground.

The MSS Technical Steering Group (TSG) did not meet during this JANNAF meeting.

### ***JANNAF Journal Electronic Prepublication Program is Live!***

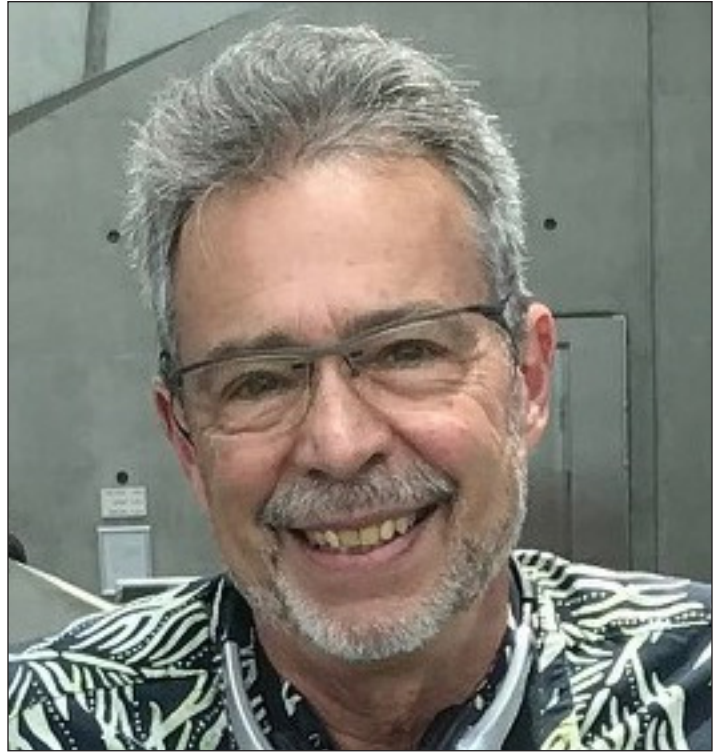
**The *JANNAF Journal of Propulsion and Energetics* is happy to announce that its new electronic prepublication program is now live. This program allows authors and readers to access articles much sooner than when the full volume is published annually. Publication-ready articles will be available electronically via JDOC, the JANNAF Digital Online Collection, as soon as they have been accepted for publication, edited, and approved by the author(s). Articles published electronically will still be available in print in the annual *JANNAF Journal* volume released each December. Five electronic prepublication articles are currently available and may be accessed via JDOC by searching for Abstract Numbers 2020-0001A through 2020-0001E. Future electronic prepublication articles will be announced via the news section on the front page of the JANNAF website.**



# In Memoriam

**T**he JANNAF community is saddened to learn of the passing of Michael Micci, Professor of Aerospace Engineering at Penn State University, on September 21, 2020, at the age of 66. Micci succumbed to cancer after an eight-month battle. Micci's research focused on all aspects of rocket propulsion and he authored and co-authored numerous papers for JANNAF Meetings from the late 1970s through the 2010s. In 2019, he presented a study on green monopropellants at the Dayton, Ohio, JANNAF Meeting.

Micci grew up in Joliet, Ill., in the 1960s and attended the University of Illinois at Urbana-Champaign, where he earned a B.S. and M.S. in aerospace engineering with an emphasis on rocket propulsion. He later completed a Ph.D. in the same field at Princeton University before joining the Penn State faculty in 1981. Micci rose through the ranks at Penn State and eventually received the rank of full professor in 1998. He also served as a visiting scientist and professor at numerous institutions including the Air Force Office of Scientific Research; the Office Nationale d'Études et de Recherches Aéropatiales in Paris, France; the University of London, Queen Mary; and various Air Force Research Laboratory facilities. His research included microwave electrothermal satellite propulsion thrusters, quantum



*Michael M. Micci, Ph.D. (1954-2020)*

computing for simulating molecular dynamic behavior in high performance liquid rocket engines, and green monopropellants. Micci published widely on the topic and also advised more than 40 masters and 14 doctoral students during his career.

Micci is survived by his wife, Catherine Cohan, sister Gina, and two children, Sofia and Carmen.

**68th JPM / PIB / 15th MSS / 12th LPS / 11th SPS**

**June 7-17, 2021**

**Virtual Meeting**

## Questions

Technical questions may be addressed to the following ERG technical representatives:

- JPM – Nick Keim ([nkeim@erg.jhu.edu](mailto:nkeim@erg.jhu.edu) / 443-718-5005)
- PIB – Kirk Sharp ([ksharp@erg.jhu.edu](mailto:ksharp@erg.jhu.edu) / 228-234-5423)
- MSS – Alex Bishop ([abishop@erg.jhu.edu](mailto:abishop@erg.jhu.edu) / 443-718-5008)
- LPS – Ben Hill-Lam ([bhill-lam@erg.jhu.edu](mailto:bhill-lam@erg.jhu.edu) / 443-718-5011)
- SPS – Alex Bishop ([abishop@erg.jhu.edu](mailto:abishop@erg.jhu.edu) / 443-718-5008)

For all other meeting-related matters, please contact Shelley Cohen ([scohen@erg.jhu.edu](mailto:scohen@erg.jhu.edu) / 410-992-7302).

# JANNAF History: Looking Back at the CPIA Bulletin

In December 1974, the Chemical Propulsion Information Agency (CPIA) introduced its bimonthly, unclassified bulletin at no charge to the propulsion community. The publication served to inform readers of CPIA's products and services, as well as JANNAF's activities, publications, participants, places, and ideas in the chemical propulsion community. While the preponderance of JANNAF technical data was released in CPIA's classified quarterly, the bulletin sought to engage with readers by encouraging them to submit articles for publication regarding their work and that of their organizations in the field of propulsion. The CPIA staff hoped that this would broaden the scope of the bulletin, while also providing information that would normally only be available from a purely technical periodical.

The enthusiastic response of readers to one of the many features of the inaugural bulletin confirmed CPIA staff's specula-

tion. The technical inquiry service, responsible for fulfilling literature searches, received nearly 100 requests for information following the publication of an initial set of literature searches in the December issue. These non-proprietary inquiries are outlined in the table, Non-Proprietary Technical Inquiries.

Editors responded to readers in the April 1975 bulletin issue, stating, "we will continue listing new searches." Thus, the literature searches printed for the enrichment of the propulsion community were substantiated by the very design that inspired the bulletin itself. These completed non-proprietary inquiries were printed in the June issue, heralding the beginning of a regular and continuing resource for the community.

*Courtesy of Peter Bearden  
Energetics Research Group*

Non-Proprietary Technical Inquiries	
Example Topics	Results Returned
Ignition and Combustion Characteristics of Mg, Zr, ZrH <sub>2</sub> particles and grains containing Mg Metal	(1957-1974, 29 references, titles and abstracts)
N-Hexylcarborane: Manufacturing Process (Pilot Plant)	(1968-1974, 6 references, titles and abstracts)
Analysis and Experimental Methods for Measuring Velocity coupled Combustion Instability	(1959-1974, 56 references, titles and abstracts)
Accelerated Aging Tests for Solid Propellants	(1969-1974, 53 references, titles and abstracts)
Rocket Motor Thrust Termination Methods	(1957-1974, 71 references, titles and abstracts)
Chemistry, Characterization and Properties of HMX and RDX	(1964-1974, 66 references, titles and data sheets)
Large Size Motor Failures and Failure Analysis	(1964-1974, 60 references, titles and abstracts)
Solid Fuels for Air Breathing Applications	(1969-1974, 57 references, titles and abstracts)
Advanced Technology for the Orbit Injection Motor	(1969-1974, 57 references, titles and abstracts)
Ignition and Combustion Problems Associated with the Development of the Navy's 2.75-in. FFAR (Mighty Mouse)	(1946-1974, 61 references, titles and abstracts)

# ERG Communications and Publications Team Keeps JANNAF Informed on the Latest News and Research

**T**he ERG Communications and Publications team consists of two full time staff—Linda McLean and Benjamin Schwantes. They can be seen at JANNAF meetings promoting and distributing the *JANNAF Journal of Propulsion and Energetics*, filming sessions, and talking to attendees about potential *JANNAF News* stories and how to improve JANNAF networking opportunities at meetings. Like most of the ERG staff, they are often in technical sessions as administrators during the virtual JANNAF meetings.

Linda McLean is the Communications and Publications Manager, overseeing all communications and publications for ERG and JANNAF, including the *JANNAF Journal* and *JANNAF News*. McLean also works on content for the various websites that ERG runs including [www.jannaf.org](http://www.jannaf.org) and [www.erg.jhu.edu](http://www.erg.jhu.edu); films keynote sessions and technical sessions that session chairs



*ERG Communications and Publications Manager  
Linda McLean*

wish to be documented at the JANNAF Meetings; conducts interviews for historical purposes and news stories; and supports the Programmatic and Industrial Base Executive Committee and working groups with editing and compiling reports.

Benjamin Schwantes has a Ph.D. in the history of technology, which has made him an astute asset to JANNAF as the managing editor of the *JANNAF Journal of Propulsion and Energetics* and editor of the *JANNAF News*. During his time at ERG, he has made substantive connections with authors, reviewers, editors, and other subject matter experts that have improved the quality of the technical journal and the efficiency of its peer review process. Schwantes can be seen at every in-person JANNAF meeting at the *JANNAF Journal* table distrib-

uting copies of the journal and networking with potential authors, reviewers, and editors. He often gives a short speech about the jour-



*JANNAF Journal Managing Editor  
Benjamin Schwantes*

nal after the Keynote Speech at JANNAF Meetings. If you have a story idea for the *JANNAF News*, or would like to submit a paper for the *JANNAF Journal*, please contact Benjamin at [BSchwantes@erg.jhu.edu](mailto:BSchwantes@erg.jhu.edu).

## ERG Offers JANNAF Technical Products and Services

The Energetics Research Group (ERG) at Johns Hopkins University offers both unclassified and classified-level technical products and services by subscription. Non-government subscribers to ERG products and services are required to maintain active registration with the Defense Logistics Agency (DLA) to receive export-controlled, militarily critical technical information. They must also be certified by a sponsoring government official to document that they are currently performing work under a government contract.

For further information please visit <https://www.erg.jhu.edu/subscriptions> or contact the ERG Customer Service Line at 410-992-7300 or Tricia Frey at [tfrey@erg.jhu.edu](mailto:tfrey@erg.jhu.edu).



# JANNAF JOURNAL OF PROPULSION AND ENERGETICS

## The Call For Papers is Ongoing

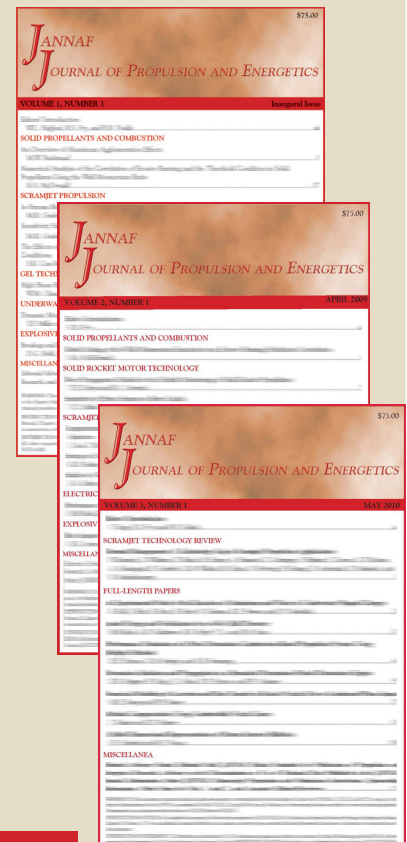
Submit your manuscript NOW for consideration in  
**Volume 12**

**F**or questions on....  
manuscript style or preparation, figures and graphics,  
submission procedures, and deadlines

Contact Journal Managing Editor  
Benjamin Schwantes at  
[Bschwantes@erg.jhu.edu](mailto:Bschwantes@erg.jhu.edu)

**F**or matters related to....  
technical topics, special focus areas, research, and data

Contact Technical Advisor Nicholas Keim  
at [JournalTA@erg.jhu.edu](mailto:JournalTA@erg.jhu.edu)



# *ERG Directory*

## **DIRECTOR**

**Peter E. Zeender**

[pzeender@erg.jhu.edu](mailto:pzeender@erg.jhu.edu) / 443-718-5001

## **DEPUTY DIRECTOR**

**Nicholas Keim**

[nkeim@erg.jhu.edu](mailto:nkeim@erg.jhu.edu) / 443-718-5005

## **CUSTOMER SERVICE**

### **General Inquiries**

410-992-7300

### **Technical Inquiries**

410-992-7301

## **Administrative Staff**

**Debbie Eggleston**

Administrative Manager

[dse@jhu.edu](mailto:dse@jhu.edu) / 443-718-5002

## **Meetings**

**Shelley Cohen**

JANNAF Meeting Manager

[scohen@erg.jhu.edu](mailto:scohen@erg.jhu.edu) / 410-992-7302

**Gabrielle Delisle-Ballard**

Assistant Meeting Planner

[gdelisle@erg.jhu.edu](mailto:gdelisle@erg.jhu.edu) / 410-992-7300 ext. 208

## **Security**

**Mary Gannaway**

Facility Security Officer

[mtg@jhu.edu](mailto:mtg@jhu.edu) / 410-992-7304 ext. 211

**Tricia Frey**

Assistant Facility Security Officer

[tfrey@erg.jhu.edu](mailto:tfrey@erg.jhu.edu) / 410-992-7300

## **INFORMATION TECHNOLOGY**

**Bruce Dennett**

IT Manager

[bdennett@erg.jhu.edu](mailto:bdennett@erg.jhu.edu) / 443-718-5003

**Paco Wong**

Software Engineer

[pwong@erg.jhu.edu](mailto:pwong@erg.jhu.edu) / 410-992-7307 ext. 213

**Rowan Harcourt-Brooke**

LAN Administrator

[rharcourt-brooke@erg.jhu.edu](mailto:rharcourt-brooke@erg.jhu.edu) / 410-992-7304 ext. 203

## **COMMUNICATIONS AND PUBLICATIONS**

**Linda McLean**

Communications and Publications Group Manager

[lmclean@erg.jhu.edu](mailto:lmclean@erg.jhu.edu) / 410-992-7304 ext. 225

**Benjamin Schwantes**

*JANNAF Journal* Managing Editor/*JANNAF News* Editor

[bschwantes@erg.jhu.edu](mailto:bschwantes@erg.jhu.edu) / 410-992-7300 ext. 227

## **TECHNICAL REPRESENTATIVES**

**William Bagley**

[wbagley@erg.jhu.edu](mailto:wbagley@erg.jhu.edu) / 443-718-5009

**Alex Bishop**

[abishop@erg.jhu.edu](mailto:abishop@erg.jhu.edu) / 443-718-5008

**Bryan DeHoff**

[bryan.dehoff@aerospacetechnic.com](mailto:bryan.dehoff@aerospacetechnic.com) / 513-378-7071

**Ben Hill-Lam**

[bhill-lam@erg.jhu.edu](mailto:bhill-lam@erg.jhu.edu) / 443-718-5011

**Kirk Sharp**

[ksharp@erg.jhu.edu](mailto:ksharp@erg.jhu.edu) / 228-234-5423

# *JANNAF Technical Executive Committee*

## **CHAIRMAN**

**Mr. Drew O. DeGeorge**  
Air Force Research Laboratory/EAFB

## **ARMY**

**Dr. Jay S. Lilley**  
Army CCDC Aviation & Missile Center/  
Redstone Arsenal

**Dr. Rose A. Pesce-Rodriguez**  
Army CCDC Army Research Laboratory/APG

## **NAVY**

**Dr. Jeffery J. Davis**  
Naval Air Warfare Center Weapons Division/  
China Lake

**Mr. Frank C. Tse**  
Naval Surface Warfare Center/Indian Head

## **NASA**

**Dr. Daniel J. Dorney**  
NASA Marshall Space Flight Center/Huntsville

**Dr. Dhanireddy R. Reddy (D.R.)**  
NASA Glenn Research Center/Cleveland

## **AIR FORCE**

**Mr. Drew O. DeGeorge**  
Air Force Research Laboratory/EAFB

**Mr. Robert A. Mercier**  
Air Force Research Laboratory/WPAFB

## **JANNAF COR**

**Mr. Carl E. Ousley**  
Air Force Research Laboratory/EAFB





# *JANNAF Programmatic & Industrial Base Executive Committee*

## CO-CHAIRS

**Dr. Christine Michienzi**

OSD (AT&L) (MIBP)/Washington, D.C.

**Dr. Thomas M. Brown**

NASA Marshall Space Flight Center/Huntsville

## ARMY

**Dr. Jamie B. Neidert**

Army CCDC Aviation & Missile Center/Redstone Arsenal

**Mr. David L. Tritt**

Army PEO (M&S)/Redstone Arsenal

## NAVY

**Mr. Shahab U. Chaudhry**

Navy Strategic Systems Program/Washington, D.C.

**Mr. Frank C. Tse**

Naval Surface Warfare Center/Indian Head

## NASA

**Dr. George R. Schmidt**

NASA Glenn Research Center/Cleveland

## AIR FORCE

**Mr. Drew O. DeGeorge**

Air Force Research Laboratory/EAFB

**Lt. Col. David Rondeau**

Air Force SAF (SPA)/Washington, D.C.

**Lt. Col. Shaun Easley**

Air Force (A10)/Washington, D.C.

## DEPARTMENT OF DEFENSE

**Mr. Jason Jouet**

OSD (R&E)/Washington, D.C.

**Mr. Sean Miller**

DCMA (Industrial Analysis Group)/  
Philadelphia

**Mr. David McNiell**

Missile Defense Agency (ECD)/Fort Belvoir

**Mr. Douglas G. Smith**

DLA (Energy Aerospace)/San Antonio

## ERG REPRESENTATIVE

**Mr. Kirk Sharp**



# JANNAF Subcommittee Chairmen and ERG Representatives

Subcommittee/Chair	Deputy Chair	ERG Representative
<b><i>AIRBREATHING PROPULSION (APS)</i></b>		
<b>Dr. Jeffrey M. Donbar</b> Air Force Research Laboratory/WPAFB	<b>Mr. Charles P. Leonard</b> NASA Langley Research Center	<b>Mr. Alex Bishop</b>
<b><i>COMBUSTION (CS)</i></b>		
<b>Dr. Heather F. Hayden</b> Naval Surface Warfare Center/Indian Head	<b>Dr. Ghanshyam L. “Gammy” Vaghjiani</b> Air Force Research Laboratory/EAFB	<b>Mr. Ben Hill-Lam</b>
<b><i>ENERGETIC SYSTEMS HAZARDS (ESHS)</i></b>		
<b>Mr. Adam J. Brand</b> Air Force Research Laboratory/EAFB	<b>Dr. Joel B. Stewart</b> Army CCDC Army Research Laboratory	<b>Mr. William Bagley</b>
<b><i>EXHAUST PLUME and SIGNATURES (EPSS)</i></b>		
<b>Dr. Milton E. Vaughn Jr.</b> Army CCDC Aviation & Missile Center	<b>Dr. Kevin D. Kennedy</b> Army CCDC Aviation & Missile Center	<b>Mr. Nicholas Keim</b>
<b><i>JANNAF PROPULSION MEETING (JPM)</i></b>		
<b>Dr. David R. Gonzalez</b> Naval Surface Warfare Center/Indian Head	<b>Mr. Bruce R. Askins</b> NASA Marshall Space Flight Center	<b>Mr. Nicholas Keim</b>
<b><i>LIQUID PROPULSION (LPS)</i></b>		
<b>Mr. James L. Cannon</b> NASA Marshall Space Flight Center	<b>Dr. Daniel L. Brown</b> Air Force Research Laboratory/EAFB	<b>Mr. Ben Hill-Lam</b>
<b><i>MODELING and SIMULATION (MSS)</i></b>		
<b>Dr. Michael D. Watson</b> NASA Marshall Space Flight Center		<b>Mr. Alex Bishop</b>
<b><i>PROPELLANT and EXPLOSIVES DEVELOPMENT and CHARACTERIZATION (PEDCS)</i></b>		
<b>Dr. Gregory Drake</b> Army CCDC Aviation & Missile Center		<b>Mr. William Bagley</b>
<b><i>ROCKET NOZZLE TECHNOLOGY (RNTS)</i></b>		
<b>Mr. Timothy W. Lawrence (Acting)</b> NASA Marshall Space Flight Center		<b>Mr. Bryan DeHoff</b>
<b><i>SAFETY and ENVIRONMENTAL PROTECTION (SEPS)</i></b>		
<b>Dr. Sara K. Pliskin</b> Naval Surface Warfare Center/Crane	<b>Dr. David R. Mattie</b> 711 Human Performance Wing/WPAFB	<b>Mr. William Bagley</b>
<b><i>SPACECRAFT PROPULSION (SPS)</i></b>		
<b>Dr. William A. Hargus Jr.</b> Air Force Research Laboratory/EAFB	<b>Dr. Hani Kamhawi</b> NASA Glenn Research Center	<b>Mr. Alex Bishop</b>
<b><i>STRUCTURES and MECHANICAL BEHAVIOR (SMBS)</i></b>		
<b>Dr. Jeremy R. Rice</b> Army CCDC Aviation & Missile Center	<b>Mr. Robert W. Pritchard</b> Naval Air Warfare Center Weapons Division	<b>Mr. Bryan DeHoff</b>

# *JANNAF Programmatic & Industrial Base Working Groups and Panels*

## **Working Group/Lead**

### ***LARGE LIQUID PROPULSION***

**Mr. Michael J. Klassen**  
The Aerospace Corp/El Segundo

### ***SMALL LIQUID PROPULSION***

**Mr. Charles W. “Chuck” Pierce**  
NASA Marshall Space Flight Center

### ***LARGE SOLID ROCKET MOTOR***

**Mr. Timothy W. Lawrence**  
NASA Marshall Space Flight Center

### ***SMALL SOLID ROCKET MOTOR***

**Mr. Frank C. Tse**  
Naval Surface Warfare Center/Indian Head

### ***ELECTRIC PROPULSION***

**Mr. David T. Jacobson**  
NASA Glenn Research Center

### ***SCIENCE and TECHNOLOGY***

**Mr. Drew O. DeGeorge**  
Air Force Research Laboratory/EAFB

### ***TEST and EVALUATION***

**Mr. Michael J. Klassen**  
The Aerospace Corporation/Chantilly

## **Panels/Lead**

### ***COMMODITIES***

**Mr. Douglas G. Smith**  
DLA (Aerospace Energy)/San Antonio

### ***ROCKET SYSTEM REUSABILITY***

**Mr. Michael H. Kynard (co-lead)**  
NASA Marshall Space Flight Center

**Col. John Strizzi (co-lead)**  
Air Force Space and Missile Systems Center/El Segundo

