The importance of maintaining reliable supplies of materials needed for military operations has long been recognized. Munitions producers and their customers need to be aware of potential supply problems before they become real problems. In so doing, they will be able to minimize the effects of shortages by establishing alternative suppliers in advance.

A properly maintained database is a useful tool for keeping abreast of changes in material supplies. The Naval Surface Warfare Center at Indian Head, Maryland, and the Air Force Research Laboratory at Edwards AFB, California, have long had an interest in supporting the necessary database development and maintenance. Most recently, they have jointly funded the establishment of an online database at CPIAC, known as the Propellant and Explosive Ingredients Database (PEID). PEID started with the 107 ingredients included in the printed CPIAC M3 Solid Propellant Ingredients Manual. In addition to converting the manual to an online version, data on suppliers and criticality of supply have been added, and the number of ingredients has been increased to 305, with corresponding data on 137 suppliers.

JANNAF Executive Committee Initiates New Plans for Meetings

by Debra Eggleston, CPIAC

Members of the Joint Army-Navy-NASA-Air Force (JANNAF) Executive Committee (EC) met in May 2007 for their Annual JANNAF Subcommittee Review. During this meeting, the recent history of subcommittee meetings was discussed and a new plan was generated to update the current arrangement of joint subcommittee meetings and the nature and rotation of the JANNAF Propulsion Meeting. These changes are being implemented to improve cross-fertilization between the subcommittees and to generate larger conferences allowing for added hotel negotiation power at desirable site locations across the continental United States.

The new subcommittee meeting cycle will begin with the conduct of the 55th JANNAF Propulsion Meeting and JANNAF 42nd Combustion, 30th Airbreathing Propulsion, 30th Exhaust Plume Technology, 24th Propulsion Systems Hazards, and 12th Spectral and In-band Radiometric Imaging of Targets and Scenes (SPIRITS) Users Group Joint Subcommittee Meeting, which will be held May 12-16, 2008, at the Boston Marriott Newton in Newton, Massachusetts. The Meeting...
CPIAC’s Technical/Bibliographic Inquiry Service

CPIAC offers a variety of services to its subscribers, including responses to technical/bibliographic inquiries. Answers are usually provided within three working days and take the form of telephoned, telefaxed, 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 program tapes and instructions, and/or theoretical performance calculations. The CPIAC staff responds to nearly 800 inquiries per year from over 180 customer organizations. CPIAC invites inquiries via telephone, fax, e-mail, or letter. For further information, please contact Ron Fry at 410-992-7306, or by e-mail to rs_fry@jhu.edu. Representative recent inquiries include:

TECHNICAL INQUIRIES

- High energy density materials (HEDM) characteristic data (Req. 25567)
- Lowest burn rate achieved in production of Al/PBAN propellant formulations (Req.25569)
- Human rating requirements for space systems (Req. 25580)
- Hazard analysis of an IRFNA/JP-8 spill (Req. 25538)
- Solid Rocket Motor Grain Crack Combustion, Analysis, Modeling, and Testing (Req. 25487)

BIBLIOGRAPHIC INQUIRIES

- Hydrogen peroxide explosion accidents (Req. 25458)
- Summary of 2x4 motor data reduction methods (Req. 25550)

Recent CPIAC Products and Publications


The Chemical Propulsion Information Analysis Center (CPIAC), a DoD Information Analysis Center, is sponsored and administratively managed by the Defense Technical Information Center (DTIC). CPIAC is responsible for the acquisition, compilation, analysis, and dissemination of information and data relevant to chemical, electric, and nuclear propulsion technology. In addition, CPIAC provides technical and administrative support to 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. A fee commensurate with CPIAC products and services is charged to subscribers, who must meet security and need-to-know requirements.

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Various meetings and events of interest are listed below. We welcome all such announcements so that the propulsion community can be better served with timely information. For information on additional industry meetings, visit CPIAC’s calendar of *Meetings & Symposia*, available at [http://www.cpiac.jhu.edu/templates/cpiacTemplate/meetings/](http://www.cpiac.jhu.edu/templates/cpiacTemplate/meetings/). The JANNAF Meeting Calendar appears on the back page.

**Global MilSatCom2007 Conference and Exhibition**
5-7 November 2007
London, UK
POC: [www.smi-online.co.uk/milsatcom3.asp](http://www.smi-online.co.uk/milsatcom3.asp) or e-mail Nicolas Pianet at npianet@smi-online.co.uk

**8th Australian Ordnance Symposium (PARARI 2007)**
13-15 November 2007
Melbourne, NSW, Australia

**46th AIAA Aerospace Sciences Meeting and Exhibit (AIAA)**
7-10 January 2008
Reno, NV
POC: [www.aiaa.org](http://www.aiaa.org)

**AIAA Strategic and Tactical Missile Systems Conference**
23-24 January 2008
Monterey, CA
POC: [www.aiaa.org](http://www.aiaa.org)

**34th ISEE Annual Conference**
27-30 January 2008
New Orleans, LA
POC: [www.isee.org](http://www.isee.org)

**NDIA Gun and Missile Systems Conference and Exhibition**
21-24 April 2008
New Orleans, LA
POC: [www.ndia.org](http://www.ndia.org)

**Space Ops 2008**
11-17 May 2008
Heidelberg, Germany
POC: [www.aiaa.org](http://www.aiaa.org)

**26th International Symposium on Space Technology and Science (ISTS)**
1-8 June 2008
Hanamatsu City, Shizuoka Prefecture, Japan
POC: [www.ists.or.jp](http://www.ists.or.jp)

**39th Annual Conference of ICT**
24-27 June 2008
Karlsruhe, Germany
POC: [www.ict.fhg.de](http://www.ict.fhg.de)

**35th International Pyrotechnics Seminar**
13-18 July 2008
Fort Collins, CO
POC: [www.ipsusa.org](http://www.ipsusa.org)

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**Meeting Reminders**

**55th JANNAF**
Propulsion Meeting/
42nd Combustion
Subcommittee (CS)/
30th Airbreathing
Subcommittee (APS)/
30th Exhaust Plume
Technology Subcommittee
(EPTS)/24th Propulsion
Systems Hazards
Subcommittee (PSHS)/
12th SPIRITS User Group
Joint Meeting

12-16 May 2008
Newton, MA

**Abstract due: 17 December 2007**

For more information on the above meeting, contact Pat Szybist or Krystle Jones, CPIAC, at 410-992-7302, ext. 215, or 410-992-7301, ext. 201, respectively, or by e-mail to pats@jhu.edu or kjones@cpiac.jhu.edu.

Visit JANNAF’s Web site [www.jannaf.org](http://www.jannaf.org) for up-to-date details and other valuable JANNAF resources.
The M3 Manual does not attempt to evaluate criticality of supply or to describe real or potential supply problems. Although criticality of supply cannot be represented as a quantitative characteristic, some means of rating it was needed. The solution that CPIAC adapted was to classify each ingredient into one of five categories, with each category symbolized by an appropriate color:

**Red** – Supply and/or technical problems with the ingredient are affecting current weapon production. (No ingredients are currently in this category.)

**Orange** – Weapon production in the near future could be affected by significant supply and/or technical problems.

**Yellow** – Weapon production is unaffected, but could be threatened in the longer term by various conditions.

**Green** – Weapon production is unaffected, and there are no known supply issues.

**Black** – The ingredient is not used commercially in energetic materials at the present time.

An ingredient does not receive a Green rating if there is no more than one current supplier in the United States.

The Technical Cooperation Program (TTCP) has been an especially valuable source of information on ingredient criticality. TTCP is an international organization that collaborates in defense-related technical information exchange, program harmonization, and shared research activities. It is comprised of eleven groups, including the conventional weapons technology group, commonly referred to as WPN. One of the technical panels of WPN, namely TP-4, has been monitoring the availability of critical materials for energetics and propulsion, and it issues annual reports on their status. TP-4 was also instrumental in developing the five-category system of rating criticality. Since CPIAC has participated in the TP-4 Critical Materials activities, it has been possible to stay informed of many potential supply problems that might not otherwise have come to our attention. The present version of PEID includes findings of the most recent panel meeting, which was in February 2007.

PEID provides rapid access to general ingredient information, physical and thermodynamic characteristics, ingredient suppliers, and downloadable ingredient data reports. Ingredient data records may be searched, browsed, displayed, and/or printed. The database user may search for ingredients by acronym or short name, criticality rating, chemical name, trade name, Chemical Abstracts Service (CAS) registry number, primary use, type of material, function, supply status, supplier, source country, and whether there is no more than one current U.S. source. Multiple search criteria may be specified. Figure 1 is a screen shot of the PEID Search page.

If the search is successful in locating at least one ingredient record that matches the search criteria (a “hit”), a Search Hits screen will appear. The Search Hits screen displays a tabular listing of the ingredient records in a brief format and allows the user to perform additional discriminating functions prior to accessing detailed ingredient records. The brief format lists each ingredient by its acronym, criticality rating, CAS Number, type of material, function, and supply status.

Detailed information on any hit ingredient is available via “View” or “Print” links. If some ingredients are not relevant to the user’s interests, they may be excluded manually, or the search may be modified and rerun. The most convenient way to view detailed information on all hit ingredients is with the...
For each ingredient, there are four Browse pages: General, Physical/Thermodynamic Properties, Safety/Handling Data, and Suppliers.

The General browsing page contains the ingredient’s acronym, chemical name(s), criticality rating, CAS number, primary use, type of material (energetic, inert, or reactive), function, supply status, a flag for single or no current U.S. source, specifications if any, remarks, and reference links. The reference links are hyperlinks to scanned data pages from the CPIA/M3 Manual, suppliers’ product data sheets, and/or material safety data sheets. Links to pages from the M3 Manual are provided because the manual contains some data that are not explicitly entered into PEID, such as sensitivity.

The Physical/Thermodynamic Properties page contains the ingredient’s physical state, color, density, molecular weight, melting point, boiling point, and heat of formation. The Safety/Handling Data page contains the ingredient’s Department of Transportation (DOT) hazard classification, shelf life, storage and stability data, toxicity, environmental and regulatory information.

The Suppliers page first appears as a brief summary listing of ingredient supplier(s). Hyperlinks provide additional information on each supplier, consisting of the supplier’s name and address, contact information, trade name(s), production status, year of most recent production, production capacity, percent of capacity utilized, ingredient pricing, and whether the supplier complies with ingredient specifications. Because most suppliers consider production capacity and percent of capacity proprietary information, only limited data are available for those fields.

Three reporting formats are available:

- The Ingredient Data Sheet format is an abbreviated version of traditional chemical data sheets. One or two pages are devoted to each ingredient, depending on how much information is available. Ingredients are not combined on any one page.
- The Criticality Index format consists of a table of all ingredients found by the search, with CAS number, status, and criticality index color code for each one. Below the table is a legend that conveys the meanings of the color codes.
- In the Ingredient Suppliers format, one or two pages are devoted to each supplier, depending on how many ingredients the supplier produces or has produced. Suppliers are not combined on any one page. Supplier identification and contact information appear first, followed by a table of ingredients associated with the supplier and found by the search.

All reports are created as rich-text format (rtf) files that can be edited, printed or saved.

It is necessary to have a Chemical Propulsion Information Network (CPIN) account to access PEID on the Web. CPIN is the secure Internet portal to CPIAC’s suite of chemical propulsion-related technical and bibliographic databases, online publications, and downloadable JANNAF papers. Information on how to obtain a CPIN account is available by calling CPIAC Customer Service at 410-992-7300, ext. 211 or 212.

SOFTWARE AND ENGINEERING ASSOCIATES, INC.

in Carson City, Nevada, is looking for two engineering professionals who have experience in fluid mechanics, combustion, and propulsion systems, and who are adept at programming in the FORTRAN language.

Ideal candidates will possess an MS or Ph.D. in Mechanical, Aerospace, or Chemical Engineering.

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For more information, visit our web site at www.seainc.com.

U.S. Citizenship Required
Announcement and Call for Papers were distributed via-mail to these respective communities on October 9, 2007.

The second meeting in this new cycle will be the JANNAF 6th Modeling and Simulation, 4th Liquid Propulsion, and 3rd Structures and Mechanical Behavior, and 35th Protection, and 17th Nondestructive Evaluation Joint Subcommittee Meeting. This meeting is tentatively scheduled for December 2008 and will be held in either Orlando, Florida, or Atlanta, Georgia. The Meeting Announcement and Call for Papers should be distributed to these respective communities in early 2008.

In approximately May 2009, the 56th JANNAF Propulsion Meeting and 39th Structures and Mechanical Behavior, 35th Propellant Explosives Development and Characterization, 26th Rocket Nozzle Technology, 24th Safety and Environmental Protection, and 17th Nondestructive Evaluation Joint Subcommittee Meeting will be conducted. The Meeting Announcement and Call for Papers should be distributed to these respective communities in the summer of 2008.

All JANNAF Subcommittee Meetings will continue to meet regularly on an eighteen-month cycle; however, the JANNAF Propulsion Meeting will meet annually in conjunction with each Spring/Summer joint subcommittee meeting. The purpose of this arrangement is to include the different “technical flavors” of the subcommittee disciplines within the JPM “systems” composition.

To provide the community a review of the JANNAF Interagency Propulsion Committee (IPC), the following information is provided. Descriptions of each subcommittee are included at the end of this article; the subcommittee descriptions are grouped according to technical discipline.

The JANNAF IPC, or just JANNAF, consists of an Executive Committee (EC) and 12 technical subcommittees. The purpose of JANNAF is to promote and facilitate exchange of limited-distribution technical information among the Military Departments, Defense Agencies, NASA, industry and academia; to establish standards and guidelines; to effect coordination and eliminate unnecessary duplication of basic research, applied research, exploratory development, and advanced technology development programs in the areas of missile, gun, space propulsion and related areas; to accomplish problem solving in areas of joint interest; and to capture and preserve essential corporate knowledge. The JANNAF scope includes the technology of solid, liquid, hybrid, airbreathing, electric, gun and advanced propulsion systems and includes ingredient synthesis; manufacturing, fabrication, processing, and characterization; thermochemistry; steady-state, transient, unstable, subsonic and supersonic combustion; detonation; physical, chemical, thermodynamic, mechanical, and ballistic properties of oxidizers, binders, plasticizers, stabilizers, burning rate modifiers, propellants, fuels, pyrotechnics, and explosives; special test equipment and techniques; analytical test techniques; interior and terminal ballistics; fluid dynamics; reacting flows; analytical and diagnostic test procedures; exhaust plume technology; component and propulsion unit design; performance prediction and measurement; health management, monitoring and control; nondestructive evaluation; service life; reliability; operational serviceability; life-cycle costs; demilitarization; safety; environmental, occupational and explosive hazards; insensitive munitions; and materials.

The JANNAF Executive Committee is the governing body of JANNAF in accordance with the Agreement and Charter of the JANNAF IPC. It is responsible for the establishment, operation, modification, and dissolution of subcommittees; periodic review of subcommittee activities; and the promulgation of guidelines for subcommittee operations. The Chairman of the EC also serves as the primary spokesperson for JANNAF.

The EC consists of eight regular members; two from each of the JANNAF affiliate agencies. Each member, appointed by his/her affiliate agency, is a full-time employee of the Federal government. Alternate members may be designated for the purpose of agency representation at meetings and receipt of information on EC activities and plans. The tenure of office of the members is at the discretion of the affiliate agency. Members shall recommend and initiate the process of appointing their successor to the JANNAF EC upon termination of their employment with the government or resignation from the EC. The chairmanship of the EC is rotated among the four agencies every three years.

The JANNAF Subcommittees focus on technical issues that are of current interest to the JANNAF agencies. Their general goals are to promote the exchange of technical information and data, establish standard procedures and nomenclature, effect the coordination of government-funded propulsion programs, and provide expertise for the identification and solution of propulsion problems. Technical Steering Groups (TSGs), composed of representatives of the JANNAF agencies, manage the activities of each of the subcommittees and form panels to address technical tasks assigned by the TSG.

The JANNAF Propulsion Meetings (JPMs) promote the exchange of technical information in the fields of missile, space, and gun propulsion systems. These meetings assemble scientists and engineers who are responsible for leading the research and engineering efforts on government-sponsored and government-performed programs in these areas for the purpose of sharing information and research results; and are part of a series of such meetings dating back to the late 1940s.

Individuals having questions regarding the new JANNAF subcommittee meeting cycles or wishing to ensure receipt of JANNAF meeting announcements should contact CPIAC’s...
JANNAF Meeting Schedule....continued from page 6

Pat Szybist or Krystle Jones at pats@jhu.edu or kjones@cpiac.jhu.edu, respectively.

COMBUSTION SUBCOMMITTEE (CS)

Technical areas of interest specific to the CS include chemical combustion phenomena within combustors of solid, liquid, hybrid, and airbreathing missile, space, underwater, and gun propulsion systems. The combustion phenomena encompass steady-state, transient, and unsteady processes. Airbreathing propulsion systems include ramjets and air-augmented systems. Work areas covered include analytical modeling and experimental research on fundamental combustion and fluid dynamic processes and their relation to the development and performance of solid, liquid, hybrid, and airbreathing rocket, missile, space, underwater, and gun propulsion systems. These work areas involve studying the dependence of the combustion and flow phenomena on parameters such as propellant systems, combustor configurations, environment, inlets, and nozzles. Specialized tests, instruments, and procedures are devised and standardized, partly to aid in validation of research methods, and eventually for use in design, testing, performance optimization, and quality control of production.

AIRBREATHING PROPULSION SUBCOMMITTEE (APS)

The scope of the APS covers technical areas which include ram-compression airbreathing systems over the entire range of atmospheric propulsion for rocket and missile applications. Airbreathing systems include solid- and liquid-fuel ramjet, ducted rockets, expendable turbojets, supersonic/hypersonic aerospace plane and missile engines and combined-cycle engines oriented towards space and missile applications. The objectives include characterization of system performance through engine cycle analysis and testing, with particular test attention currently being given to supersonic and expendable turbojet systems; and understanding engine design from propulsion system and airframe integration through thermal management to characterizing advanced airbreathing fuels.

EXHAUST PLUME TECHNOLOGY SUBCOMMITTEE (EPTS)

The EPTS explores phenomena associated with the exhausts from missile, space, and gun propulsion systems. These phenomena can be divided into three technical areas: plume flow-fields, plume radiation, and a broad area incorporating other plume effects. The plume flow-field encompasses the physical phenomenology required to describe the thermodynamic, gas dynamic, chemical and physical processes associated with the emission, scattering, adsorption, and reflection of electromagnetic radiation from exhaust plumes ranging over the spectrum from the ultraviolet and visible through the infrared and microwave regions. Plume effects include the interaction of plumes with external structures, leading to the imposition of loads of thermal, chemical, and mechanical stresses, and the electromagnetic interference effects which degrade guidance and sensor systems.

SPECTRAL AND IN-BAND RADIOMETRIC IMAGING OF TARGETS AND SCENES (SPIRITS) USERS GROUP

SPIRITS is a panel within the EPTS that concentrates on electro-optic/infrared (EO/IR) target signature phenomenology; EO/IR atmospheric transmission/radiation phenomenology and modeling; EO/IR signature target measurements; SPIRITS code development and improvement; validation and calibration of SPIRITS target modules; computational fluid dynamic analysis and modeling for exhaust and related flowfields; exhaust plume radiation; applications of SPIRITS data for acquisition programs, signature reduction, and operational warfighting.

PROPULSION SYSTEMS HAZARDS SUBCOMMITTEE (PSHS)

The PSHS examines potential hazards associated with missile, space, and gun propulsion systems. Included are hazard analyses for both tactical and strategic missiles, small- and large-caliber gun systems, solid and liquid propellant systems, hazards encountered in loading and firing operations, and hazard technology areas identified from hazard analyses.

MODELING AND SIMULATION SUBCOMMITTEE (MSS)

Activities of the MSS include virtual engineering (VE); integration of propulsion components and integration of propulsion systems with other vehicle systems; uncertainty assessment and management; and integrated health management (IHM). Modeling and simulation ranges from hard computing to soft computing, to knowledge-based computing involving simulations of ground-based testing, to sub-scale and flight-testing. The credibility assessments of models and simulations include verification and validation (V&V). Guides, procedures or standards are developed for conducting V&V and for managing simulation uncertainty.

LIQUID PROPULSION SUBCOMMITTEE (LPS)

The charter of the LPS addresses technical problems and issues of greatest national needs associated with liquid engine systems. Topics include technology, components and engines of main propulsion, divert and attitude control, reaction control and post boost systems applied to tactical,
ballistic missile defense and strategic, in-space, and access-to-space propulsion.

Liquid propulsion technology issues examined include overall engine system, component combustion, and propellant feed systems. Components issues that may be examined include liquid engine systems such as thruster assembly and thrust vector control; liquid combustion elements such as the thrust chamber and gas generator/preburner; and liquid propellant feed systems such as turbomachinery, tubes and ducting, pressurization systems, and propellant management. Fuel types include liquids, slurries, gels, endothermics, and cryogenics. Characterization of system and component performance is done through analysis, modeling and simulation, and engine testing and validation.

**SPACECRAFT PROPULSION SUBCOMMITTEE (SPS)**

The SPS focuses on technical problems and issues of national needs associated with technology applied to space-based primary or auxiliary propulsion. These issues (for both system and component level) include design, development, materials, lifetime, performance, ground testing, flight testing, validation, qualification, spacecraft integration, fabrication processes, standards and cost.

Technologies of interest to SPS include the following: advanced chemical propulsion, aerocapture, electric propulsion, nuclear thermal propulsion, propellant management, solar sails, solar thermal propulsion, tether systems, and in-space propulsion infrastructure. Possible applications to these technologies are orbit-to-orbit transfer, attitude control, non-terrestrial ascent/descent, station keeping, deep space, formation flying, drag makeup and orbital rephasing.

**STRUCTURES AND MECHANICAL BEHAVIOR SUBCOMMITTEE (SMBS)**

The SMBS analyzes experimental, analytical, and statistical techniques required in the preliminary or detailed structural design of solid propellant rocket motors, gun ammunition, and their components, and in the prediction and assessment of their structural integrity and structural service life. Specific technical areas of activity include thermomechanical characterization of response and failure behavior in propellants, liners, insulation, case materials and ammunition; structural analysis and design methods for solid rocket motors and various test specimens; experimental structural analysis methods; environmental load definitions; determination of failure mechanisms for rocket motors and components; aging characterization and predictive modeling for motor materials and components; and motor and gun ammunition service life prediction and surveillance methods.

**PROPELLANT AND EXPLOSIVES DEVELOPMENT AND CHARACTERIZATION SUBCOMMITTEE (PEDCS)**

The PEDCS covers the technology areas required to develop, manufacture, and characterize propellants and ingredients. The manufacturing technologies of interest include mixing procedures, sampling and quality control, safety and handling practices, and the design and operation of mixing equipment. The characterization tests involve classical wet chemistry, instrumental analysis, chemical stability, compatibility, and calorimetric measurements.

**ROCKET NOZZLE TECHNOLOGY SUBCOMMITTEE (RNTS)**

The focus of the RNTS is on problems associated with the application of advanced composite materials, including carbon-carbon, ceramic matrix, and carbon phenolic composites, as applied to solid rocket nozzles and their components. Its areas of interest are materials and material properties; structural analysis and modeling, materials processing; quality assurance and control of composite exit cones and other nozzle components through nondestructive evaluation; nozzle design, testing, and evaluation; and thrust vector control/actuation technology.

**SAFETY AND ENVIRONMENTAL PROTECTION SUBCOMMITTEE (SEPS)**

The SEPS is charged to develop and exchange information for safety, health, and environmental risk criteria. In addition, it critiques and develops recommendations for operational procedures and practices to manufacture, handle, transport, transfer, store, test, use, decommission, and dispose propellants, ingredients, pressurants, and propulsion systems.

The primary focus of this subcommittee is to eliminate or reduce loss or injury to operating personnel, systems, and the surrounding environment due to dangers inherent in the nature of materials used. Based on the nature and extent of hazards defined, this subcommittee provides guidelines for user safety, control of hazardous operations, health effects, environmental impacts, use permits, product dispersion, waste disposal, demilitarization of aging or obsolete inventory, and risk analysis procedures. The SEPS also develops guidelines and models for responding to incidents involving these materials.

**NONDESTRUCTIVE EVALUATION SUBCOMMITTEE (NDES)**

The NDES addresses technical problems and issues associated with applying nondestructive evaluation (NDE)
and inspection techniques to solid rocket motors and liquid engines. Work areas include component inspection standards, advanced inspection system implementation, liquid propulsion unique issues, solid propulsion unique issues, and space systems issues. This subcommittee serves to enhance the transfer of NDE technology from the laboratory to its integration into design and manufacturing, as well as support the development of standardized inspection methods, protocols, and terminology.

The JANNAF Journal is an unclassified, limited-distribution technical journal dedicated to the publication of scholarly work in the fields of aerospace propulsion and energetic materials research and development.

The JANNAF Journal has been established to provide a publishing venue for authors to submit high quality scientific and technical work for peer review and formal recognition.

For preparation and submission instructions, visit the JANNAF Web site at:

http://www.jannaf.org/pdfs/Author_Guide.pdf.

For additional information, contact Managing Editor Rosemary Dodds at rdodds@jhu.edu.

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http://www.jannaf.org/pdfs/Author_Guide.pdf.

For additional information, contact Managing Editor Rosemary Dodds at rdodds@jhu.edu.
The Seventh International Symposium on Special Topics in Chemical Propulsion (7-ISICP) was held September 17-21, 2007, at the Kyoto International Conference Center in Kyoto, Japan, with more than 120 attendees from 15 different industrialized countries spread over five continents. This symposium was designed for scientists, researchers, scholars, engineers, and graduate students interested in the synthesis, ignition, combustion, and detonation of energetic materials with applications for propulsion, demolition, and power generation. Co-Chairs Prof. Kenneth K. Kuo of The Pennsylvania State University, University Park, Pennsylvania, and Prof. Keiichi Hori of the Institute of Space and Astronautical Science (ISAS) / Japan Aerospace Exploration Agency (JAXA), Kanagawa, Japan, organized the week-long event. A 206-page Abstract Book was printed and distributed to all participants.

The 7-ISICP, which addressed recent advances in the material synthesis and combustion characterization of energetic materials, placed particular emphasis on new technologies in the areas of nano-sized materials, nanotechnology, micro-combustors, miniature thrusters, safety enhancement, environmental impact, combustion diagnostics, theoretical/numerical model simulation, and commercial applications. The symposium included 14 technical sessions, comprising a total of 52 oral-presented papers, and a poster session that included 23 poster-presented papers. Eight invited plenary lectures were also featured, with presentations by the following distinguished speakers: Dr. Ruth Doherty of the U.S. Naval Surface Warfare Center, Indian Head, Maryland, “Wrestling with New Energetic Ingredients;” Prof. Alon Gany of Technion-Israel Institute of Technology, “Accomplishments and Challenges in Solid-Fuel Ramjets and Scramjets;” Prof. William A. Sirignano of University of California, Irvine, “Recent Theoretical Advances for Liquid-Fuel Atomization and Burning;” Prof. Herman Krier of The University of Illinois at Urbana-Champaign, “On the Transition from Classical Diffusion Limited Combustion Behavior for Fine and Ultra-Fine Aluminum Particles;” Prof. Valery I. Levitas/Prof. Michelle Pantoya of Texas Tech University, “Mechanochemical Mechanism for Fast Reaction of Metastable Intermolecular Composites Based on Dispersion of Liquid Metal;” Prof. Steven F. Son of Purdue University, “Nanoenergetic Composite Combustion in Microsystems;” Prof. Gary Flandro of The University of Tennessee, UTSI, “Oscillatory Behavior of Liquid Propellant Rockets, Scramjets, and Thrust Augmentors;” and Prof. Charles A. Wight of The University of Utah, “Science-Based Simulation Tools for Hazard Assessment and Mitigation.”

All technical papers presented at the
continued on page 11
7-ISICP symposium are being processed for refereed technical review for formal publication. Accepted papers will be published in an edited book by Begell House, Inc. Both Prof. Kuo and Prof. Hori are working with the author groups for this book-editing effort. It is anticipated that the book will be published in approximately 12 months.

On Thursday, September 20, the concluding session included an award ceremony during which four awards were presented. Prof. Alon Gany of Technion-Israel Institute of Technology was selected for the Martin Summerfield Best Paper Award for his invited paper, “Accomplishments and Challenges in Solid Fuel Ramjets and Scramjets.” Prof. Quinn Brewster of the University of Illinois was the recipient of the Best Paper Award for his oral-presented paper, “Thermal Radiation from Burning Aluminum and Oxide Particles in Solid Propellants,” co-authored with J. Harrison. Mr. Jeffrey Moore, a Ph.D. student at The Pennsylvania State University, also received a Best Paper Award for his oral-presented paper, “Effect of Flash-Tube Vent Hole Patterns on the Combustion Product Discharge Rate,” co-authored with K. K. Kuo, R. Acharya, and P. J. Ferrara. Also, Dr. Hakima Abou-Rachid of Defence R&D-Canada was given the Best Poster Paper Award for “Novel Nanoscale High Energetic Materials: Nanostructured Polymeric Nitrogen and Polynitrogen,” co-authored by A. Hu, D. Arato, X. Sun, and S. Désilets.

The symposium ended on Friday with a technical tour of the plant at Daicel Chemical Industries and a sightseeing excursion to the nearby Himeji Castle.

The 7-ISICP was co-sponsored by the following organizations: Ministry of Education, Culture, Sports, Science and Technology of Japan; U.S. Air Force Office of Scientific Research/Asian Office of Aerospace R&D; U.S. Office of Naval Research; U.S. Army Research Office; Japan Aerospace Exploration Agency; The Foundation of International Symposium on Special Topics in Chemical Propulsion, Daicel Chemical Industries, Ltd., Japan; Society for Promotion of Space Science, Japan; Tsubakimoto Kogyo Co., Ltd., Japan; Mitsubishi Heavy Industries, Ltd., Japan; IHI Corporation, Japan; Seika Corporation, Japan; Photon, Ltd., Japan; Kanomax, Japan; NOF Corporation, Japan; Nichiyu Giken Kogyo Co., Ltd., Japan; and the Japan Explosives Society.

Three possible sites were proposed for the 8-ISICP: Sochi, Russia; Pune, India; and Cape Town, South Africa. After discussion and voting by the Chairpersons Committee, it was decided that the 8-ISICP will convene in Cape Town, South Africa, with a tentative time frame of November 2009. The next symposium will be Co-Chaired by Prof. Ken Kuo of The Pennsylvania State University, Prof. Hansie Knoetze from the University of Stellenbosch, and Dr. Deon van Zyl of Denel Munitions, Western Cape. Hopefully, many JANNAF participants can attend this upcoming symposium.
The 2007 International Autumn Seminar on Propellants, Explosives and Pyrotechnics (2007 IASPEP) is the seventh and latest in a series of biennial seminars organized by the State Key Laboratory of Explosive Science and Technology, Beijing Institute of Technology, Beijing 100081, China. Total registration was approximately 160, with 35% of the attendees traveling to the event, which was held at the Nan Yang Hotel, from outside China. The official language of the meeting series is English.

The format of this meeting was different from meetings held in the United States. Prior to the meeting, 179 papers on a wide range of topics were published in a hard-bound volume. During the meeting, papers were selected from the volume for presentation. The absence of some authors reduced the expected presentations from over 50 to only 38, yet many of the technical goals of the meeting were met. One obvious improvement from previous meetings was the increased English proficiency of the Chinese student authors who were better able to present and respond to questions in English without the assistance of a translator.

Professor Fuming XU, former president of Nanjing University of Science and Technology, and now with the China Ordnance Society, described the use of coatings on multi-perforation gun propellants that reduced the apparent temperature sensitivity of the gun charges. The coatings act as plugs or ‘switches’ temporarily closing the perforations, thereby reducing the progressivity of the grains, lowering the maximum pressure in the gun and improving the accuracy of the artillery rounds.

Dr. Luigi DeLuca of Laborotario di Propulsione – SP Lab, Politecnico di Milano, Milan, Italy provided an update on his continuing efforts using both nano-scale and micron scale aluminum in composite propellants. He reports strand burning rate exponents as low as 0.15 in selected AP/HTPB/Aluminum formulations. Motor data is not yet available.

Ms Yang YU of the Electromechanics and Materials College, Dalian Maritime University, Liaoning, China, gave a thorough analysis of using a Dynamic Mechanical Analyzer plus finite element modelling to predict the deformation of a freestanding, 350 mm diameter, 660 mm long, 20 mm i.d. NEPE propellant grain when stored on end, either before loading into the rocket motor case, or after loading. The conclusion was that gravity would cause structural failure if stored for a long time before loading into the case.

A typical interrelationship and cooperation of various institutions and departments is shown in the printed paper, “New Method for Synthesis and Crystallizing of HNIW in Nitric Acid,” a joint effort of the Chemistry Department and the Water Supply and Drainage Department, Shijiazhuang Institute of Municipal Design and Research, Shijiazhuang 050011, Hebei, China, plus the School of Materials Science and Engineering, Beijing Institute of Technology, Beijing. The gamma HNIW yield was 95% and purity over 98%, and the crystal transition to epsilon HNIW can be carried out in the same system.

Papers available only in printed format provide many additional insights into energetic material research, development and production efforts in China and in other countries.

The broad definition of “energetic materials” used by this seminar allowed the presentation of a very interesting paper by Dr. Alexander Ustimenko of the Research Department of Plasmodechnics, Almaty, Kazakhstan, on the use of plasma sources to initiate and to sustain efficient combustion of low-grade coal in power plant boilers.

The next meeting will be held in October 2009, in Kunming, China. Called the City of Eternal Spring, Kunming is a subtropical city at 6000 feet elevation. Kunming is also the terminus of the Burma Road created during WW II. When further information about this meeting becomes available, it will be posted on: www.iaspep.com.cn.
In Memoriam
Dr. Adolf E. Oberth, 1928-2007

World renowned propellant chemist, Dr. Adolf Eduard Oberth, died October 24, 2007, after a four year struggle with prostate cancer. Born December 29, 1928, in Medias, Romania, he grew up in Germany during World War II, first living in Dresden and then in Nuremberg, seeing combat duty in the German Army during the final years of the war. After the war, Oberth studied chemistry, first at the Philosophic Theological College in Regensburg, Germany, and then at the Institute of Technology in Munich, Germany, where he received his doctorate in chemistry.

In 1952, Oberth married Helga Mattejat, with whom he had three children. The only surviving son of rocket pioneer Prof. Hermann Oberth, Adolf followed his father’s footsteps into the rocket industry by immigrating with his family to the United States in 1957, moving to Sacramento, California in 1960 to work for Aerojet as a rocket propellant chemist. There, he formulated high energy rocket propellants, many of which are currently used in our nation’s missiles. During his career, Dr. Oberth was awarded over 20 patents and published over 30 technical papers. His book, Principles of Solid Propellant Development, first published in 1986, is still a much sought after text by aspiring propellant chemists. His book was published again in 1987 as CPIA Publication 469. In 1985, Dr. Oberth received the American Institute of Aeronautics and Astronautics Wyld Propulsion Award for his pioneering work in the development of bonding agents for solid rocket propellants.

Adolf’s gruff humor, honesty, intelligence and kindness will be sorely missed by all who knew him, including his many friends and former colleagues in the rocket propulsion community. He is survived by his sister Erna Roth-Oberth of Feucht, Germany; his second wife Valentina Oberth, the former Valentina Krmova, of Rescue, Calif.; his son Michael Oberth of Lincoln, Calif.; his daughter Christine Oberth of Fair Oaks, Calif.; his son-in-law Robert Ueltzen, also of Fair Oaks; and seven grandchildren. He was predeceased by his first wife Helga, and his daughter, Eva Ueltzen.

This article includes excerpts from the Sacramento Bee, 11/3/2007.
Propulsion News Highlights

**NASA Selects Ares I Upper Stage Production Contractor**
Source: NASA, 22 Oct. 2007

NASA has selected The Boeing Co., Huntsville, Ala., as the contractor to provide manufacturing support for design and construction of the upper stage of the Ares I rocket. Ares I will launch astronauts to the International Space Station and eventually help return humans to the moon. Boeing will provide support to a NASA-led design team during the design phase and will be responsible for production of the Ares I upper stage. Boeing will manufacture a ground test article, three flight test units and six production flight units to support NASA's flight manifest through 2016. NASA's testing schedule includes a possible Ares I launch of a test crew to the International Space Station by Sept. 2013.

**NASA Constellation Targets include:**
- April 2009 - Testing an escape tower.
- Sept. 2012 - First unmanned test of the rocket.
- Sept. 2013 - First test flight to the ISS.
- Mar. 2014 - Second manned test flight.
- Sept. 2014 - Third manned test flight.

Ares I is an in-line, two-stage rocket that will carry to low Earth orbit the crew exploration vehicle Orion, which will succeed the space shuttle as NASA’s primary vehicle for human exploration in the next decade. The Ares I upper stage, with an engine and an avionics unit procured separately, will provide the navigation, guidance, control and propulsion required for the second stage of the rocket’s ascent. The Ares I first stage will consist of a five-segment solid rocket booster and motor similar to those used on the space shuttle. The second, or upper, stage will consist of a J-2X main engine, a fuel tank for liquid oxygen and liquid hydrogen propellants, and associated avionics.

The Ares I upper stage development is managed by NASA’s Marshall Space Flight Center in Huntsville, Ala., for NASA’s Constellation Program.

**NASA’s Ion Engine Breaks Performance Record**
Source: NASA, PHYSORG.com, 28 Sept. 2007

An ion engine prototype developed at NASA’s Glenn Research Center has now accumulated more than 12,000 hours of operation and processed over 245 kilograms of xenon, setting a record for most propellant throughput ever demonstrated by an ion engine. The engine is the critical component of NASA’s Evolutionary Xenon Thruster (NEXT) system, which uses xenon gas and solar electric power to drive future robotic science spacecraft to distant asteroids, comets, planets and their moons. The propellant throughput achieved exceeds the previous record of 235 kilograms demonstrated by the 30,000 hour ground life test of the spare Deep Space 1 engine. Additionally, the ion engine has demonstrated over 10 million Newton-seconds total impulse, the highest total impulse ever demonstrated by an ion engine in the history of space propulsion. Full press release: [http://www.physorg.com/news110204367.html](http://www.physorg.com/news110204367.html).

**Missile Defense Exercise and Flight Test Successfully Completed**

The Missile Defense Agency (MDA) announced today it has completed an important exercise and flight test involving a successful intercept by a ground-based interceptor missile designed to protect the United States against a limited long-range ballistic missile attack. The flight test results will help to further improve and refine the performance of numerous Ballistic Missile Defense System (BMDS) elements able to provide a defense against the type of long-range ballistic missile that could be used to attack an American city with a weapon of mass destruction. The exercise was designed to evaluate the performance of several elements of the Ballistic Missile Defense System (BMDS). Mission objectives included demonstrating the ability of the Upgraded Early Warning Radar at Beale Air Force Base, Calif., to acquire, track and report on objects. The test also evaluated the performance of the interceptor missile’s rocket motor system and exoatmospheric kill vehicle, which is the component that collides directly with a target warhead in space to perform a “hit to kill” intercept using only the force of the collision to totally destroy the target warhead. Initial indications are that the rocket motor system and kill vehicle performed as designed. Program officials will evaluate system performance based upon telemetry and other data obtained during the test. Full press release: [http://www.mda.mil/mdalink/pdf/07news0048.pdf](http://www.mda.mil/mdalink/pdf/07news0048.pdf).

*These excerpts have been taken from press releases that have been approved for public release.*
CPIAC is pleased to announce that during the last few months, our organization has continued its growth with the addition of four new employees who have skills and talent across the disciplines. CPIAC’s Technical Staff has been joined by engineers **Nicholas Keim** and **David B. Owen II**. Nick received his bachelor’s degree in mechanical engineering from The Johns Hopkins University in 2005 and his master’s in mechanical engineering from Imperial College in London in 2006. Prior to joining CPIAC, he held internships at The Johns Hopkins University Applied Physics Laboratory (JHU/APL) in both the Space Department and the Global Engagement Department. At CPIAC, Nick’s areas of responsibility include enhancement of CPIAC’s Performance and Plume code capabilities, thermochemical analysis, and enhancement of the Liquid Propellant Database (LPD), formerly CPIA/M4 Manual. Dave received his bachelor of science degree in Aerospace Engineering Sciences from the University of Colorado at Boulder in 2006. His specific roles at CPIAC include enhancement and expansion of the Rocket Propulsion Test Facilities (RPTF) Database and test community support activities, development of the upcoming SpaceCraft Propulsion Database (SCPD), and CPIAC library expansion and technical document acquisition. Additionally, both Nick and Dave will research technical and bibliographic inquiries, support CPIAC technical projects and Technical Area Tasks (TATs), and compile propulsion news articles and events for the CPIAC Bulletin. Nick can be reached at 410-992-7300, ext. 229, or by e-mail to nkeim@cpiac.jhu.edu. Dave is available at 410-992-7300, ext. 210, or by e-mail to dowen@cpiac.jhu.edu.

**Krystle Jones** is the newest member of CPIAC’s Business and Marketing division. As a JANNAF Meeting Planner, Krystle is responsible for coordinating and supporting JANNAF and IHPRPT meetings and providing customer service to the JANNAF community. Krystle is a 2006 graduate of Morgan State University, where she received a bachelor of science degree in Communication Studies with a concentration in Public Relations. She was previously employed as a Marketing and Administrative Assistant for the Center for Nonprofit Advancement in Washington, DC. JANNAF customers can reach Krystle at 410-992-7301, ext. 201, or by e-mail to kjones@cpiac.jhu.edu. Lastly, **Beryl Whipple** has joined the Information Systems division as a Scanner Specialist for the library collection. Beryl has a bachelor’s degree from Morehouse College in Atlanta, Georgia, and a master’s degree from Wake Forest University, in Winston-Salem, North Carolina. He can be reached at 410-992-7300, ext. 221, or by e-mail to bwhipple@cpiac.jhu.edu.


**JANNAF Meeting Calendar**

**2008**

**55th JANNAF Propulsion Meeting/42nd Combustion Subcommittee/30th Airbreathing Propulsion Subcommittee/30th Exhaust Plume Technology Subcommittee/24th Propulsion Systems Hazards Subcommittee/12th SPIRITS Users Group**

**Date:** May 12-16, 2008  
**Abstract Deadline:** December 17, 2007  
**Paper/Presentation/ Paper Clearance Deadline:** April 7, 2008  
**Boston Marriott Newton, Newton, MA**  
**Ph. 617-969-1000/800-228-9290 (Refer to JANNAF Meeting)**  
**Hotel Reservation Deadline:** April 21, 2008  
**Reg. Forms due at CPIAC by:** April 28, 2008  
**For more information on the above meeting, contact Meeting Planner Pat Szybist at 410-992-7305, ext. 212, or by e-mail to pats@jhu.edu.**

Visit the JANNAF Web site at [www.jannaf.org](http://www.jannaf.org) for meeting updates.

**Policy on Non-Government Attendees at JANNAF Meetings.** Attendance at JANNAF meetings for non-government employees is restricted to U.S. citizens only and whose organizations are 1) registered with the Defense Logistics Information Service (DLIS) AND 2) have a government contract registered with the Defense Technical Information Center (DTIC). If the government contract is not registered with DTIC, the attendee’s registration form can be certified by a sponsoring government official from one of the participating JANNAF agencies. Additional information concerning registrations with DLIS and DTIC can be obtained by contacting DLIS at 1-800-352-3572 ([www.dlis.dla.mil/jcp/](http://www.dlis.dla.mil/jcp/)) or DTIC at 1-800-225-3842 ([www.dtic.mil/dtic/registration/index.html](http://www.dtic.mil/dtic/registration/index.html)).

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