PROPULSION DIRECTORATE

Monthly Accomplishment Report
September 2002

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MINUTEMAN II MOTOR SUCCESSFULLY FIRED - TEST MANAGER RECOGNIZED: On 7 June 2002, a Minuteman II Stage 2 solid rocket motor was successfully fired at the Propulsion Directorate's Test Area 1-32 at Edwards AFB, California. Mr. Jamie Malak of PR's Experimental Demonstration Branch (AFRL/PRSO) was placed on special assignment to manage test preparations and conduct the sea-level static motor firing. This testing was performed in support of the Space and Missile Systems Center (SMC)/ Detachment 12/RPE Aging Surveillance Program Office to gather data for predicting the lifetime of the Minuteman II Stage 2 fleet. In addition, Mr. Malak worked with PR's Aerophysics Branch (AFRL/PRSA) and the Space Vehicles Directorate (AFRL/VS) to collect remote sensing measurements of the motor firing. These measurements are used for early launch detection, and they support the warfighter's boost phase intercept theater and strategic missile defense programs. During Mr. Malak's first assignment as a test conductor, he led a team of five engineers, seven instrumentation technicians, and eight mechanics in an intense facility preparation and test program. He accelerated the schedule from a 2-month effort down to 3 weeks (in spite of two crane failures) and flawlessly and safely executed a one-chance-only solid rocket motor firing. For his outstanding efforts on this test program, Mr. Malak was named the Propulsion Directorate's Engineer of the Month for June 2002. (R. Drake, AFRL/PRSO, (661) 275-5542)

Mr. Jamie Malak

Minuteman II Stage 2 motor firing

TURBINE ENGINE TECHNOLOGY SYMPOSIUM A MAJOR SUCCESS: From 9-12 September 2002, the foremost authorities in the turbine engine business converged on Dayton, Ohio, to attend the 2002 Turbine Engine Technology Symposium. The symposium, which was held at the Dayton Convention Center, was hosted by the Propulsion Directorate's Turbine Engine Division (AFRL/PRT) and chaired by Ms. Kathleen Sargent. The theme of this year's symposium was "A Century of Power for Flight," which acknowledges the contribution of propulsion to the centennial celebration of powered flight that will occur in 2003. The symposium is the only forum where the US turbine engine community gathers to review and discuss the latest technology advances achieved through the Integrated High Performance Turbine Engine Technology (IHPTET) and, more recently, the Versatile Affordable Advanced Turbine Engines (VAATE) Programs. The technical program emphasized accomplishments and future challenges to develop superior propulsion capability for US weapon systems. In addition to the many technical presentations given, other highlights included a panel discussion on "The Future of Propulsion for Flight" and a full day of workshops (10 in total) on a variety of topics. The opening day of the symposium featured a Keynote Address by the Honorable F. Whitten Peters, Vice-Chairman, Commission on the Future of the US Aerospace Industry and former Secretary of the Air Force. In addition, on 10 September 2002 a banquet was held at the Air Force Museum, and the banquet address was given by Mr. A. Paul Metz, F-35 Director of Test and Evaluation at Lockheed Martin Aeronautics Company. The symposium was attended by nearly 700 people from government, industry, and academia, and was an unqualified success. (K. Sargent, AFRL/PRTC, (937) 255-2611)

The Honorable F. Whitten Peters gives the Keynote address

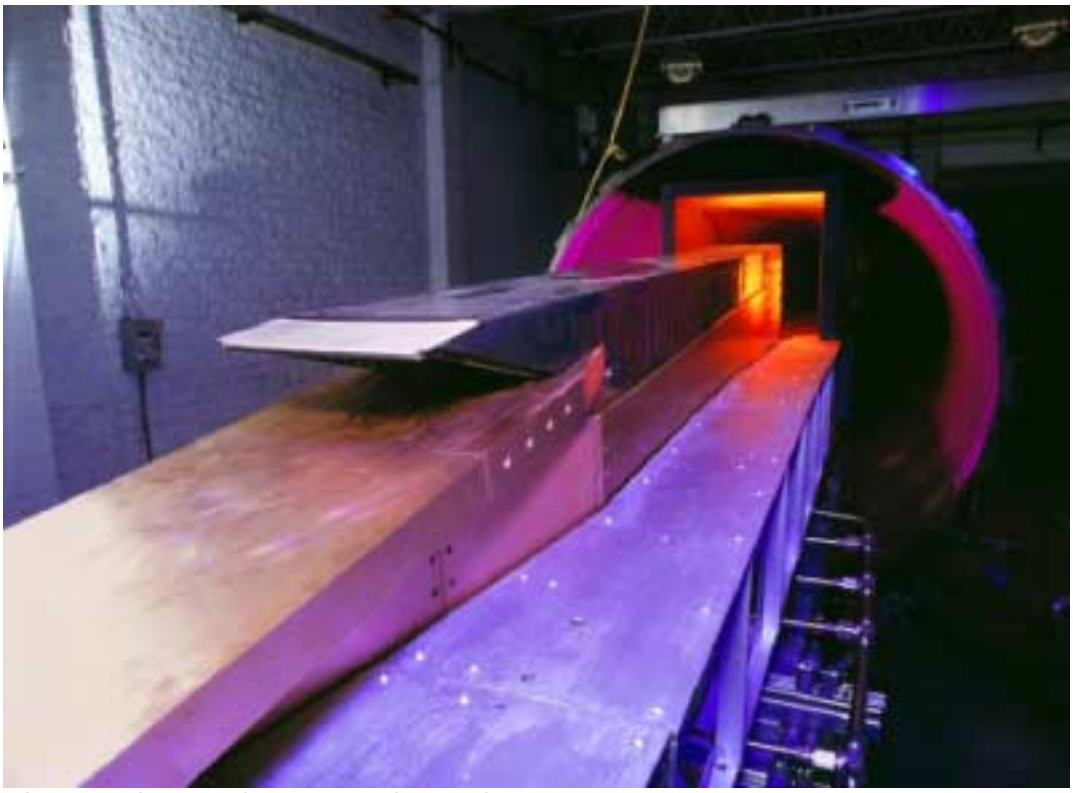

Mr. A. Paul Metz gave the banquet address

Want more information?

- The official website for the 2002 Turbine Engine Technology Symposium can be found here.
- An excellent article on the symposium can be found at the Air Force News website by clicking here.

GROUND DEMONSTRATION ENGINE TESTING COMMENCES: Testing of the Ground Demonstration Engine (GDE) under the Propulsion Directorate's Hypersonic Technology (HyTech) Program commenced on 6 September 2002. The GDE is a flightweight hydrocarbon-fueled scramjet (supersonic combustion ramjet) engine demonstrator being developed by Pratt &

Whitney under sponsorship of PR's Aerospace Propulsion Office (AFRL/PRA). GDE testing is being performed at the facilities of the GASL Division of Allied Aerospace Industries, Inc in Ronkonkoma, New York. This testing follows on the heels of the highly successful freejet tests of the Performance Test Engine (PTE), which were completed on 15 January 2001 and garnered a 2001 Aviation Week Laureate Award for the scramjet development team. The PTE tests verified engine performance and operability in the Mach 4.5 to 6.5 flight regime for a *heavyweight*, hydrocarbon-fueled scramjet. Testing of the fuel-cooled GDE will move beyond the PTE tests by demonstrating, for the first time ever, performance and structural durability of a *flightweight* hydrocarbon-fueled scramjet operating from Mach 4.5 to 6.5. Although the scramjet engine under development is sized for a tactical missile, the technologies being investigated have widespread applicability to high-speed airbreathing propulsion research. The maturation of high speed airbreathing propulsion technology is a critical step in the development of combined cycle engines that will enable more cost effective, on-demand access to space for future systems. (R. Mercier, AFRL/PRA, (937) 255-7081)



The HyTech Ground Demonstration Engine

FULL SPEED AHEAD FOR INTEGRATED POWER: The Integrated Power Unit (IPU) Advanced Development Program recently achieved a major milestone with the successful demonstration of full operating speed of the power unit on its magnetic bearings. The IPU, being developed by Hamilton Sundstrand under sponsorship of the Propulsion Directorate, is an F-16 Jet Fuel Starter (JFS) turbine engine directly driving a high power density switched reluctance starter/generator. The IPU can provide 200 kW (cold day) and 125 kW (standard day) of continuous electrical power. IPU power level is scaled to provide sufficient electrical starting power for the main propulsion engine, as well as power for in-flight emergencies and for ground


Integrated Power Unit rotor

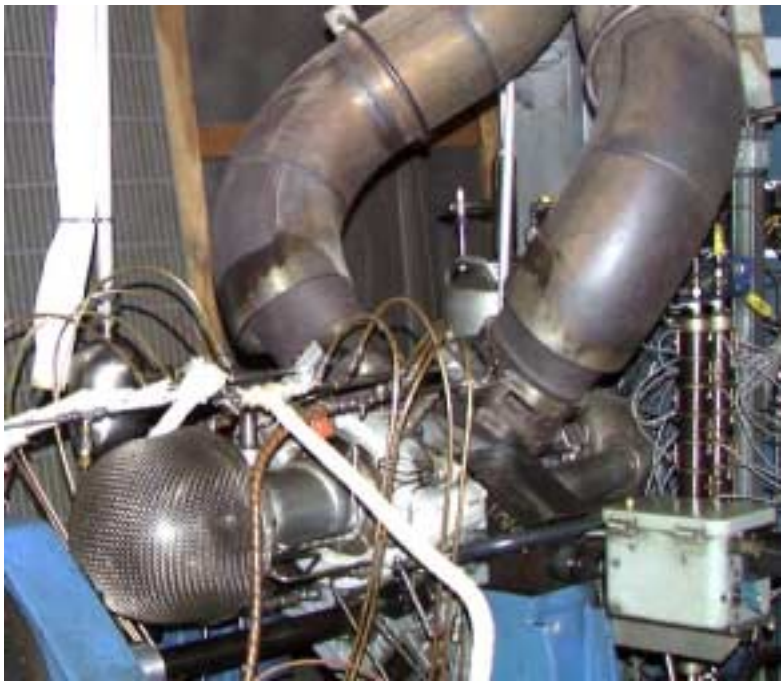
checkout of aircraft systems. Electric start capability for the main engine can help eliminate the need for an aircraft-mounted accessory drive (AMAD) gearbox external to the engine, thus reducing aircraft weight and maintenance requirements. By using magnetic bearings and air cooling of the starter/generator, the IPU requires no separate oil lubrication system and oil coolers, which further reduces weight and maintenance needs. The IPU could also be used as an in-flight power source for directed energy weapons (DEW) systems. In recent demonstrations, the IPU rotor system was driven by the JFS powerhead to the operating speed of 61,565 rpm. This key test helped validate that the IPU magnetic bearings can support the dynamic motion of the full rotating group while also controlling the radial and thrust forces from the powerhead. (J. Tschantz, AFRL/PRPG, (937) 255-5813)

COPENHAVER SELECTED AS AFRL FELLOW: Dr. William W. Copenhaver of the Propulsion Directorate's Fan and Compressor Branch (AFRL/PRTF) was recently named an AFRL Fellow for 2002. The AFRL Fellows Program is designed to recognize and reward AFRL's most outstanding in-house scientists and engineers for their accomplishments and technical excellence. This year's five new Fellows were formally recognized at the AFRL Fellows Banquet held on 26 September 2002 at the Air Force Museum. Dr. Copenhaver is a leader in compression system aerodynamics whose breakthroughs in jet engine stall prevention are benefiting both military and commercial aircraft. He has been involved in compression system research for nearly 25 years, and he has led the Air Force's in-house research program on compressor aerodynamics for the past 12 years. He represents the Air Force in compression system research throughout the world, and has been requested by many foreign governments to provide seminars on the research efforts under way in his laboratory. He has made significant contributions in the field of compressor aerodynamics related to stall in multistage compressors, shock system unsteadiness, and blade row interactions. In 1988,

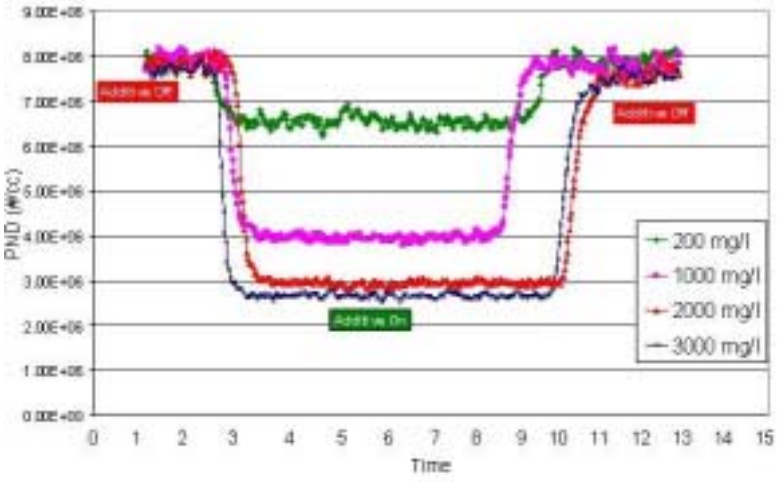

Dr. William W. Copenhaver

Dr. Copenhaver won the Propulsion Directorate's highest award for in-house research, the Heron Award. (Col A. Janiszewski, AFRL/PR, (937) 255-2520)

FIRST EVALUATION OF PARTICULATE MITIGATION ADDITIVES: The Propulsion Directorate's Fuels Branch (AFRL/PRTG) recently completed the first evaluation of fuel additives to mitigate soot particulate emissions from turbine engines. Airborne particles pose both health and environmental risks, and as such, the EPA has a health-based regulation to control particulate emissions with diameters equal to or smaller than 2.5 μm (PM2.5). These fine particles can easily enter the lungs and cause a variety of respiratory problems. In addition, particulate emissions contribute to visibility impairment (haze), increased aircraft signature (IR emissions), problems basing legacy and advanced aircraft, and reduced engine life due to higher radiative heat loads. Furthermore, aircraft particulate exhaust form nucleation sites that lead to contrail formation that may contribute to global warming and ozone depletion at high altitudes. Essentially all of the solid particles from aircraft exhaust are PM2.5. In recent tests, 17 additives (commercial additives to reduce emissions in internal combustion engines, diesel cetane improvers, and experimental/proprietary additives) were tested in a T63 helicopter engine. Engine exhaust was analyzed using a suite of state-of-the-art instrumentation to characterize particulate number density (number of particles per cubic centimeter), size distribution, mass, and particulate chemical composition. Results show that commercial additives and cetane improvers were ineffective in reducing particulate emissions or altering particle size distribution. However, dramatic reductions in particulate emissions were observed with one of the proprietary additives. The detergent-type additive reduced particulate number



The T63 engine used for particulate emissions testing



Test results show reduction in emissions with additive use

density by 67%, resulting in a calculated particulate mass reduction of 53%. Further investigations into this and other additives of similar chemistry are ongoing in the T63 and in atmospheric combustors to help elucidate the mechanisms by which the additive reduces particulate emissions in the T63. These results were presented at the International Conference on Air Quality III held in Arlington, Virginia, in September 2002 and were also published in the proceedings of the conference. (E. Corporan, AFRL/PRTG, (937) 255-2008)


NASA's Heated Tube Facility

NASA AND AFRL COLLABORATE ON PROPELLANT STUDIES: NASA and AFRL's Propulsion Directorate recently reported progress in jointly-planned research and development of hydrocarbon propellants. The purpose of this effort is to assess the performance of candidate propellants for advanced rockets, scramjets, and combined cycle engines. At the 38th AIAA/ASME/ SAE/ASEE Joint Propulsion Conference in Indianapolis, Indiana, results of rocket regenerative cooling tests performed by the University of Kansas at the NASA Glenn Research Center (GRC) Heated Tube Facility were reported. In tests sponsored by the NASA Advanced Space Transportation Program (ASTP), JP-7, JP-8, JP-8+100, JP-10, and RP-1 were compared for "coking" (i.e., deposition) potential under regenerative cooling conditions in both copper and stainless steel channels. The major finding was an expected incompatibility between relatively high sulfur-containing JP-8 and the copper material. This interaction was not mitigated by the presence of the additive package in JP-8+100. An unexpected finding was the relative insensitivity to fuel type of the deposition in stainless steel channels. In tests under scramjet regenerative cooling conditions co-sponsored by the Propulsion Directorate, United Technologies Research Center reported on results for JP-7, JP-8+100, JP-10, and n-octane. The highest heat sink was achieved with JP-7 and was limited by coking. JP-10 and JP-8+100 produced lower heat sinks due to the fuel's condensed ring structure and aromatic content, respectively. The rocket regenerative cooling tests are being followed by testing of sub-cooled hydrocarbons (e.g., propane) and high energy, strained-ring hydrocarbon propellants. Combustion testing of these classes of hydrocarbon propellants is also planned in support of the NASA ASTP program and the Air Force Integrated High Payoff Rocket Propulsion Technology (IHPRPT) Program. (T. Edwards, AFRL/PRTG, (937) 255-3524)

TIBBS HONORED FOR EXPERT MANAGEMENT OF DESKTOP COMPUTERS: The Propulsion Directorate's Mr. Gregory B. Tibbs has been selected to receive the Meritorious Civilian Service Award in recognition of his distinguished technical excellence and leadership

Mr. Gregory B. Tibbs

from 1 August 2000 to 12 April 2002. Mr. Tibbs is the senior government technical lead for desktop computer management in the Integration and Operations Division's Engineering Support Branch (AFRL/PROE). His technical expertise is widely recognized throughout AFRL and within the 88th Communications Group, the Air Force Materiel Command (AFMC) Network Operations Support Center (NOSC), and the AFMC Tivoli Program Management Office (PMO). Mr. Tibbs single-handedly developed an installer application that made it easy to automatically distribute software upgrades using a command-wide IBM/Tivoli product that did not perform its intended function well. Based on this work, the AFMC NOSC and IBM/Tivoli name requested him to demonstrate his implementation of Tivoli Software Distribution. Mr. Tibbs also headed PR's transition to Windows 2000, developed technologies to limit Windows administrative access, and handled day-to-day Information Assurance security issues for directorate computers. In all his efforts, he demonstrated superb leadership, energy, and competence to solve complicated technical problems, not only affecting PR but also the rest of AFRL and AFMC. He readily sought out and accepted the most difficult tasks, inspired and motivated his peers to perform at a higher level, and earned the respect of his superiors. His distinctive accomplishments make him well-deserving of this honor. (C. Kessler, AFRL/PROE, (937) 255-4210)

Ms. Sally A. Martin

MARTIN NAMED JULY EMPLOYEE OF THE MONTH: Ms. Sally A. Martin was named the Propulsion Directorate's Employee of the Month (Secretary Category) for July 2002 in recognition of her outstanding efforts in support of the Power Division (AFRL/PRP). Ms. Martin serves as the PRP division secretary, but since 15 January 2002, she has also taken on the duties of a branch secretary in order to fill a void created by the short notice departure of the full-time branch secretary. Despite taking on numerous additional duties, she has flawlessly executed her full-time duties as the PRP secretary. During this period, she made reservations, prepared travel orders, and picked up tickets for 59 trips, which included

32 trips for the branch that she supported. This was more than double her normal workload. She was also able to develop a R&D case file reference book for PRP branches that contained records of inspections of all division case files. The reference book contained copies of the form (AF 2519) used to document problems detected by inspectors as well as documenting the dates corrective actions were completed. She modified and updated a spreadsheet to plan and track the division's Recognition Award pool funds more effectively and she worked with the division's branch chiefs to ensure that the award write-ups were completed on time. It is notable that she was able to perform these multiple tasks concurrently without affecting the quality of her work, which is consistently excellent. Ms. Martin's invaluable contributions to the accomplishment of PRP's mission make her a worthy recipient of this honor. (Lt Col J. Erno, AFRL/PRP, (937) 255-6178)