ACCOMPLISHMENT REPORT

PROPULSION DIRECTORATE
September 1999

NEW WORLD RECORD SET AT TEST STAND 1-A: Boeing's Rocketdyne Division recently set a new world record at the Propulsion Directorate's Test Stand 1-A at Edwards AFB, California. During a hot fire test of the new RS-68 rocket engine, a thrust level exceeding 650,000 pounds was achieved. This is the most thrust ever attained for a liquid oxygen/liquid hydrogen engine. This record was captured during the first 100 percent power level tests of the RS-68 rocket engine. All objectives were achieved during the test, and this engine has now logged over 300 seconds of hot fire testing. The RS-68 is the engine targeted for the new Delta IV/Evolved Expendable Launch Vehicle (EELV) Program, which is an effort aimed at reducing space launch costs by more than 25 percent. The RS-68 is the first large liquid-fueled rocket developed in the US since the Space Shuttle Main Engine (SSME), and it will be the lowest-cost American rocket engine ever produced in terms of dollars per pound of thrust. The next phase of testing at Edwards AFB will include long duration tests of the RS-68 engine. Preparations are also being made to test the RS-68 concurrently at NASA's Stennis Space Center in Mississippi. The first launch of the RS-68 powered Delta IV is scheduled in 2001. (L. Quinn, AFRL/PRR, (661) 275-5630)
[See the Boeing press release at http://www.ple.af.mil/press/articles/RS68_1.html]

The RS-68 Rocket Engine

A hot-fire test of the RS-68 at Edwards AFB

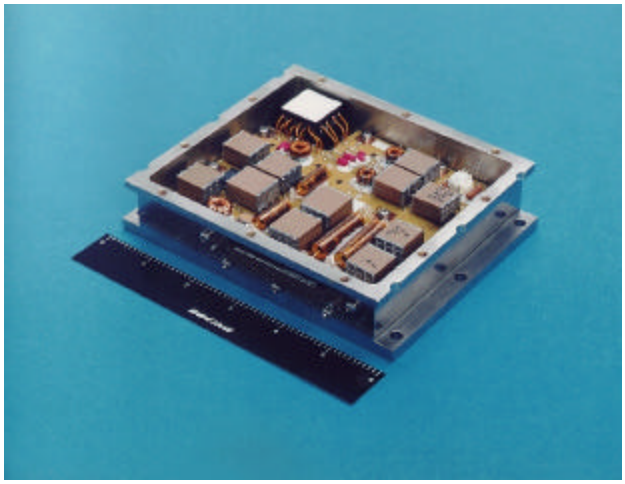
POTENTIAL LOW-COST SOLUTION FOR COLD START PROBLEMS: The Propulsion Directorate's Fuels Branch (AFRL/PRSF) is interfacing with the Propulsion and B-52 Divisions at

Oklahoma City Air Logistics Center (OC-ALC) to solve cold starting problems. PRSF is touting the potential application of ignition enhancing (i.e., combustion initiating) additives to alleviate cold start problems experienced by B-52 aircraft engines powered by TF-33 engines. Since the transition from JP-4 to JP-8 fuel, TF-33 engine ignition/startup at low temperatures (< -20°F) has been a major problem in the B-52, KC-135, and C-141 aircraft. Engine ignition difficulties have also led to other problems such as "torching" (flames exiting the engine) and excessive engine smoking. Several fuel control and fuel nozzle modifications have been assessed with little or no benefit, and engine retrofits proposed by Pratt &Whitney, manufacturer of TF-33, will cost in excess of $300 million to implement.

The B-52 Stratofortress

As a low-cost alternative, a SBIR Phase II with TDA Research Inc is developing fuel additives that increase the reactivity of the fuel by reducing its ignition delay time. In shock tube experiments, several additives have shown tremendous potential to improve the ignition characteristics of hydrocarbon fuels. TDA will assess the additives in a cold combustor chamber to investigate effects on ignition at very low temperatures. OC-ALC and Air Combat Command (ACC) have expressed great interest in this effort and are willing to collaborate in the project by testing the most promising additives in the B-52 aircraft. (E. Corporan, AFRL/PRSF, (937) 255-2008)

IHPTET TECHNOLOGY GOING TO SPACE: Over the past six months, the High Temperature Distributed Control Systems (HiTeC) consortium has achieved several significant milestones with respect to maturing high temperature electronics for jet engine applications. A 200°C capable actuator control module was designed and fabricated, and module components underwent over two months of continuous cyclic testing between room temperature and 200°C. The complete module successfully completed 100 hours of testing at 200°C while controlling a compressor variable vane actuator. These successful bench tests were followed by the first ever demonstration of a high temperature smart actuator on Pratt & Whitney's XTE66 Joint Technology Demonstrator Engine (JTDE), an Integrated High Performance Turbine Engine Technology (IHPTET) demonstrator engine in the large turbofan/turbojet class. As a result of these achievements, Boeing has transitioned the high temperature module to their X-37 experimental space plane program. The X-37 is a NASA/Air



High-temperature electronics module of the type that may be headed for space aboard the X-37

Force-sponsored test bed for reusable launch vehicle technologies. It is intended to demonstrate technologies enabling low-cost ($1000/lb of payload), routine access to space with fast turnaround and minimal operational crews. Boeing will slightly modify the HiTeC module design, fabricate new hardware from the HiTeC-developed set of high temperature integrated circuits (now commercially available from Honeywell), and integrate them with two or more sensors to demonstrate distributed smart sensing on the X-37. NASA and Air Force X-37 program officials have expressed great interest in this technology and are considering expanding its application to other sensors on the X-37. (T. Lewis, AFRL/PRTA, (937) 255-6690)

MINIATURE HEAT PIPES FOR ELECTRONICS COOLING: The ability to control the temperature of electronic components is essential, especially in light of the diminishing size and increasing volumetric heat production of these components. Miniature heat pipes (MHPs) hold great promise for isothermalization and cooling of electronics (including laser diodes), and researchers at the University of Connecticut (UConn) have recently demonstrated copper-water MHPs at heat fluxes in excess of 100 W/cm^2. This demonstration was accomplished under a Propulsion Directorate managed program that was sponsored by the Office of Innovative Science and Technology of the Ballistic Missile Defense Organization (BMDO/IST). Although these devices have remarkable performance, they are very difficult and costly to manufacture. Under the Air Force's in-house R&D program for thermal technologies, Power Division (AFRL/PRP) researchers have originated two new fabrication techniques to produce MHPs on a large scale. The two alternate construction methods proposed for invention are a folded copper sheet fin and folded copper wire-cloth micro-porous grooves, which perform a similar function to UConn's machined-groove design. Patent applications on these new heat pipe wick designs were submitted in August 1999. Eight experimental heat pipes (four of each design) are now being fabricated to demonstrate the feasibility and performance of the two concepts. The fin forming, brazing process, filling, and test plan matrix have already been prepared. Experimental results of the new MHPs will be compared with the available performance data of UConn's MHP. (R. Ponnappan & J. Leland, AFRL/PRPG, (937) 255-2922)

Sections of folded copper sheet fin heat pipe

PROPULSION DIRECTORATE NCO EARNS ACCOLADES: At the 23 June 1999 graduation banquet for the Air Force's Senior Non-Commissioned Officer (NCO) Academy at Maxwell Air Force Base, Alabama, Master Sergeant Mark E. Whittaker was praised as a top performer. MSgt Whittaker was recognized as a Distinguished Graduate of the six-week training academy; an honor bestowed on only the top ten percent of the class of 323 senior NCOs. More impressively, MSgt Whittaker was selected by his peers and instructors for one of the top three awards presented to the

class, the Commandant's Award. This award, sponsored by the Non-Commissioned Officers Association, is presented to the student who demonstrates the highest degree of professionalism and leadership capability. The purpose of the Senior NCO Academy is to provide education for senior NCOs to allow them to become more effective leaders and managers. MSgt Whittaker currently serves as the Superintendent of the Propulsion Directorate's Rocket Propulsion Division (AFRL/PRR) at Edwards AFB, and he is a great credit to the organization. (L. Quinn, AFRL/PRR, (661) 275-5630)
[See the Air Force press release at http://www.ple.af.mil/press/articles/whittaker.html]

MSgt Whittaker graduates NCO Academy with honors

JTAGG OUTGROWTH TO POWER DoD COPTERS: The US Army's Aviation Applied Technology Directorate (AATD) is preparing to move the Common Engine Program (CEP) into the first phase of development. The CEP is an outgrowth of the Joint Turbine Advanced Gas Generator (JTAGG) which was developed by AlliedSignal under the Integrated High Performance Turbine Engine Technology (IHPTET) Program. The CEP's charter is to build a helicopter engine that is more powerful, more fuel efficient, and easier to maintain than current engines. The CEP is being designed for Air Force H-60 Black Hawks, Navy SH-60 Seahawks, Army AH-64 Apaches, and Special Operations Forces helicopters. New mission equipment packages and increases in capability are desired for all of these helicopters to support future battlefield scenarios, and a better engine is key in achieving these results. Next summer the JTAGG engine will be tested against its Phase II goals of a 30 percent reduction in fuel consumption, an 80 percent increase in power to weight, and a 20 percent reduction in operating costs compared to engines currently powering Black Hawks and Seahawks. By 2003, the JTAGG should meet its Phase III goals of a 40 percent reduction in fuel consumption, a 120 percent increase in power to weight, and a 35 percent reduction in operating costs. The engine could be integrated into Black Hawks and Apaches by early 2004 with first fielding of the engines to follow in 2007. (M. Huffman, AFRL/PRTP, (937) 255-2767)

UNDERSTANDING ROCKET MOTOR AGING: Thiokol, a Division of Cordant Technologies Inc, recently kicked-off the Critical Defects Assessment (CDA) Program at their Wasatch, Utah facility. The purpose of the Propulsion Directorate sponsored CDA Program is to develop computer software and improve analysis models to more accurately forecast aging in solid rocket motors (SRMs). This program is part of the Strategic Sustainment portion of the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) Program, and the CDA Program is the last of three interrelated programs to be awarded. The other programs, one on service life prediction and the other on non-destructive evaluation technology, were awarded last year. These two programs will provide the CDA Program with the data required to meet IHPRPT's strategic sustainment goal of doubling the reliable service life prediction for

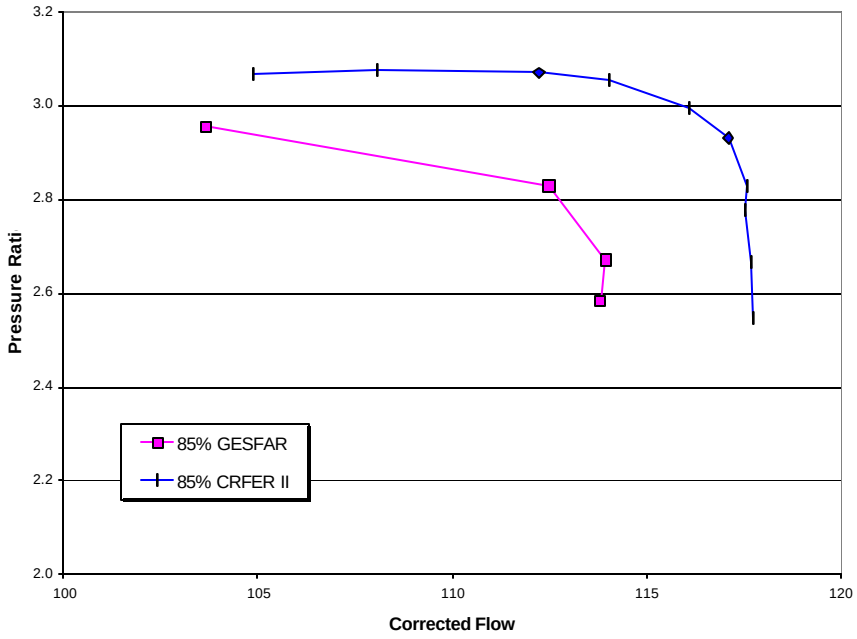
SRMs. Ultimately, the tools developed in these three complementary programs will be integrated into one computer analysis code on the CDA Program. This code will improve the accuracy of SRM analysis and extend the accuracy of predicting long-term aging of SRMs. (L. Quinn, AFRL/PRR, (661) 275-5630)
[See the Cordant Technologies news release at
http://www.cordanttech.com/html/news/releases/1999/9942.htm]

PLASMA FLAME STABILIZATION DEMONSTRATED: The Propulsion Directorate's Combustion Branch (AFRL/PRSC) has successfully completed testing of a radiative ignition/flame stabilization system. The testing was performed in support of the Turbine Engine Division's (AFRL/PRT) Compact Radiatively Stabilized Combustor Program. This program is focused on developing technology to enhance ignition and flame stability in advanced combustion systems. A joint effort between PRSC, the Components Branch (AFRL/PRTC), and General Electric Aircraft Engines, the tests were completed during the week of 26-30 July 1999 in the Room 20 High Pressure Combustion Research Facility at Wright-Patterson AFB. The combustor test article utilizes a microwave-generated plasma torch to stabilize the flame. Testing was conducted with full optical access into the combustion flow-field via quartz windows located in the sidewalls of the combustor rig. This enabled a visual assessment of the characteristics of the plasma. Data at each test point were taken with and without the presence of the plasma, and testing included mapping the combustor stability, emissions, exit temperature profiles, ignition, and plasma system durability. This was the first ever demonstration of a plasma flame stabilization system in a combustor at pressures as high as 200 psia. (D. Shouse, AFRL/PRSC, (937) 255-4636)

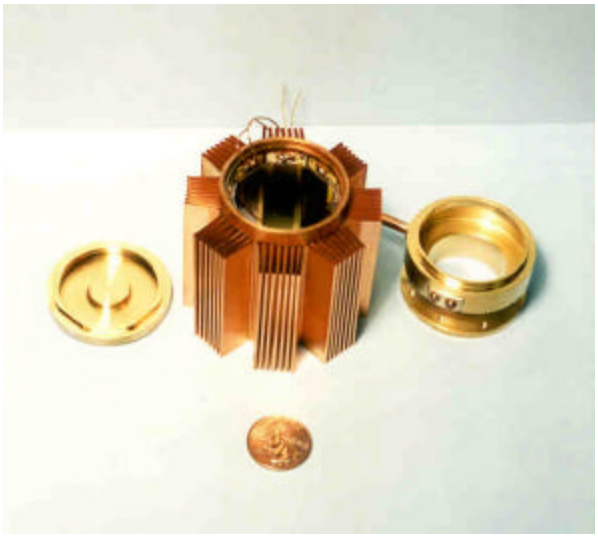
FORWARD SWEPT BLADES YIELD ENHANCED PERFORMANCE: Preliminary results from compressor testing in the Propulsion Directorate's Compressor Research Facility Experimental Rig (CRFER) II show a significant improvement in overall performance. The test article being investigated incorporates the original first stage General Electric Forward Swept Blisk (GESFAR) with a new set of forward swept blades for the second stage rotor. This is the first time that multistage blade leading edge forward sweep has been experimentally investigated. Data from these tests were compared to the configuration tested during the GESFAR test, which used the original straight blades. At 85 percent speed, multistage forward sweep increases peak efficiency flow by 3.4 percent, pressure ratio by 3.5 percent, and efficiency by 2.8 percent in comparison with the original GESFAR configuration. In addition, the 85 percent speed stall margin increased significantly. At the 100 percent design point, flow increased by 2.1 percent. Continued testing has been delayed due to damage

Comparison of straight (top) and forward swept (bottom) leading edge blades

on the second stage blades from a case rub following a stall event. The new forward swept blades have been removed, and evaluation of the damage is under way with the current plan to rework the blades and continue testing as soon as possible. This multistage forward sweep concept shows a large performance improvement over the original configuration, which will aid in meeting Integrated High Performance Turbine Engine Technology (IHPHET) performance goals. (M. Reitz, AFRL/PRTE, (937) 255-6802)



Performance comparison for straight and forward swept leading edge blades



TPV array and heat sink

NEW POWER SYSTEMS FOR REMOTE STATIONS: In August 1999, a five-year contract was awarded to UES, Inc to help model and characterize power systems related to space, ground and unmanned air vehicle (UAV) applications. A large portion of the effort will involve development of a stand alone, turn-key power system for remote site applications. The deliverable power system will be based on a thermophotovoltaic (TPV) energy converter and will have a power output of 100-120 watts. Other advanced energy conversion technologies such as Alkaline Metal Thermal to Electric Conversion (AMTEC) and thermionics will also be investigated to

determine their suitability for these same applications. Power systems used by the DoD that could be supported by AMTEC/TPV technology include air combat training range communicators and data relay stations, seismic observatories, remote monitoring stations, and intelligence gathering stations. In one example of a potential AMTEC/TPV application, AMTEC/TPV-based generators would be 3-5 times more efficient than the present generators used on an Alaska combat training range that require costly resupply flights. If fully implemented on this combat range, the new generator types would reduce the annual resupply logistics cost by $8 million and the number of resupply flights by 70 percent. In the UAV ground support role, the advanced power systems would be lighter, more mobile, and more reliable than existing diesel generator systems. Some commercial uses of these power systems include air/marine navigation stations, gas metering stations, weather monitoring stations, off-shore platforms, communication relay stations, cathodic protection, and oil exploration. (T. Lamp, AFRL/PRPE, (937) 255-6235)

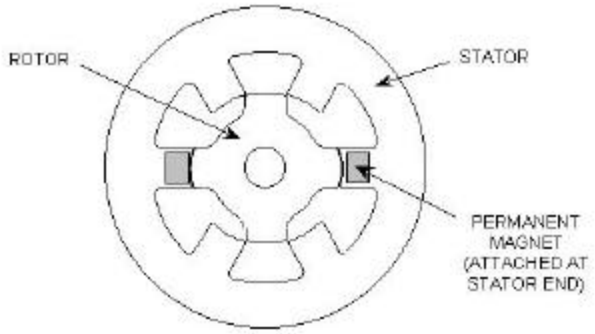
CMSgt Washington retires

CHIEF WASHINGTON RETIRES: The Propulsion Directorate has bid farewell to Chief Master Sergeant Glenn E. Washington after 30 years of distinguished service. CMSgt Washington retired from active duty on 4 August 1999 in a ceremony held at Edwards AFB, California. Colonel Wesley R. Cox, the Edwards Research Site commander, presided over the ceremony. CMSgt Washington's tributes included letters from the nation's Commander-in-Chief, California Congressman Bill Thomas, and the AFRL Commander, Major General Richard R. Paul. CMSgt Washington arrived at Edwards AFB in 1990 where he was responsible for enlisted activities across the 65 square mile expanse of Edwards. The vital mission of his troops was the operation and maintenance of the high thrust rocket test stands that reside at Edwards AFB. These test stands are a precious national asset, representing two-thirds of the nation's high thrust rocket test stands. CMSgt Washington was a valuable member of the Propulsion Directorate team and he will be sorely missed. (L. Quinn, AFRL/PRR, (661) 275-5630) [See the Air Force press release at http://www.ple.af.mil/press/articles/99washington.html]

COMBATING HIGH CYCLE FATIGUE: High Cycle Fatigue (HCF) is a major factor negatively impacting safety, operability, and readiness of high performance turbine engines. As more performance is demanded from turbine engine propulsion systems, the percentage of failures related to HCF rises. Between 1982 and 1996, HCF accounted for 56 percent of all Class A engine-related failures, and that percentage approaches 87 percent for newer engines such as the F-100-229 and the F-119. Current estimates put the added cost associated with HCF at more than $400 million per year. To combat this problem, a National HCF Program was established with the goal of reducing HCF related non-recoverable in-flight shutdowns by 50 percent and virtually eliminating HCF related Class A mishaps. Achieving these goals will save an estimated three to four fighters per year and reduce engine

maintenance costs by $200 million per year. The Science & Technology (S&T) portion of the National HCF Program, directed by AFRL's Propulsion Directorate and including participation from the Navy, NASA, and industry, is now 60 percent complete. To date, the major success of the S&T Program has been to predict unsteady pressures and their resulting stresses on fan and compressor blades. These prediction methodologies were successfully conceived despite skepticism from industry about the ability to make such predictions. While accuracy of the predictions varies appreciably, industry has adopted these predictive tools and is now putting them to use. In addition to this success, progress is being made in a number of other areas such as blade damping schemes, foreign object damage (FOD) life models, non-intrusive stress measurement systems, and advanced surface treatment methods. (T. Fecke, AFRL/PRTC, (937) 255-2611)

SELF-EXCITATION FOR SWITCHED-RELUCTANCE MACHINES: The switched-reluctance machine (SRM) remains a primary candidate for Air Force more-electric power systems due to its potential fault-tolerance capability and a simple rotor design that allows higher operating speeds. However, a typical SRM has no inherent means to energize its controller during start-up, and electric power must come from an external source like a battery. Providing a means of "self-excitation" would enhance the SRM's system-level redundancy when used in flight vehicle applications. One means of doing this is to attach a permanent magnet (PM) within the stator, then rotor rotation will provide a passive voltage through a winding that is wrapped near the PM magnetic field. This passive voltage is used to charge the SRM's DC-link capacitor, which in turn can energize the SRM control switches for start-up of generating mode. This concept was initially proposed within the Propulsion Directorate's Power Generation Branch (AFRL/PRPG), and the University of Wisconsin-Madison's (UWM's) electric lab was contracted under a scholarly research project (SRP) to further study the concept. A follow-on SRP by UWM to demonstrate the self-excitation concept was completed in August 1999 where two commercial SRM's were modified with PM attachments. In one configuration, the DC-link capacitor (680 μF) was charged to 240 V in 0.4 seconds, while other configurations required 3-12 seconds for capacitor charging. Minimizing the charge time of an SRM DC-link capacitor is a desired goal to allow quick start-up of the SRM, which may be required for in-flight restart and power-up of a more-electric aircraft's power system. (E. Durkin, AFRL/PRPG, (937) 255-6241)



Self-excited SRM (3-phase example)

IHPTET DEMONSTRATOR NEARS TEST COMPLETION: The Pratt & Whitney (P&W) Integrated High Performance Turbine Engine Technology (IHPTET) Phase II Joint Technology Demonstrator Engine (JTDE) has now completed over 60 hours of testing. The JTDE incorporates a supercooled high pressure turbine which will transition to the Joint Strike Fighter (JSF) F-119 engine. Additional JTDE technologies that are being considered for transition to the JSF include a vaneless low

pressure turbine (LPT), high cycle fatigue (HCF) reduction measures, an integrated light weight pump, and active stability control. Testing at P&W's facilities in West Palm Beach, Florida, has consisted of initial start/shakedown, structural clearance, LPT performance assessment, turbine exhaust case (TEC) performance evaluation, LPT thermal assessment, spherical convergent flap nozzle (SCFN) thermal evaluation, and dry maximum thrust demonstration. Throughout the entire testing sequence, additional data has been collected on the performance of the multivariable engine control schemes. Preliminary results indicate that the JTDE has demonstrated significant progress toward the IHPTET Phase II turbofan/turbojet goals of a 60 percent increase in thrust-to-weight and a 20 percent reduction in production and maintenance cost. In addition, the goal turbine rotor inlet temperature (TRIT) has been exceeded. (Capt A. Cerminaro, AFRL/PRTP, (937) 255-2767)

ROCKET MOTORS FOR AGING STUDIES FABRICATED: The casting of all 16 HTPB (hydroxy terminated polybutadiene) and PBAN (polybutadiene acrylic acid acrylonitrile) Aging Analog Motors under the Service Life Prediction Technology (SLPT) Program has been completed. Sponsored by the Propulsion Directorate's Rocket Propulsion Division (AFRL/PRR), the SLPT Program will determine aging characteristics of these motors and validate analytical aging models currently under development. All of the aging motors will undergo a three-year accelerated aging program with periodic non-destructive evaluation (NDE) inspections followed by chemical and mechanical evaluations. Zero time chemical and mechanical property testing is currently in progress on the recently cast HTPB and PBAN motors, and this testing will be completed in September 1999. The final eight motors to be examined in the SLPT Program will be cast with high-elongation propellant. The results of this program will provide critical information on the aging of rocket motors that will allow more accurate determination of the service life of these systems. (L. Quinn, AFRL/PRR, (661) 275-5630)

EXPERT ADVICE REDUCES RISK: Expert advice from Dr. Claude Merrill of the Propulsion Directorate's Propellants Branch (AFRL/PRSP) at Edwards AFB is reducing the hazard associated with the disposal of Army rocket boosters. The Army wants to dispose of boosters from retired Spartan anti-ballistic missiles (ABM). However, they have safety concerns because the boosters contain 2.5 percent of ferrocene, a burn rate accelerator that has been associated with a number of very serious accidents. Representatives of the Army Ammunition Center in McAlester, Oklahoma, requested guidance from Dr. Merrill and provided him with propellant combustion data and the composition of the propellant in Spartan boosters. Dr. Merrill noted that the propellant contains 5-micron sized aluminum particles that render the propellant easily ignited by electrostatic discharge. This led Merrill to recommend against an "expert" panel decision to remove the nozzles and burn the motors out in a static firing since the risk of generating an electrostatic charge would be high once the propellant was exposed. Instead, Dr. Merrill

Spartan anti-ballistic missile

recommended that disposal should be conducted with nozzles on in either a normal, remote, static firing or by linear shaped charge splitting of the metal cases. The Army was pleased with the expert input which may have well averted a serious accident. (C. Merrill, AFRL/PRSP, (661) 275-5169)

IMPROVING PROPERTIES FOR CAPACITOR DIAMOND FILMS: The Propulsion Directorate's Electrical Technology Branch (AFRL/PRPE) is performing research aimed at developing Chemical Vapor Deposition (CVD) diamond (and other dielectrics) for next generation, high-temperature, high-power AC/DC filter capacitors. Natural diamond has many extreme properties that make it attractive as a high-power dielectric including high resistivity, moderate dielectric constant, very low dielectric losses, the highest voltage breakdown strength and thermal conductivity of any material on earth, and radiation hardness. CVD is a relatively inexpensive means to produce thin diamond films (where capacitance is inversely proportional to film thickness). Efforts in AFRL/PRPE have shown that the deposition process can be manipulated to produce CVD diamond with the desired morphology and electrical properties of dielectric quality natural diamond. This work supports More-Electric Aircraft (MEA) Generation II Power Generation and Distribution goals by improving capacitor temperature capability to greater than 400°C, increasing power density by 400 percent over the state of the art, and decreasing the size, weight and volume of the state of the art by 40 percent. The high radiation hardness and high thermal conductivity of diamond make diamond devices highly applicable in space power management and conditioning. (S. Heidger, AFRL/PRPE, (937) 255-6016)

FIRST AIRFOIL FATIGUE TESTS PERFORMED IN TEFF: Fatigue testing of Pratt & Whitney (P&W) F-100 4th stage airfoils has commenced in the Propulsion Directorate's Turbine Engine Fatigue Facility (TEFF). Multiple Class A failures have occurred due to foreign object damage (FOD) sensitivity of the 4th blade leading edge. Class A mishaps are those involving either a fatality, more than $1 million in damage, or a destroyed aircraft. The first airfoil fatigue tests were performed in the TEFF on 27 Jul 99, and, to date, approximately 12 airfoils have been driven to failure. Each airfoil is mounted in a broach block and attached to a Unholz-Dickie 4000 lb electrodynamic shaker. Airfoils are vibrated in their first bending mode (approximately 600 Hz) to failure at various alternating stress levels ranging from 70 ksi to 95 ksi. A full matrix of fatigue tests are planned to evaluate the capability of laser shock peening (LSP) on the leading edge of airfoils. Airfoils with and without LSP and simulated foreign object damage will be driven to failure and the effectiveness of LSP as a technique for enhancing the fatigue life of turbine engine airfoils damaged by foreign objects will be quantified. Validation of LSP as a surface enhancement will directly impact the goal of the High Cycle Fatigue (HCF) initiative to increase the tolerance of fans to leading edge defects by a factor of 15. (C. Cross, AFRL/PRTC, (937) 656-5530)

POLISH LABS WESTERNIZING: At the North Atlantic Treaty Organization (NATO) AC/112 (Aviation Fuels & Lubricants) Working Party Meeting in Brussels, Belgium, in April 1999, Poland announced its intention to model its fuels and lubrication laboratories after those operated by the US Air Force at Wright-Patterson AFB. The goal of this endeavor is to elevate Poland's fuels and lubrication technology to the standards of other NATO allies and alleviate concerns about interoperability with Polish forces. In August 1999, representatives of the Propulsion Directorate's Fuels (AFRL/PRSF) and Lubrication (AFRL/PRSL) Branches visited the Polish Armed Forces Military R&D Centre for Petroleum, Oils, and Lubricants. Technical leaders from the Polish Government gave presentations on

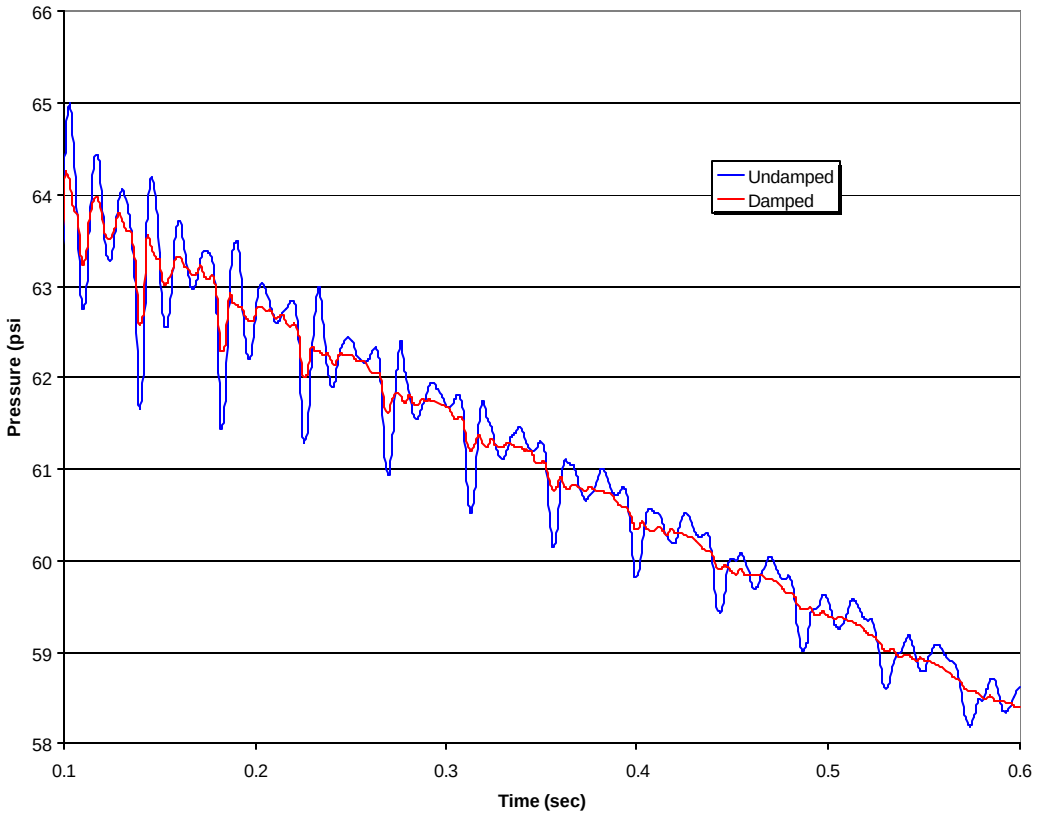
their current programs, which are largely focused on converting from Russian fluids to standardized NATO fluids. The Poles also have an extensive program studying the lubricity and quality control of fuels and lubricants. The Polish contingent was briefed on AFRL's current fuels programs and updated on lubricant and condition monitoring technologies. The Poles expressed interest in the use of the Air Force developed +100 fuel additive in their Russian aircraft, and they also have an interest in PRSF's cold flow program. There is optimism that cooperative efforts in these areas can be established; however, the Poles' primary focus on fluid quality control rather than R&D may limit the benefit to the Air Force of any data exchange or other agreement that might be instituted. (P. Liberio, AFRL/PRSF, (937) 255-6918 & R. Wright, AFRL/PRSL, (937) 255-5568)

EDDY CURRENT ROTOR EXCITATION PROGRAM COMMENCES: Representatives of the Propulsion Directorate and the Navy recently attended the "Spin Pit Excitation for High Cycle Fatigue Research" kick-off meeting held at Hood Technology Corp in Hood River, Oregon. The objective of this program is to develop a non-intrusive (eddy-current) blade excitation system capable of replicating a turbine engine rotor's high cycle fatigue forces in a steady-state vacuum spit pit test. This technology will enable a developmental or fielded engine's rotor to be evaluated for high cycle fatigue life/durability at a fraction of the cost and risk of current rig or engine testing methods. This Air Force funded Phase II SBIR contract was awarded to Hood Technology Corp following a successful demonstration of the eddy-current method on a sub-scale rotor in the Phase I effort. In the Phase II effort, Hood Technology Corp will develop a full-scale system at the Naval Postgraduate School in Monterey, California, and evaluate a full-scale Joint Strike Fighter (JSF) first-stage fan rotor. Successful completion of this program will provide the Air Force and Navy with a valuable research tool in the effort to identify and eliminate high cycle fatigue problems in rotating engine components before they enter service. (F. Lieghley Jr., AFRL/PRTC, (937) 255-1867)

Screen installed in the supply tank

DAMPING SUPPLY TANK OSCILLATIONS IMPROVES DATA: Experience with the Propulsion Directorate's Turbine Research Facility (TRF) has revealed the existence of a facility oscillation that can adversely effect testing. The oscillation is a pressure disturbance of approximately ±0.5 psi with a fundamental frequency of about 20 Hz. The oscillation is initiated by the startup transient and it exists during the test window. Several methods were considered to remove the oscillation, and the option of adding a pressure drop screen in the main supply tank to damp out the oscillations was selected as the most promising. To evaluate this concept, a one-dimensional flow solver was created to model the TRF blowdown dynamics. The model was validated by demonstrating that the facility oscillation could be duplicated. Having validated the model, it was then used to select the optimum amount of damping. The numerical results show that the pressure drop screen substantially reduces the pressure oscillations (compared to the undamped case) within the first

0.5 seconds out of a 2-second run. The analysis suggested the need to reduce the effective flow area of the supply tank to 12 percent of the actual area. To accomplish this, a wall of perforated sheet metal was installed which contained over 300,000 holes! A complete structural dynamics analysis was done to verify the stability of this structure, and the screen is now installed in the TRF. (D. Hoying, AFRL/PRTE, (937) 255-6802)



Numerical results showing a comparison of damped and undamped response