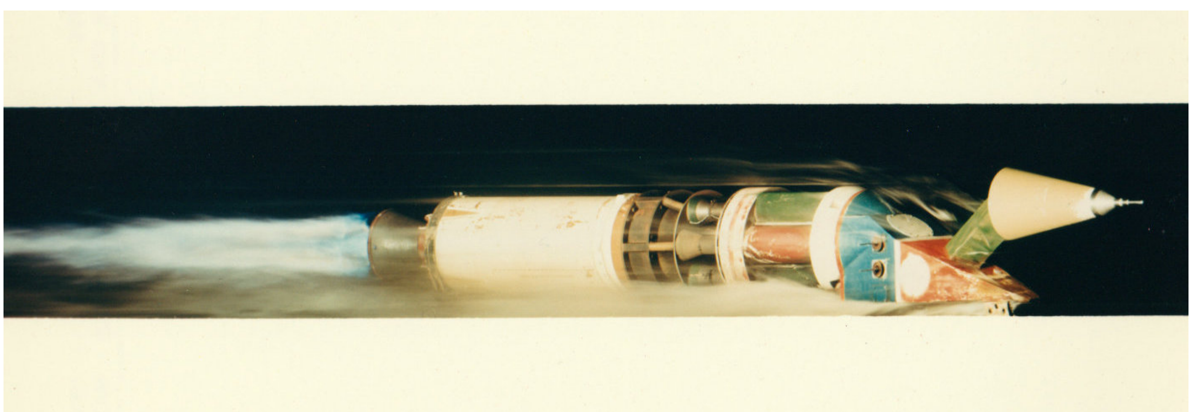
Brief Memories of a Career in the Air Force Materials Laboratory
John Williamson

I arrived at the "Lab" in April 1967 and found out that the Lab was holding a big celebration for me on my arrival. Then I found out it was really for the 50th Anniversary, in which I quickly got heavily involved. I was a skinny shaved head 2nd Lt just out of Officers Training school. Originally the Air Force had selected me to go into Missile Defense, but the Officers Training School said they had a request from the AF Materials Laboratory for some young officers and asked if I would go. (Luck is better than being good any time) But when I showed up, no one was expecting me. I think they called around and Jim Mattice the ManTech Chemical Branch Chief, said he would take me. My Tech Area Manager was Gail Eichelman. One of the first programs I had was developing a rain erosion resistant cover for the Short-Range Attack Missile (SRAM) radome. The cover was made of a ceramic material. One of the major subcontractors on the program was COOR's Brewing Company. I am probably the only person in the Air Force that ever had a contract with COOR's. It turns out they used a lot of ceramics in the brewing process and had developed their own in-house ceramic producing capability. The most interesting part of the program was the tests of the ceramic cover. The testing was done on the 9 ½ mile long sled track at Holloman AFB, NM. The missile nose mock-up with the ceramic cover was fired down the track at Mach 3 though a rain field. To assure no thermals to effect the pattern of the rain field, the tests were conducted at 2 AM and a second test at 4 AM. I can tell you that it is cold out in the desert at that time of the morning. Unfortunately, the pre-fab Coor's cover failed miserably, assumed to be because of possible air pockets between the cover and the radome. A plasma sprayed on ceramic, however, did survive the rain field. Here is a picture of one of the runs:



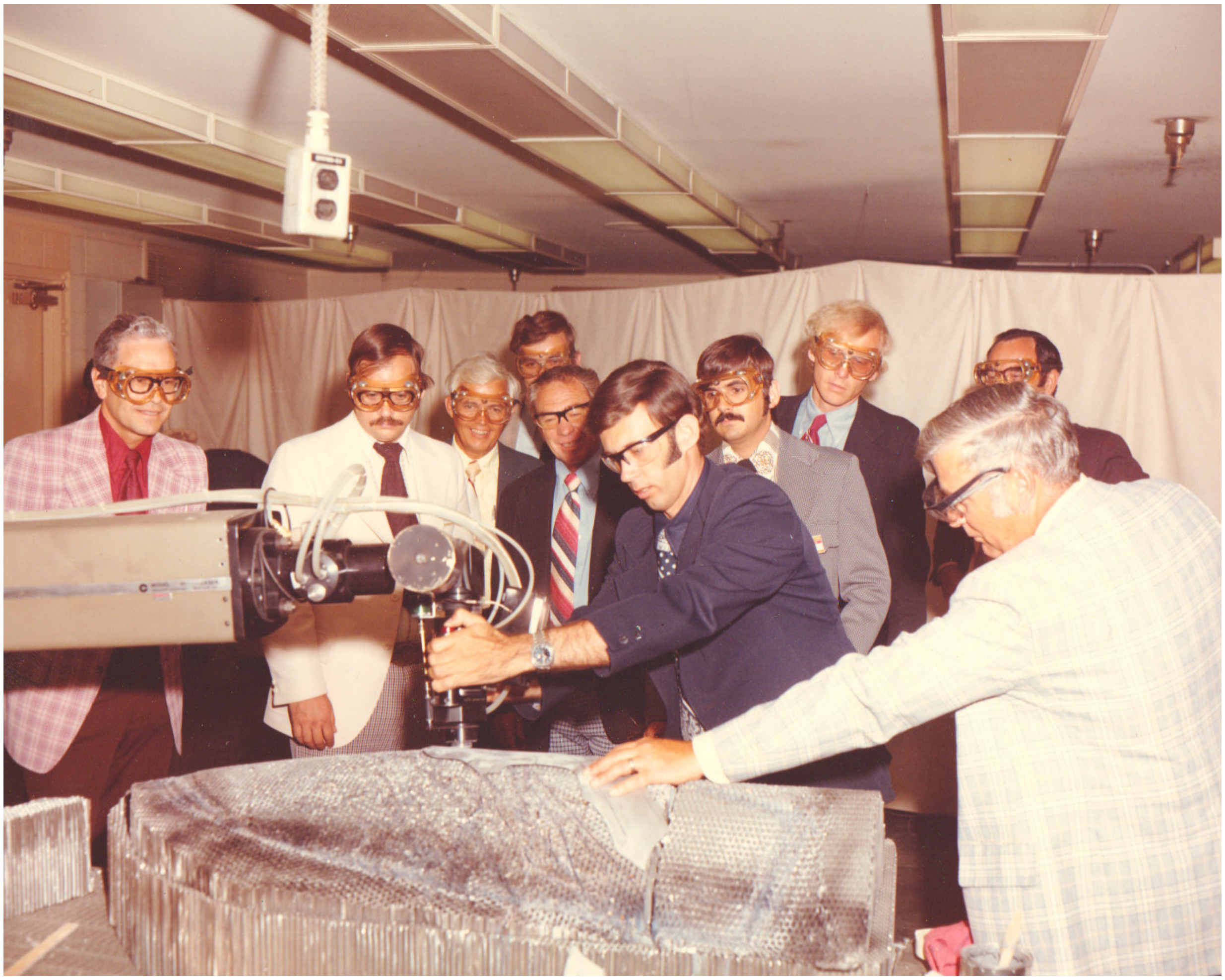
Other programs I had at that time involved application of high temperature coatings to turbine engine blades.

One of the interesting things we (the military) did in that time period was host annual tours for Air Force Academy cadets. The tours involved presentations on what the Lab did and tours of the facilities. The picture below shows one of these tours:

In 1968 the Materials Laboratory decided to send people to Vietnam to identify materials issues in the field and address them through technology programs back at WPAFB. The Air Force Academy first volunteered to do this to get some of their professors field experience. They sent a couple of professors over each for 2 week tours. The shortness of the tour and their lack of understanding of the Lab provided no value to the Lab. I heard about this program and volunteered to go. It turned out my 2 week tour became 3 months. I ended up at Tan Son Nhut Air Base, Saigon from Nov 1968 to Feb 1969 (leaving just before the second Tet Offensive). Over those 3 months, I visited every air base in Vietnam and 3 of the 5 air bases in Thailand (with great over night stops coming and going in Bangkok). A picture of me there is shown below:

In 1971 the Manufacturing Technology was re-organized into a Fabrication Branch and a Processing Branch. I was assigned to the Metals Fabrication group, under Gail Eichelman. My first program was in developing the manufacturing process to drill turbine blade cooling holes with a laser. This process was successful and the General Electric Company at their turbine blade plant in Kentucky installed a large number of laser machines and converted the drilling of holes from the slow electro-discharge process to laser. Below is a picture of one of the blades that has been laser drilled.

This program was following by two programs on laser cutting of titanium. The first was at Grumman Aircraft on Long Island. They used a gimbaled 250 watt laser to cut the titanium and it went into production on the F-14 Navy aircraft. The second program was at Boeing, Seattle. This program used similar technology and developed a laser router for trimming titanium sheet material. A picture of a handsome young man using this router is shown below:



A major new program I initiated in this time period was superplastic forming of titanium. This program went from making an ash tray size titanium sheet component to a full size aircraft component. Rockwell International was the contractor and the first part made with this technology was a nacelle frame for the B-1 aircraft. Hank Johnson, Chief of Metals Branch, Manufacturing Technology Division, and I are shown holding this component. This ManTech program eventually led to the Air Force Materials Laboratory being awarded an Industrial Research magazine award as one of the top 100 most significant new technical products for 1976.

This program was followed by other programs combining superplastic forming with diffusion bonding technology. The first superplastic formed and diffusion bonded titanium structure flown on an airplane came off one of these programs and is shown below. In the picture I am with Jim Door, the McDonnell Douglas program manager, who later became Director of Advanced Materials and Structures at McDonnell Douglas.

Also in this time period, George Peterson the ManTech Division Chief decided to hold a conference at Sagamore, NY to address how to reduce the cost of air frame and engine components. A picture of the Metals Secondary Structures sub group is shown below. This conference identified that the most significant cost in most airframe structures was the assembly cost. This led to a revolution in the type of programs being conducted out of the Man Tech program and eventually to major computer automation activities to be discussed later.

George Peterson also led many visits to ManTech contractors to review their efforts. I had a program at TRW, Cleveland and organized a review for George. A picture of that visit is below:

In 1975 I moved to the Advanced Metallic Structures Advanced Development Program Office (a joint ADP program with the Flight Dynamics Laboratory). In building off the superplastic forming and diffusion bonding efforts I had managed in ManTech, I initiated the Build-up Low Cost Advanced Titanium Structures (BLATS) program. One of the contractors under this program was McDonnell Douglas, St. Louis. Under this program they redesigned the center keel section of the F-15 to reduce cost and make more space available for electronics. The design of this structure and the production demonstration article is shown below. When the Air Force decided on a new version of the F-15, the F-15E, this design concept was chosen and went into production of the F-15E.

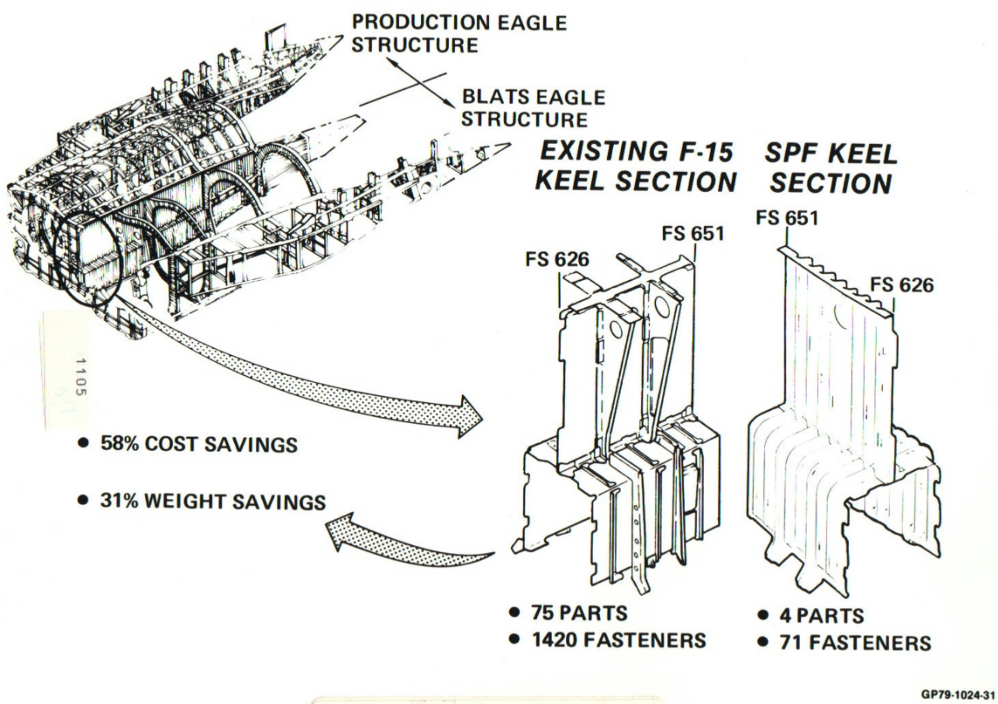
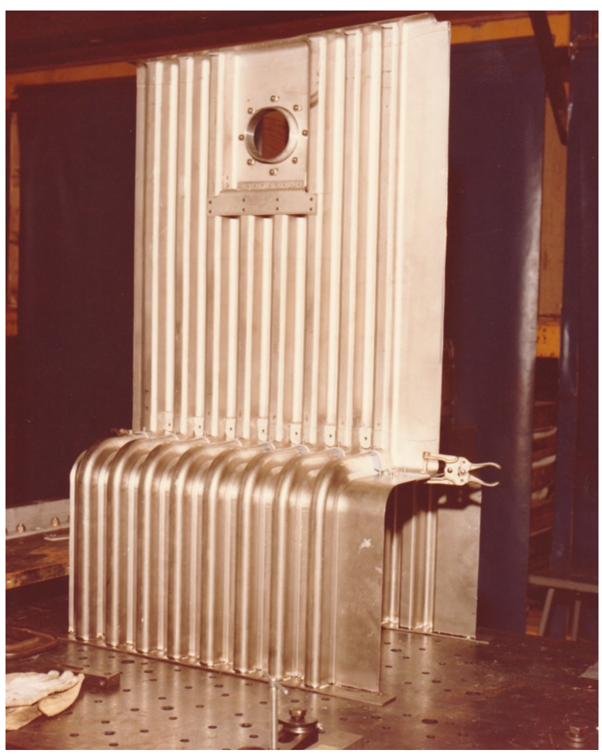


Fig. 22 F-15 SPF/Aft Fuselage Design



Nate Tupper, my boss in the ADP office, asked me to look into aluminum casting technology to see if I thought it could be used to make larger components for primary aircraft structure applications to reduce assembly costs. After visiting several aluminum foundries, I became convinced that it could be possible. This led to the Cast Aluminum Structures Technology (CAST) program. The Boeing Company was the contractor and selected the front bulkhead of the YC-14 (prototype for C-17). This large one piece bulkhead is shown below:

Unfortunately Boeing lost out to McDonnell Douglas for the C-17. But shortly after this, Boeing was in competition for the Air Launched Cruise Missile (ALCM). ManTech formed a team of visit both competitors to review their designs and possibly identify technology programs that ManTech could run to support the ALCM program. The Boeing ALCM design originally had 14 forgings that had to be machined on both sides, with significant amount of the aluminum ending up as scrap material, and then welded together. Nate Tupper was on the team to visit Boeing. Before he left he had me look at the Boeing design to see what suggestions I had. I said, well they just finished the Cast program, here on this non-man rated system is a perfect opportunity to get some production experience with cast aluminum primary structures. So at the meeting with Boeing, Nate suggested they consider casting the vehicle. Boeing took his suggestion and redesigned the ALCM into 4 large cast aluminum sections, which resulted in an estimated savings of $150,000 per vehicle. Boeing ended up winning the competition and credits their switch to the aluminum casting design as the major factor in the win. The President and CEO of Boeing sent me a plaque for my “promotion of aluminum casting technology” and the Aluminum Division of the American Foundry Society awarded me their top service award for the year 1985.

In 1980 I moved back to ManTech as the Technical Area Manager for Metals Fabrication. During this period two things were going on. First the philosophy coming out of Sagamore was resulting in more and more efforts to reduce manufacturing costs. Secondly, ManTech made a concerted effort to do more to support the Air Logistic Centers by helping them get into the computer automation age. This thrust was called Repair Technology (RepTech). Some of the programs in my Technical Area are discussed below, with the engineers managing the programs.

In the Automated Dimensional Inspection system led by Lee Gulley, an automated system was established at Boeing to inspect parts in the production of the Air Launched Cruise Missile (ALCM). A computer told a robot to go and get a missile part and take it to a laser dimensional inspection system. The part was loaded onto the machine and the computer downloaded the inspections instructions. Meanwhile the robot was busy getting another part to load onto a second machine. When the inspection was done the part was taken by the robot and placed in storage ready to go the assembly area.

The Advanced Machining System, managed by Veronica Guenther, was a $10 million program to develop the manufacturing technology for an automated computer controlled full machine area operation. The technology was developed and General Dynamics, Ft. Worth, TX spent $30 million to build the complete machine system, operated from a glass booth above the shop floor. It was used in production of the F-16.

In the RepTech area ManTech made huge strides in support to the logistics centers. At San Antonio 4 systems were developed. The first of these was an Automated Plasma Spray System managed by Sylvester Lee. The system involved robotic sand blasting of engine burner cans, followed by the transfer of the can to another booth were it was plasma sprayed with a coating.

A second program was Automated Electrophoretic Coating of turbine blades. This program also led by Sylvester Lee, automated an existing process to achieve better uniformity and reduced cost.

A third program was the Integrated Blade Inspection System managed by Lee Gulley. Turbine blades were being inspected by manual inspection, which was slow and subject to human error. This program automated the application of penetrants to the blades and then laser scanning of the blades to identify the ones with cracks.

The most successful program, however, in payoff to the Air Force, was the Retirement for Cause program managed across the Lab by Dr Wally Reiman. The ManTech portion of this major effort was first managed by Dick Rowland and later by Bruce Rasmussen. Engine disks that cost tens of thousands of dollars each were being operated to what was considered a safe engine life, and then discarded, whether they were still safe to use or not, because it was not known what surface defect or crack would cause the part to fail and even if we could find that size of defect. This program performed a huge amount of failure analysis to work to identify critical flaw sizes and then developed the technology to find flaws of that size reliably. The system installed at San Antonio ALC was projected to save $ 1 Billion over the life of the F-100 engine.

Another successful program in Metals Fabrication during this time was a Computed X-Ray Technology for Rocket Motors, managed by Lee Gulley. The concern was that air pockets were some times created when filling the rocket with solid propellant and that these air pockets could lead to the rocket exploding. This program developed a computed x-ray machine capable of taking x-ray slices of large rocket motors. Lee also managed other successful programs in non-destructive testing and evaluation, such as a Capacitance Hole Probe system.

Ed Wheeler led the development of a ManTech program Portable Ultrasonic C-Scan Inspection system, which led to the Mobile Automated Ultrasonic Scanner (MAUS), which is now widely used in the aerospace industry.

In 1987, I became Program Manager for the Advanced Materials for Space Structures (under the Strategic Defense Initiative Organization (SDIO)) systems in development. Programs included metal matrix composites, thermoplastic composites, viscoelastic damping materials, space radiator materials, and others. Unfortunately none of the SDIO space systems ever proceeded to production.

From 1990-1994, I was Chief of Plans for the Lab. While in this job I participated in two major initiatives:

I was the Air Force member of a DOD team to review defense companies in Greece and to determine potential areas of cooperative research and development and other methods of modernizing the Greek defense industry.

I was also a member of a small Air Force team to review South Korea aircraft technology for potential support to Air Force systems operating in Asia area.

From 1994-1997, I was Chief of the Integration and Operations Division. During this period I developed the first (and probably only) Strategic Plan for the Materials Lab.

Over the years as my knowledge and experience in aircraft structures materials and manufacturing technology grew, I was identified by the Lab to support many Air Force level reviews. These have included:

C-17 Aircraft Preliminary Production Readiness Review team
Joint A-10 Aircraft Operational Readiness Review team
Corona Quest (B-1 aircraft study)
Space Shuttle External Tank Source Selection team (NASA source selection)
C-5 Aircraft Wing Redesign team
Air Force Systems Command 5-Year Manufacturing Plan team
MX Missile Reentry System Source Selection team
ASALM missile Materials & Processes Review team
F101 Aircraft Engine Critical Design Review team

I don't think the Lab gets enough recognition for the importance of the Lab to these review teams, maybe some of the most important things we ever do.