In late May 1940, a contract was negotiated for the RAF to purchase 320 Mustang I airplanes, numbered AG345 to AG664, with the design to be in accordance with Project NA-73. NAA Test Pilot Bob Chilton began flight tests in May 1941 with Airplane No. AG345. Notable differences from the original NA-73X design were the extension of the carburetor intake scoop forward to the spinner and a flat panel armored glass windshield instead of a curved one.
Dear NAA Retiree Bulletin Subscriber

Since becoming editor in 2001, we have made a concerted effort to enlist authors with very little success from the divisions that were formed in the 1950s. The general attitude was that the North American Aviation Retirees Bulletin was a product of the Los Angeles Division; therefore, our interests are limited to the airplanes produced in Inglewood. Well, this year, the Sleeping Giant has awakened and we are publishing articles from all divisions and test sites. From Space Division we had Ben Boykin and Ellis Katz; from Autonetics we had Gene Andreosky; from KSC we had John Tribe. In this issue we have articles by Vince Wheelock taking a look at the early days at Rocketdyne, Paul McCormick describing the fantastic growth of the Columbus Division in Ohio and John Tribe, again, with a detailed report on the Apollo 1 fire. To top off all these stories, Norm Avery takes us back to those terrible Great Depression days when every airplane company was struggling to stay alive by trying to sell their airplanes to foreign governments.

We have more great stories lined up for the Winter Issue but we are always eager for more. If you have a story that you think we could use, don’t be shy. Nervous about your spelling? Don’t worry! Our brilliant staff of editor will make sure it comes out perfect!

In our forty-nine years with North American Aviation/Rockwell we never met the man. However, in these years as editor, his name came up many times associated with various planes and projects. We asked him for a story once and he favored us with an article about NAA trainers. He even provided photos to go with the article including ones of his own T-6 and T-28C. We finally met him at a Bald Eagles Reunion. His name came up again in the article by Paul McCormick about Columbus. He is not Mr. “Dutch” Kindelberger. He is not Mr. Lee Atwood. But, he certainly is Mr. North American Aviation: he is Mr. Frank Compton.

One of our readers asked, in writing this quarterly summary, do we use the term “we” because “we” wish to usurp it from the Queen of England or because “we” have a small mouse in our pocket? Neither! It’s because my words get “wire brushed” so thoroughly by our small but very viable staff that I feel it is a group effort!

With this issue, we have only the Winter Issue to complete the year and engage in the usual scramble to renew subscriptions. This places a heavy burden on our wonderful volunteer in charge of subscriptions, Sonnie Robertson. It would be a tremendous help if you renewed early to avoid the year-end rush! Just send us your check made out to the “Bald Eagles, Inc.” for $10.00 per year or $100.00 for the lifetime “Silver Eagle” subscription. You don’t have to cut out the subscription form and ruin your copy. Send your check and Sonnie will credit you with the renewal. If you send $100.00, she might even acknowledge it with a nice note! If you know of a friend that is bed ridden or getting on in years, this would be a good time to consider a gift subscription. We will send him a copy of the Winter Issue in addition to all four issues next year with a note telling him who is the thoughtful donor.

Congratulations and Best Wishes to

Gordon and Bee Toomey of Auburn, California celebrating their 59th Wedding Anniversary
Fred and Colleen Bowman of Trinity, Texas celebrating their 56th Wedding Anniversary
Jack and Priscilla Clark of Etowah, Tennessee celebrating their 59th Wedding Anniversary
Vincent and Peggy Lariviere of Riverside, California celebrating their 50th Wedding Anniversary
Exporting Airplanes to Survive
by Norm Avery

Author's Note: An account of North American Aviation's export sales during the 1930s would not be complete without a brief summary of the exports sold by other major contemporary aircraft manufacturers at the time. These sales, as indicated in this article, are not complete but do provide the magnitude of the role assumed by exports in the survival of American aircraft firms during the tough post Depression years.

During the mid 1930s, as America was slowly recovering from the Great Depression, many foreign nations began modernizing their obsolete air forces with substantial purchases from American factories. All major companies did well with export sales although all sales were subject to the Neutrality Act and required approval of the State Department. In the interest of promoting his foreign policies, President Roosevelt eased the rules considerably.

In 1934, about 40% of American built aircraft were exported. By the first quarter of 1938, the number of exports were almost double the number exported during the same period in 1937. These sales were significant in financing much of the American technology when, during certain periods, the delivery of aircraft abroad exceeded those to the domestic services. A major advantage of the export business was that the price was far greater than to the U.S. services or commercial buyers. Not until 1940 did domestic sales began to exceed exports.

The Glenn L. Martin Company faced bankruptcy in 1934 after heavy losses on commercial flying boats. The company was temporarily saved by a loan from the Reconstruction Finance Corporation for production of 100 B-10 bombers for the U.S. Army Air Corps, which had been basically configured by the Engineering Department at Wright Field. When replacement time came, the B-10 lost to the Douglas B-18. This proved to be no disadvantage, since Martin made large sales of the B-10 to anxious foreign buyers. Between 1936 and 1937, 34 were sold to Argentina, 9 to China, 120 to Holland, 6 to Siam, 20 to Turkey and, under license, 42 were built in Spain. After nearly going under in 1934, Martin declared 1937 the company’s best year ever! It was of little concern to Martin that their XA-22 lost in the attack bomber competition of 1938. In January 1939, France ordered 265 “Maryland” attack bombers and Holland ordered 120 for the protection of their oil interests in the East Indies.

Douglas was also doing well. In addition to the domestic DC-3 sales, the company sold two Douglas-Northrop Gamma bomber derivatives to China. In 1936, Japan purchased 4 A-17 attack bombers, 2 flying boats, the tri-tailed DC-4X and 22 DC-3s with license to manufacture. One hundred and fifteen units of the ill-fated DB-7, later designated the A-20, were purchased by France with substantial follow-on orders. Two hundred had been delivered by the fall of France and Britain assumed all remaining deliveries. One Gamma and one DC-2 (at double the price to TWA) were sold to Russia. In 1938, two Model 8A-1, similar to the A-17, with fixed landing gear were sold with manufacturing rights to Sweden. Eight more went to Argentina and in 1939 ten were sold to Peru and twenty to the Netherlands. In 1940, fifteen more were sold to Iraq and thirty-six to the Norwegian forces in Canada.

In 1940, Canada purchased twenty B-18 bombers. That same year Anthony Fokker in Holland became the chief foreign sales agent for Douglas, buying production and export rights for the DC transports with Douglas receiving a royalty on each plane sold.

Lockheed, a relatively small company in 1934, was trying to avoid bankruptcy. Deliveries were almost complete of their sleek plywood monoplanes designed by Jack Northrop in the late 1920s. In February, two Altairs were sold to Japan which was of little help. The all metal, twin engine and 10 passenger Electra was in the early stages of production and had exceeded estimated development costs, straining the company's finances. Domestic sales were only fair but the sale of 100 to Japan was a welcome boost. The smaller 6-passenger Electra Junior sold fairly well in the United States but in 1936 about 65 were sold to Argentina, Brazil and the Netherlands East Indies. However, the 14 passenger Super Electra was failing to compete with the Douglas DC-3 although some were sold to domestic airlines and some were in the works for Japan. By then, Lockheed began the design and development of the Model 22, the P-38, and more shop space was available than money.

Miracles do happen! Earlier in the year, the company had made studies of the Super Electra airframe as the basis for a bomber. In 1938 when the British Purchasing Commission was soliciting American aircraft companies as potential sources of anti-submarine patrol bombers, Lockheed was a likely source. With only 5 days notice, Kelly Johnson and his team made a Super Electra mockup with gun turrets and a bomb bay and were rewarded with a 25 million dollar contract for 200 examples of the plane, now named the Hudson. Thanks to this initial export sale, Lockheed became the fastest expanding aircraft company and quite literally overnight went from near bankruptcy to the big time. This order was soon followed by one for 350 more planes. Ultimately, 1,382 Hudsons were purchased by the British and another 1,302 for lend-lease.

In 1939, the Allied Purchasing Commission, consisting of Britain and France, negotiated with Lockheed for more than 600 as yet to be designed fighter aircraft capable of 400 mph. At the time, only the future P-38 had any prospects of meeting that requirement.

These negotiations and subsequent sales to foreign buyers were approved by President Roosevelt under a revised policy for sales to France and Britain. As war in Europe became even more certain and with agreement with the USAAC, a number of the newest combat planes would be diverted to these countries. In return, these countries would furnish the U.S. with current combat performance.

On Long Island in New York, the Seversky Aircraft Company (later Republic) had fallen on hard times after completing deliveries of the BT-8 trainers and P-35 fighters to the USAAC. Fortunately, they sold twenty bomber escorts to Japan and twenty to Siam. A few more sales ensured survival until the huge WWII contracts swamped the industry. Two export variants of the P-35 were sold to Russia with manufacturing rights and another twenty to the Japanese navy. In 1937, Sweden ordered a hundred of which forty were delivered and the remainder requisitioned by the USAAC.
In the small community of Downey, located east of Los Angeles, the small Vultee Aircraft Corporation was surviving with domestic sales of the V-1A single engine transport. Following the government edict that forbid single engine airliners, Vultee revised the design to a light attack-bomber variant and made substantial foreign sales as the V-11. Thirty-five were sold to China in 1935, some to Russia and forty to Turkey. The follow-on V-12 was sold to China with two assembled and forty for assembly in China.

The prominent Curtiss Aircraft Corporation in Buffalo, New York did a thriving business with their Hawk Model 75 fighter with fixed landing gear. China bought 112 in 1938, 200 were built under license in Argentina and France purchased 200 as the Hawk 75A-1 with retractable landing gear. In 1939, France ordered 430 more, followed by orders from Iran, Norway and the Netherlands East Indies. The final order from France was unfulfilled when France capitulated and Britain assumed the contract for the remaining airframes.

The Great Depression notwithstanding, North American Aviation was better financed during those difficult years than some of the other aircraft companies. It was also to North American Aviation’s advantage to have entered the airplane manufacturing business shortly before a significant surge in both export sales and domestic military orders. Of equal importance, the company had a dynamic management and directors willing to take reasonable risks. Ever increasing orders during the 1930s required continual plant expansion and increased employment. Although, North American Aviation fulfilled all contracts with the American air services from 1936 to 1940, during that period the company delivered more military aircraft to foreign purchasers than to the U.S. air services.

North American Aviation’s export business got off to a less auspicious beginning than that of Lockheed or Martin and their almost instant sales of hundreds of aircraft. North American export sales in 1937 were 5.1% of American aviation exports. By 1938, this figure was 10.1% and by 1939, it rose to 33.3%. These ratios dropped to 14% in 1940 when orders from the U.S. air services began a significant increase.

Except for the sale of thirty airplanes to Argentina and fifty to China, most of the North American deliveries were for only a single airplane and it was common for five or six national insignias to be seen in the final assembly line at one time.

It was the BT-9 that became the antecedent airplane for thousands of follow on trainers, attack bombers and basic combat types. Export sales began in 1935 when Argentina purchased the single Dundalk designed NA-16 prototype trainer, at the time with Civil Registry X-2080. In 1937, Argentina purchased thirty airplanes and Honduras bought three.

In 1936, Canada purchased a single BC-1 type and the following year bought the NA-44 attack bomber demonstrator with integral fuel tanks. Another single BC-1 sale was made to the Fokker Company.

The year 1937 was no better than 1936. Sweden bought two BT-9s, with one delivered disassembled. Japan purchased a single BT-9 with a larger geared engine and a three blade propeller with Mitsubishi obtaining the manufacturing rights.

And Australia bought two BC-1 types with fixed landing gear and manufacturing rights for the Commonwealth Aircraft Corporation. Later in the year, Venezuela ordered two BC-1s.

Export sales took a profitable turn in 1938 with a sale to China of thirty-five BT-9Cs and almost concurrently, a sale of fifteen BC-1s. The purchase of seven fighters powered by 840 hp Wright engines by Peru marked the company’s entry into the design and manufacture of a fighter aircraft. As the probability of a major war was becoming all too obvious, North American, in February, received its first large order when Britain purchased two hundred BC-1s types designated as the Harvard I. This contract, combined for another twenty five more in equivalent spares, was valued at $6,500,000. This was soon increased by an additional two hundred aircraft. In December, Brazil purchased twelve BT-9Cs.

In 1939, business for North American got off to a good start when, in February, France ordered 230 BT-9s and 27 more in equivalent spare parts, a contract valued at $7,000,000. In September, this order was increased by another 230 airplanes.
In April, China ordered 50 BC-1 types with fixed landing gear and, in May, Canada contracted for 30 Harvard I airplanes for the RCAF. The year was also noted for the largest order ever received by the company when, in November, Britain placed an order for 600 Harvard II trainers. This model differed from the Harvard I with major wing and fuselage changes and a different engine. Basically, it was the USAAC AT-6.

The final sale of the year occurred in November when Siam ordered six fighters powered by 870 hp Wright engines. All were completed, tested, paid for and awaiting shipment when the political situation in South East Asia caused the U.S. State Department to revoke the export license. All were diverted to the USAAC as the P-64. Siam had also purchased ten attack-bombers based on the NA-44. These, too, were intercepted before delivery and diverted to the USAAC as the A-27.

A modest sale of three AT-6 types to Venezuela got 1940 off to a slow start and later in the month Brazil ordered thirty attack-bombers based on the NA-44.

In April, the company was advised by the British Purchasing Commission of its acceptance of a new, modern fighter in preference to the company tooling up as a second source to produce the already obsolete Curtiss P-40s for the RAF. Assigned the North American designation NA-73X, the prototype became the ancestor of the immortal P-51. The initial contract for 320 airplanes based on a yet to be designed and proven airplane may well have been the most important export contract received by NAA. This was followed in May by a sale of twelve BC-1s to Chile and 100 Harvard IIIs to Canada.

Prosperity continued when, in June, Britain assumed the contract for 450 Harvard IIIs which were originally ordered by France. In July, another 125 were ordered. In September, the final sale for the year was to Britain for another 300 NA-73 fighters, now identified as the Mustang I.

As the second decade between the wars drew to an ominous close, the number of American military aircraft purchased by foreign governments exceeded domestic deliveries. Between 1935 and the end of 1940, North American sold nearly 3,000 airplanes to foreign air forces. All were single engine types. The annual dollar value of exported airplanes rose from $6,000,000 in 1935 to $196,352,000 in 1940. Annual USAAC appropriations were $27,400,000 in 1935, rising to $186,250,000 in 1940. It was the large orders from Britain and France that financed the expansion of the American aircraft industry, preparing it for the great production miracle of World War II.

About the Author: Norm, a marvelous engineer, historian, and aviation author, is well known to our readers because of his many scholarly contributions to this publication. He is the author of: NORTH AMERICAN AVIATION AIRCRAFT 1934-1998 VOLUME 1, and B-25 MITCHELL, THE MAGNIFICENT MEDIUM.

Norm now resides in Agoura Hills, California.
It was January 1967 and the pace of work at Cape Kennedy (as Cape Canaveral was called from 1962 to 1973) and the Kennedy Space Center on Merritt Island was very demanding. We had successfully launched the first two unmanned Apollo capsules, S/C-009 and S/C-011 in February and August 1966 on Saturn I launch vehicles from Launch Complex 34 on the Cape and were getting ready to launch the first manned spacecraft, S/C-012, from the same pad. In addition, we were activating Pads 39A and 39B at KSC and Pad 37 on the Cape as the pace of the Apollo program picked up to full speed ahead.

S/C-012 was the first of the Block 1 manned spacecraft (Block 2 would be the subsequent lunar flight configuration) and it had arrived at KSC in June of 1966. It went through an intense checkout flow in the Manned Spacecraft and Operations Building (MSOB) where it had endured multiple vacuum tests in the altitude chamber (with and without the crew) to clear problems and work off squawks. Work had continued throughout this period on a 7-day/3-shift basis with just one day off at Christmas and finally S/C-012 was moved out to LC-34 on January 6, 1967 for a scheduled launch on a Saturn IB (AS-204) in February.

Flowing along behind S/C-012 was a second manned mission using S/C-014 on a Saturn IB and S/C-017, which would be the first unmanned S/C to fly on the giant Saturn V. The workload on North American Aviation (NAA) engineers and technicians with multiple flows and very tight work schedules was very heavy and home life took a back seat.

The Reaction Control Systems (RCS) group at NAA had grown during the previous year from Larry Whitacre and myself to include Marty Cioffoletti, who moved over from the Gemini/Mercury program and Paul Rolloson, a new grad from the University of Arkansas. Another two engineers, Wayne Fisher and Joel Robinson, were en route to join the group. Meanwhile, we were all working some very long hours.

The day was Friday January 27th and S/C-012 and the AS-204 stack were undergoing a “Plugs-Out” test. This procedure, OCP-K-0021, was to demonstrate all space vehicle systems and operational procedures in as near flight configuration as feasible. A simulated countdown and flight would be conducted with umbilicals disconnected and the spacecraft on simulated fuel cell power. In addition the crew were to perform an unaided egress at the conclusion of the test. The simulation would include cabin pressurization with pure oxygen to a pressure of 16.7 psia. This was similar to the procedures used in Mercury and Gemini spacecraft and despite the inherent huge increase in potential flammability that it presented, it did not merit a hazardous classification for the test. After all, we had just gone through four simulated

The Apollo I Crew (left to right): Gus Grissom, Ed White, and Roger Chaffee on Pad 34.
runs in the altitude chamber with a pure oxygen atmosphere in the cabin without issue. While many upper level managers subsequently denied knowledge of the test conditions, no one involved at all levels of management ever stopped to really contemplate exactly how hazardous such an environment could become.

It should be noted: a pure oxygen breathing environment for the crew precludes ‘bends’ from the nitrogen in their blood coming out of solution as the cabin pressure decreases during ascent to its space flight level of about 5 psia. In addition, from a design viewpoint, a single gas supply is far less complex and lighter in weight than a mixed gas system. The hazard of flammability in a zero gravity environment is also significantly less because there is no convection. On the ground the latter is very definitely not the case!

The “Plugs-Out” Test

As the lead engineer for the RCS group, I had assigned Paul Rolloson to cover the Plugs-Out test. Although he was a relatively new engineer, the test was reasonably benign as far as RCS activities were concerned. However, Paul needed to get home early (i.e. on time) that evening so I volunteered to cover the remainder of the procedure. Unfortunately, a series of communication glitches and an unidentifiable smell in the cabin had prolonged the test far beyond its scheduled time.

I was working from the MSOB Automated Checkout Equipment (ACE) Station that was where we conducted all spacecraft testing – not from the blockhouse or firing room where most people assumed we were. The NASA test conductor was “Skip” Chauvin and the NAA test conductor was Hank Kuznicki. Skip could communicate directly with the crew; the rest of us could listen to them but only talk to them through him.

At about 6 p.m., Skip suggested we go ahead with the simulated RCS static fire while we were waiting. In the actual countdown we would be test firing the RCS thrusters prior to flight but this test would merely be a simulation of the firing since we had no propellants on board at this time. It would be an opportunity to cycle through the switching and obtain a time hack on the operation. Consequently, I initiated the test working with Skip and Gus Grissom. It was uneventful and, unknown to me at that time, would be the last functional action on the part of the Apollo 1 crew. More communication problems caused another hold after we had finished.

At 6:30 p.m., we were still holding at T-10 minutes in the simulated countdown. I was filling the time by writing a test preparation sheet to conduct some RCS Command Module (CM) isolation valve heating tests the next day. In parallel with the Plugs-Out test, I was working with a technician on Pad 34, evaluating where to install temperature sensors on the valves. All the RCS closeout panels had been removed exposing the tanks, valves and plumbing in the ‘pork chop’ area of the command module. The ‘pork chop’ area was that volume around the base of the CM between the pressure cabin and the heat shield. He had been reaching through those open panels into the interior area checking access for the installation. When that last hold started I told him to take a break.

With the hold continuing, I was unaware of events happening in the CM that became evident after the subsequent data review. Right about 6:30 p.m., the biomed data from the crew together with guidance and navigation accelerometer indications, increased oxygen flow to Grissom’s suit and live microphone sounds all pointed towards movement on his part. This stopped at 6:30:45. At 6:30:55, 10 seconds later, a significant voltage transient occurred in AC Bus 2. In the ACE station, my first indication of a problem occurred at 6:31:05, a further 10 seconds after the voltage spike. It was Grissom with an exclamatory remark that sounded like “Fire!” I turned to Dave Stewart, the Stabilization and Control engineer who was sitting at the next console and said, “Did he say Fire?” Before he could answer Chaffee shouted, “We’ve got a fire in the cockpit”. We listened in disbelief not quite appreciating what we were hearing when there was a last garbled transmission, also from Chaffee, that sounded like “We’ve got a bad fire—get us out—we’re burning up” followed by a scream of pain and then silence. This last transmission finished at 6:31:22.

Meanwhile, unknown to us, the fire in the cabin had explosively flashed across the flammable materials, burning so rapidly that the increased internal pressure caused the pressure vessel to rupture around its base. Searing flames had blown through the failed walls of the cabin, into the pork chop area, flared out the open panels where my technician had been working and up the side of the outer heat shield, dangerously close to the live launch escape rocket atop the CM. If that solid propellant had ignited, it would have incinerated everyone on the top levels of the pad. Luckily, it was just charred and did not ignite.
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In the ACE station we were stunned and Skip could raise no one on the net—we knew that something dreadful had happened. I rose from my seat and went to the wall phone in the ACE station and called my wife. I told her that we’d had an accident out on the center but I was fine and not to worry if I was much later than planned getting home. I replaced the phone and Dave Stewart picked up after me to make a similar call. He asked what was wrong with the phone—he couldn’t get a dial tone... it was dead. I looked around and a security guard was locking the door of the station. The KSC emergency reaction procedure was in work and all affected areas were locked, sealed and isolated.

By this time Skip had made contact with the pad leader and technician supervisor on the A8 level of Pad 34 who had a five-man team struggling to get the outer boost protective cover off and the outer structural and inner pressure hatches open. The latter was too hot to handle and technicians burned their hands working on it while the atmosphere in the white room around the capsule was filled with dense, unbreathable smoke. Technicians took turns cycling in and out of the white room to complete the task. When the inner hatch was finally slid aside at 6:36 p.m. and the pad leader could make out through the smoke the condition of the crew, his words to Skip were, “I can’t begin to tell you what it’s like...” or words to that effect. We all knew then that the crew was dead.

Security came through the ACE station and collected all our procedures and “smarts” books that we always had with on station with us and we were bussed over to LC-34. The pad was a sea of lights, ambulances, and fire and security vehicles. We looked up at the A8 level and knew what remained of S/C-012 and three brave astronauts were still there (it was 0700 the next morning before the bodies were finally removed). We were taken into the ready room and were interrogated on tape as to our actions, memories, involvement in the test etc., and we were not released until 2:30 a.m. with instructions to be back in at 6:30 a.m. It would be a short night but sleep would not be easy anyway.

The Aftermath

Next morning we began the miserable task of trying to determine what had happened, poring over yards of data displays, listening over and over again to the crews’ last transmissions and plotting timelines and evaluating every data point that might have relevance to the fire. Everything back and forth to the data review area took us over the breezeway to the area near the astronaut quarters where the three red, white and blue Corvettes belonging to the dead crew were still parked. This activity went on for days and then the removal and grim disassembly of both S/C-012 and the new S/C-014 began in parallel in the Pyrotechnic Assembly Building on KSC. They were dark, depressing days until we could turn the corner and begin to recover from the accident. From this terrible accident a better and safer spacecraft would emerge together with operating procedures that would include greater oversight and safety controls. Training and configuration controls would be increased and strengthened. Wiring specifications would be reviewed and strengthened. Inspections across every aspect of the spacecraft would be increased.

Significant hardware changes that were incorporated included:
- The hatch was completely redesigned to eliminate the two-part inward-opening hatch and replaced with a single quick outward-opening hatch (as originally proposed by North American Aviation).
- Launch pad cabin atmosphere for pre-launch testing changed from 100% oxygen to 60% oxygen and 40% nitrogen to reduce support of combustion. The crew suit loops still carried 100% oxygen and after launch the 60/40 mix was gradually replaced with 100% oxygen at a cabin pressure of 5 psia.
- Vulnerable wiring was protected.
- Vulnerable plumbing carrying combustible or corrosive coolant was protected and leakage clean up would be more thorough.
- Combustible materials in the CM were eliminated or severely restricted.
- Ground-to-airborne communications were improved.

The lives of Gus Grissom, Ed White, and Roger Chaffee would not have been lost in vain. The moon was still within reach.

The Investigation

Eventually the investigations were completed and the Thompson Review Board issued its Apollo 204 Review together with a summary of what had happened in S/C-012 that dreadful night as best determined from the data available.

It is believed that the most probable cause of the ignition source was a short in an electrical power harness that ran under the access door to the lithium hydroxide canisters on the lower LH side of the cabin, next to Grissom’s couch. This wire, possibly damaged by the opening and closing of the access door during build and checkout, was the prime candidate in the region selected as the probable source although the extensive destruction of the cable and door made positive determination impossible. Why it chose that moment to arc is not known although we know that Grissom was moving around up until about 10 seconds before the voltage spike was recorded. No one has ever tied his movements to the short because it cannot be proven and no one wanted to cast dispersions on a dead hero. However, to my mind, his action at that time coupled with the unprotected wire bundles and other hardware adjacent to his couch present both the site and a plausible cause for damage and a spark. Another incident that occurred during an Apollo 9 altitude ground test 2 years later – one where Jim McDivitt generated an electrostatic spark in the CM during handling of a lithium hydroxide canister – lends credence to this. (This later event warranted grounding of the canisters during all subsequent change outs.)

The spark from the short in the 100% oxygen environment needed very little flammable material for ignition, and there was plenty close by. The lower part of the cabin had a ring of debris trap netting to stop floating articles in zero-g from lodging under difficult to get to areas. In addition, there were many patches of velcro fastened to every available open area on panels throughout the CM. This velcro was installed both by design action and by crew selection to accommodate convenient attachment of articles in zero-g. Both the netting and the velcro were highly flammable and provided the transport mechanism for the fire.
The fire burned in three stages. The first stage had a rapid temperature increase as the fire flashed up the LH wall of the cabin and across the ceiling with the cabin pressure increasing correspondingly until rupture approximately 15 seconds after the first report of fire. The last transmission from the crew also occurred at this time.

With the cabin rupture the brief second stage of the fire began. This was the period of greatest conflagration due to the forced convection resulting from the rush of gases through the ruptured pressure vessel. The swirling flow scattered firebrands throughout the cabin completing the spread of fire. The intensity at this point was indicated by the burst and burned aluminum tubing in the oxygen and coolant systems at floor level.

The third stage was characterized by rapid production of high concentrations of carbon monoxide that filled the cabin as the last of the oxygen was depleted. Heavy smoke formed and as the fire diminished from lack of oxygen the atmosphere inside became lethal. Localized burning continued around the environmental control unit close to where the fire is believed to have started as failed oxygen and glycol lines continued to supply oxygen and fuel.

Based on the positions where the crew were found it appeared that in all probability the Command Pilot (Gris- som) had left his couch to get away from the initial fire and was found on the floor of the cabin with his head beneath the Senior Pilot’s (White’s) couch and his feet back on his own couch. The Senior Pilot remained in his couch as planned for an emergency egress attempting to open the hatch until his restraints burned through. He was found lying transversely across the cabin beneath the hatch. The pressure in the cabin acting against the inward opening pressure hatch had made opening it an impossibility until the cabin rupture relieved that pressure. At rupture, the widespread fire and the rapidly increasing carbon monoxide concentrations would have incapacitated the crew and prevented further action on their part. Meanwhile, Chaffee had remained and was found in his expected position in the RH couch.

Since part of Grissom’s suit was found outside the command module, five feet from the point of rupture, it was apparent that his suit integrity was lost prior to the rupture and medical analysis estimated that crew consciousness was lost some 15-30 seconds after they lost their suit oxygen flow. The medical terminology said that loss of consciousness was due to cerebral hypoxia due to cardiac arrest resulting from myocardial hypoxia. In layman’s terms there was a lack of oxygen getting to the brain, breathing stopped and then the heart. Possibility of resuscitation was irrevocably lost after four minutes. The medical analysis did not address what burns they suffered during these final stages.

Epilogue

During the week before the fire I had asked Gus Grissom if he would get the crew to sign a photograph for my parents who were visiting from England. Six months after the fire the crew secretary, Lola Morrow, called me up and said they were finally clearing out Gus’ desk and they had found an envelope with my name on it. I went over and she gave it to me—it was the signed photograph of the crew. I still have it.

Notes of Clarification: Vehicle Number Assignments

1. Spacecraft and Flight Numbering confusion. The Mercury, Gemini and early Apollo spacecraft did not have named designations but were identified by their launch vehicles such as MA (Mercury Atlas), GT (Gemini Titan) and AS (Apollo Saturn). AS-201, -202, and -204 for S/C-009, -011, and -012 respectively were the flown and planned designations. The Apollo Fire Review Board actually used the terminology Apollo 204 in the title of their report (for the record AS-203 was a launch vehicle test flight without a spacecraft). The S/C-012 launch vehicle, AS-204, was subsequently used as the Apollo 5 launch vehicle for the first lunar module test flight from LC-37.

2. The terminology “Apollo 1” was assigned to the S/C-012 flight vehicle after the fire even though it would have made more sequential sense to have called it Apollo 3. As it was, no Apollo 2 and 3 flights were ever assigned. The next Apollo flight to be numbered was Apollo 4. This was the unmanned S/C-017 on the first Saturn V, AS-501, and was followed by Apollo 5 (above) and Apollo 6 the second unmanned S/C (-020) on AS-502. Finally, the first manned Block 2 S/C-101 flew as Apollo 7 on AS-205 in October 1968. After that, the sequence was consecutive from Apollo 8 through Apollo 17, the final lunar flight in 1972.

About the Author: John joined NAA Florida Operations on the Apollo Program in 1965. He was the supervisor of the CSM propulsion systems group for all the Apollo missions through 1972 and, again, in 1975 for the Apollo-Soyuz Test Project. He subsequently worked on the Space Shuttle Program until he retired in 1997 as Chief Engineer, Launch Support Services. John resides on nearby Merritt Island, Florida with his charming wife Melinda.
When Curtiss Wright’s F-87 Blackhawk Interceptor lost out to the Northrop F-88 Scorpion and their contract for 88 airplanes was cancelled, Curtiss had to throw in the towel and give up after 41 years of successfully manufacturing airplanes from 1909 to 1950.

When Dutch was offered the 3.5 million square foot plant owned by the U.S. Navy in Columbus, Ohio, he must have jumped with glee. His Inglewood and Downey plants were loaded with work and the Navaho intercontinental missile was coming on with very little room to expand.

The man Dutch selected to be General Manager of the Columbus plant was probably the least one expected. He chose Chuck Gallant, who had been his assistant for a number of years. Chuck had not had any hands-on experience in Engineering or Manufacturing, but he was intelligent, articulate and polished and he understood the role of subordinates.

Chuck surveyed all the units that comprised the Curtiss staff and decided to offer all of them positions with North American Aviation.

Then Chuck decided he needed a factory manager from the Inglewood plant. Stan Smithson offered him a worthy candidate in Reggie Clarke. Reggie had just finished the production of the B-45s in the rented space at the Douglas Long Beach plant. Reggie was the General Superintendent and needed a new challenge. He started at Inglewood, soon after the plant was opened, as a sheet metal worker building the all-metal fuselage of the O-47 observation plane. He quickly rose to department head and was sent to Kansas City to build B-25s, where he became General Superintendent. Reggie kept the manufacturing staff in place and brought in superintendents from LAD in the areas of tooling, sheet metal, machine parts and production control.

Next, the AJ-2 and AJ-2P programs were transferred from Downey. The T-6G and the T-28 programs were also transferred together with appropriate supervision in both Manufacturing and Engineering.

Next, the FJ-2 program was installed. This was the Navy version of the famous F-86. Columbus then became the second source for the F-86 because of the heavy demand to support the Korean War. To meet this schedule, Columbus ramped up to sixty F-86s per month and completed a total of 700 airplanes.

Then, the company needed a second source for the F-100s and 450 were built at the rate of 45 per month. In addition, Columbus built all of the F-86H models for a total of 470 units.

In 1955, the Columbus facility was expanding as new programs replaced second source programs and production lines began to grow.
In the first few years, the employment rose from 1,500 to 20,000 employees and Reggie promoted two men to the General Superintendent position, one for details and experimental and one for assembly.

With all this going on, Chuck established an engineering department. Ray Rice gave Chuck a Chief Engineer in the person of George Gehrken. George joined NAA in 1937 and was in project engineering. He became the project engineer on the P-51 Mustang and was sent to England to help integrate the P-51s into the Eighth Air Force. We all know how successful that turned out to be.

George brought in project engineers from the Inglewood engineering departments experienced in the areas of trainers, fighters and bombers. His most significant change was bringing in Frank Compton for advanced design. Frank had worked on many proposals and new designs in Advanced Design at Inglewood.

Chuck and George were doing the customer contacts and Frank would do the proposals. George’s first discovery was that the Navy was no longer interested in more FJ-3s unless the speed and range could be increased.

George and Frank came up with a proposal for the FJ-4 that featured a thinner wing and wet wing as well as a cockpit canopy reshaped all the way back to the vertical fin. The program was sold and hundreds of FJ-4s were added to the fleet.

The next win was the A3J-1, a Mach-2 carrier-based bomber for the Navy, that was the first Mach-2 vehicle in production anywhere in the United States. This was followed by the T2J-1, the Navy’s first jet basic trainer, to replace the T-28s.

George and Frank had ground out three new airplanes for North American Aviation in a two-year period.

Due to the heavy commitments involved in the development of two new airplanes and a missile simultaneously, Chuck called on the consulting firm of Booz, Allen and Hamilton to help solve his management problems. The answer and solution was to establish three assistants to the president and three program managers over each area with responsibilities of that of a president for each of the programs. One was for the A3J-1 program, one was for the T2J-1, missiles and surface-based electronics, and the third for commercial programs. This change to a matrix management system approach was one of the first at NAA and proved to be very successful.

The result was that Columbus was established as a full-fledged division of North American Aviation, completely autonomous and self-supporting.

Chuck was promoted to President, Reggie to Vice President of Manufacturing and George to Vice President of Engineering.

Thus, Dutch’s gamble paid off in spades and now he had won from the Navy a faster fighter, a Mach-2 bomber, and the Navy’s first basic jet trainer.

Shortly after this, Dutch moved Chuck Gallant back to the Corporate Office as Executive Vice President under Lee Atwood and over all the other new divisions established. Will Yahn was promoted to President of the Columbus Division. Will had come up through Curtiss Wright as head of Contracts and Pricing, but needed some manufacturing experience and was sent to Fresno, California to head up that operation before returning to be Executive Vice President. Dick Walker advanced to Executive Vice President and John Fossnes, who had been Project Engineer on the A3J-1, had advanced to Assistant to the President A3J-1. With this, other things started to happen.

The Navy was forced to give up nuclear warheads on carriers in favor of the Triad, which consisted of the USAF’s ICBMs, the USAF long-range bombers, and the Navy Polaris missiles fired from nuclear submarines. That brought the A3J-1 production line to an end.

But meanwhile, John Fossnes, in charge of a program that was shutting down, worked with the Navy and sold them on a reconnaissance version of the A3J-1, which would be redesignated as the RA-5C. This followed the Cuban Missile Crisis and the Navy needed a high-speed reconnaissance airplane. The configuration already incorporated major modifications that included a greater fuel capacity and the installation of improved high-lift devices on the wings that reduced the speeds, but would still allow landing on carriers within reasonable speeds.

The changes made for additional fuel gave the slim fuselage a graceful humback appearance. Receiving the reconnaissance version was a major coup for Columbus. In fact, it allowed Will Yahn to promote John Fossnes to Vice President.

Meanwhile, the T2J-1 ran into a problem when the Navy decided to close down the Westinghouse engine plant in Kansas City, eliminating the J34 jet engine, thus reducing the order for jet trainers from over 500 to 317 and leaving the production line idle for two years. Consequently, Will Yahn charged his Assistant for Trainers find another engine and get the program started again!

Before the production line was completed, a variety of new designs were proposed. They included a General Electric J85-GE-4 fan engine, a radar jet, and two Pratt and Whitney J60-P-6 engines. After 40 marketing trips proposing the startup with two J85s or two J60s, Admiral Goethaite at Pensacola requested that NavAir buy two prototypes for evaluation and possible production.

Upon receiving the prototype contract for 3.3 million dollars, engineering and experimental were started and the airplanes were flown within eight months. The twin Pratt and Whitney J60s provided 6,000 pounds of thrust compared to the 3,400 pounds provided by the singular Westinghouse J34. This gave the T-2B superior performance in all categories.
We also added six hard points under the wings for future bomb racks, a feature used by Greece when it procured the trainer for its air force. The T-2B was built by the hundreds and later changed from the Pratt and Whitney engines to the General Electric J85-GE-4 engines due to lower price. The T-2s were the life blood of the Navy from the 1950s into the 21st Century and are now being phased out. North American Aviation trainers have been used to train American service pilots for over eighty years!

Meanwhile, Columbus was designing and building missiles, such as the Red Head/Road Runner target missile, for the U.S. Army. This missile was ramjet powered drone, zero-launched with a Rocketdyne solid propellant booster and sustained by a Marquardt MA-74 ramjet. After a number of developmental problems, it was successfully deployed and was followed by an electro-optical missiles series that were used in Vietnam. The Missiles function was split off from Columbus, sent to Albany, Georgia as part of Electronics Operations and, eventually, ended up in St. Louis as a current part of The Boeing Company.

After this success, the next major win for Columbus was the turboprop version of the T-28 which developed 2,450 hp for the Special Forces stationed at Eglin AFB. We also proposed on a counter-insurgency plane for the Defense Department which would be in competition with the turbo-prop T-28. In 1964, seven bidders returned proposals and Columbus won the competition with the OV-10A design. The OV-10A became the standard counter-insurgency airplane for the Air Force, Navy, and Marines and saw action in Vietnam along with the RA-5C.

As the RA-5C was phased out, the additional production of T-2s and OV-10s kept the Columbus plant operational and available for Space Division, producing major components subassemblies and details for the Space Shuttle, and for the Los Angeles Division, as a major supplier for the B-1 program. Columbus maintained this position until 1988 when the last of the 100 B-1Bs were completed.

Thus, from 1950 until 1988, the Columbus Division was a major supplier of airplanes, missiles, and electronic equipment for the U.S. Government, the Space Division, and the B-1 Division. When the Columbus Division closed in 1988, the industry said goodbye to an outstanding producer that was, unfortunately a non-survivor.

If this is the end, let this be a final salute to a grand company and a magnificent group of people whose company I shared these many years!

About the author: After spending 13 years in the Inglewood plant in Manufacturing, Paul transferred to Columbus as Superintendent Sheet Metal and a year and a half later, rose to General Superintendent Details and Experimental. In 1957, he was appointed Assistant to the President Trainer Aircraft, Missiles and Surface Based Electronics. After the go-ahead on the twin engine T-2B, Paul was named Vice President. When Missiles split off, he became Vice President Aircraft. During this period the T-28 turboprop and OV-10A were sold off. Paul remained in various management positions until the last B-1B was delivered, retired in March 1988 and consulted for the corporation for ten years. Paul currently resides in Worthington, Ohio.
With the end of World War II, North American Aviation’s vision of a strong America not only placed continued emphasis on Aviation in the development of state-of-the-art aircraft systems, but an expanding horizon into Aerospace to include new technologies in missiles, space power and energy systems. This expansion over the following 10 years resulted in NAA forming four new divisions in 1955, in addition to the already existing aircraft divisions. These were (1) Missile Development Division for missiles and launch vehicles; (2) Autonetics Division for electronics systems; (3) Atomics International Division for nuclear power; and (4) Rocketdyne Division for rocket engine systems.

In 1946, NAA received a letter contract from the Air Force for analysis and design of a supersonic guided missile with a range of 175 to 500 miles. NAA formed the Technical Research Laboratory to pursue this contract and within a short period of time, the Technical Research Laboratory had grown to over 500 personnel. NAA then created a separate department and renamed it the “Aerophysics Laboratory”.

While designers were aggressively analyzing requirements and designing Navaho systems, propulsion testing was initiated in the NAA Los Angeles Division East Parking Lot to gain experience and develop test data acquisition systems. Surplus JATO units and Research personnel’s small thrusters were the primary systems tested.

In 1948, the Aerophysics Laboratory was moved to the Consolidated Vultee factory in Downey, California and renamed “Missile and Control Equipment”. At this time, work was progressing on the North American Test Instrumentation Vehicle (NATIV) and the first launch of this vehicle occurred at the Alamogordo Army base in 1948.

The NAA East Parking engine test noise levels, although impressive to many, was causing concern of nearby tenants and the thrust levels had to be greatly curtailed. Looking elsewhere for testing expansion, a site in the Santa Susana mountains was selected as NAA’s first large liquid propellant engine test site. This site was perfect because it was secluded and the canyons were natural rocky bowls and provided security from viewing. Years earlier, the Chumash Indians roamed these mountains. Their big red boulders and rugged terrain later provided the backdrop for many Western movies. This test site was first named the Propulsion Field Laboratory (PFL), later the Santa Susana Field Laboratory (SSFL).

Meanwhile, the initial Navaho propulsion efforts continued with the first two phases to analyze the V-2/A-4 engine components and to Americanize them with U.S. design standards and manufacturing methods. Although, three engines were assembled, none were hot fire tested as the pace of progress was great on a new Navaho Phase Three engine with its many improvements. This introduced a totally new turbopump-fed liquid propellant engine generating 75,000 lbs of thrust at Sea Level. It was designated by the Air Force as XLR43-NA-1, or, to some, just “Engine No. One”.

The Rocket Engine Test Facility located in the NAA LAD East Parking Lot with the new control center replacing the bulldozer blade that initially provided personnel protection during testing.

Using Dr. Robert Goddard’s and German A-4 technology as base line data and advancing many of the design features produced a new and higher thrust engine, “Engine No. One”.

Rocketdyne, the Early Years
by Vince Wheelock
The first large engine test stand at the Santa Susana site, Vertical Test Stand No. 1 (VTS-1), was activated in January 1950 with “Operation Sunrise” and a large liquid propellant thrust chamber ignition test. This was followed by a pressure-fed full thrust chamber test in March 1950 and a full-up turbopump-fed engine test, generating 75,000 lbs of thrust, in November 1950. The VTS-1 test stand stood tall to prevent erosion at the base where the rocket engine exhaust impinged. Later, water-cooled flame buckets were developed that allowed follow-on test stands to be built much closer to the ground.

During this time, the Propulsion Research Organization was busy analyzing and testing different propellant combinations, ignition systems, instrumentation and small rockets. Early emphasis on large liquid propellant propulsion systems was developing reliable hardware and uprating the thrust to meet increasing demands. The Army had selected the Redstone Missile and the Rocketdyne A-6, and later A-7, propulsion systems. The Redstone vehicles achieved many “First” in America’s Space Program, namely:

- The first all American produced large ballistic missile, launched in 1953;
- America’s first satellite into space, Explorer I in 1958;
- The only launch of a live atomic warhead into space that was detonated, launched from Johnson Island in the Pacific in 1958; and
- The launching of America’s first man into suborbital space, Alan Shepard in 1961.

Much of the A-6/A-7 Redstone engine testing was accomplished at the White Sands Missile Range 500,000 lb thrust test stand.

The Air Force concentrated on the Navaho Missile and the Rocketdyne G-26, and later the G-38, propulsion systems. Major technology breakthroughs occurred during the Navaho engine development and the Rocketdyne Engine Advancement Program (REAP). These included increased thrust levels, change from LOX/Alcohol to LOX/RP propellants, and hinged engines for vehicle directional control.

Starting in 1950, Rocketdyne was active in providing rocket propulsion systems for various sled programs required by the Air Force. These were the Cook Sled, Air Force Sleds No. 1 and No. 2, and the Air Force RS-2 Sled. The rocket propulsion systems were pressure-fed liquid propellant rocket engines with thrusts ranging from 50,000 to 150,000 pounds. The sled designs were primarily for releasing and testing parachute recovery systems and missile inertial guidance systems.

At Santa Susana, the 1950s saw a vastly increasing number of large engine test stands and component test areas brought online to meet large liquid propellant engine numbers and requirements of the Cold War and space launch vehicles. In all, by the early 1960s, 18 large engine test stands were built, some with dual positions, along with five labs and an advanced Propulsion Test Facility supporting over 145 projects. Approximately 3,000 people worked the test facility on a seven-day, 24-hour per day schedule.

TV and movies continued at the site, only instead of Westerns, the theme was Space, Science Fiction, and Star Wars. Over the years, Santa Susana has survived through fire and floods, an occasional snowstorm, and the food at Goldie’s lunch shack. Testing today of large liquid propellant rocket engines is phasing out with tests being conducted at more isolated areas;
namely, the Air Force Research Lab in California; Marshall Space flight Center in Alabama; and the Stennis Space Center in Mississippi. In November 2001, the SSFL was designated as an American Institute of Aeronautics and Astronautics Historic Aerospace Site.

In early 1955, a site was selected in Canoga Park, California close to the Santa Susana large engine test area to build a facility to house the expanding propulsion design and production activities. Propulsion people had been located at many different locations in the Los Angeles area namely Slauson, Beverly Hills, Deering, NAA Los Angeles, and Downey. On November 7, 1955, Rocketdyne became a NAA Division with Sam Hoffman the General Manager and by the end of 1955, over 2,500 personnel had been relocated to the new facility.

To meet increasing production engine demands, Rocketdyne activated a production facility in Neosho Missouri in 1956. MA-2, MA-3, and MA-5 Atlas, MB-3 Thor, H-1 Saturn, Vernier, and P4-1 Drone engines were assembled and hot fire tested there. The facility shut down in 1968 due to declining production needs.

Rocketdyne was in the solid-propellant rocket field from 1959 to 1978. A site was procured from Phillips Petroleum in McGregor, Texas that was a Naval Industrial Reserve Ordnance plant. This site housed operations for research, development, manufacture, and test of solid-propellant propulsion systems and gas-generating devices. The static test facilities consisted of seven bays for static firing of solid-propellant motors with thrusts up to three million pounds. The site was sold to Hercules, Inc. in 1978.

The Intercontinental Ballistic Missiles (ICBMs) were the ultimate goal of the United States as a deterrent to aggression. The long-range systems with a 5,500-mile range, previously considered offensive weapons, were quite a challenge in the 1950s. Therefore, interim systems were developed with intermediate ranges of 1,500 miles. These were the Thor and Jupiter missiles powered by Rocketdyne MB-3 and S-3D propulsion systems. The Thor missiles were deployed in the United Kingdom and the Jupiter missiles in Turkey and Italy. These liquid-propellant ICBMs were subsequently developed and performed with amazing accuracy. The Intermediate Range Ballistic Missiles, (IRBMs), and the ICBMs were removed from service by 1965 as their function had been served as immediate deterrents in favor of the more storable, operationally friendly, solid-propellant rocket Minuteman missiles.

While the real contributors to the advancement of liquid propellant propulsion technology were the many dedicated employees of Rocketdyne, names were purposely avoided in this article because there were just too many. To represent them all, we mention our first General Manager, and later President, Sam Hoffman.

The 1960s saw Rocketdyne personnel counts peak at over 20,000 during the Cold War deployment of the ICBMs and...
gearing up for the Saturn Apollo program. This article summarized much of the Rocketdyne activities over the first 10 to 20 years, but the next 45 years saw such grand achievements of providing:

1. Large Liquid Propellant Engines for the Saturn I and IBs, Saturn V, Atlas II, Delta II, Space Shuttle Main Engine, Delta IV, and the Reusable Launch Vehicle Technology Demonstrator;
2. Small Space and Aircraft Engines and Thrusters for the Gemini Capsule, Apollo Command Module, Minuteman Postboost, Lance, Mars Mariner and Viking, aircraft boosters, target drones, and Peacekeeper Postboost Systems;
3. Missile Stages for the Nomad, Homing Overlay Experiment, and Peacekeeper;
4. Commercial/Utility Products of Jetfoil Pumps, and oil and coal slurry feed-pump systems;
5. Solid Rockets/Rocket Motors for at least 14 different products;
6. Atomic Energy Related Business for at least 35 different products; and
7. many Government Non-Rocket Engine Projects such as the International Space Station Electric Power system. Some of Rocketdyne's products have probably been missed, but each has an amazing story within itself.

Rocketdyne has been recently acquired by Pratt & Whitney, a United Technologies Company, from the Boeing Company. The new division has been titled Pratt & Whitney Rocketdyne, Inc. This union provides for a stronger, more competitive rocket engine company and greater freedom to pursue business in a much downsized propulsion market.

Note: All photos are from the Author's Collection.

About the Author: After a four year stint in the USAF with service in Korea, Vince graduated in 1958 from Iowa State University with a degree in Mechanical Engineering. He then joined Rocketdyne and participated in booster rocket engine installation, checkout, test and launch of all Rocketdyne major engine systems including those for early Thor and Atlas ballistic missiles, Project Mercury, Saturn V, Apollo and Space Shuttle. He held various management positions at Rocketdyne including the Field Operations Site Manager at the General Dynamics Astrodynamics Facility in San Diego, California during the Cold War Atlas Missile Deployment and Project Mercury, and at NASA's Marshall Space Flight Center in Huntsville, Alabama during the Saturn V/Apollo Program. He retired as the Director of Field Engineering & Logistics in 1996 and continues to be active in propulsion support at Rocketdyne, and as a Rocketdyne Liquid Propellant Rocket Engine Historian. Vince currently resides with his charming wife Gail in Westlake Village, California.
North American Aviation Scholarship Fund

As all of you know, our company no longer exists and our very name is fading into the forgotten shadows of the past. It is tragic that the company and people that accomplished so much in the creation of flying machines that carried man faster, farther and deeper into the unknown is only a tiny footnote in the pages of history. As the years slip by, our ranks are thinning out and there are fewer of us to trumpet what we have created and what we have accomplished. The volunteer staff of your North American Aviation Retirees Bulletin have given this much thought. Thanks to you, the Bulletin is on solid financial ground. Now we are considering the implementation of a NORTH AMERICAN AVIATION INC. SCHOLARSHIP FUND in cooperation with a local university to provide a prestigious award with a small cash stipend yearly to the student with greatest achievement for the year. We thought of UCLA but since that institution sold off the donated Super Sonic Wind Tunnel, we are inclined toward USC. The Bulletin can get this project started by providing the seed money but we will need help from you retirees. Before we move out on this project, we want to hear from you. Are you for the project? What are your ideas? How should the students apply? What criteria should be used to pick the winner? If you have some ideas, let’s hear from you! If you want to make a pledge, even better!

Contrails From The Past
by Ed Rusinek

Dear Ed,

Enclosed is my check to extend my subscription for two more years. I wanted to let you know how much I have enjoyed the Retirees Bulletin since I retired in 1984.

My entire career at NAA since 1952 was in Tooling at LAD, Downey, Seal Beach, Palmdale, and Cape Canaveral. I was a toolmaker for seven years and then held management jobs in various tooling departments.

My wife and I had a great retirement until she died in 2004. My children and grandchildren have kept me busy since then.

—Aaron “Mac” McKelvey, Laguna Woods, CA

Ed’s Ans.: Thank you for the kind words regarding the bulletin and for sharing a bit your life with us. Our deepest sympathy for the loss of your loving wife. May you enjoy your children for many years to come.

Dear Ed,

I enjoyed the article about Jack Fox very much. I was privileged to have worked with him for a short while before he retired. His fine example of working in remote wartime locations with minimal facilities to achieve desired results was mirrored by the NAA Tech Reps in other theaters.

—Lowell Ford, Torrance, CA

Ed’s Ans.: Jack Fox represented the finest qualities that were so true of NAA employees. He just didn’t roll up his sleeves, he took off his shirt, salvaged some metal from a scrapped B-25 fuselage and installed a 75 mm cannon in the front end of a B-25 with no blueprint, no automatic tools and a lot sweat! He then informed the engineers in Inglewood on how he did it.

Dear Ed,

In this Summer Issue, I went directly to the article about the Apollo-Soyuz because I had a special interest in it. It was my “Astronauts Patch” design that was selected by the crew from a national design competition. I met with Deke Slayton to discuss some changes that were requested. The changes were so substantial that I wondered if I had really won or if the astronauts decided it would be nice to allow a woman to be credited with the design. It has been published many times but I do not recall ever seeing it on the astronauts’ flight suits.

Of great interest also was the Apollo’s return to Earth—which was a near disaster. We never heard about that!

—Jean E. Pintaro, Los Angeles, CA

Ed’s Ans.: It is difficult to see the details; but if you examine the photo with the article, you will see the crew patch on the left chest of each crewmember. The return to Earth was a close call but superb training and practice won the day!

Dear Ed,

The “Space Walk of Fame” museum at KSC has the names of all the contributors on display including many from North American/Rockwell. I worked with many of them at KSC.

I enjoy the articles in the bulletin, especially the one written by John Tribe. When will we get more recognition in the Bulletin?

—Thelma Martin, Buena Park, CA

Ed’s Ans.: The “Space Walk of Fame” museum is located in Titusville, just outside the gates at KSC. It displays the names of all the contributors and their company affiliations. Under “Apollo” you will find many of our best known and unknown names. Sadly, many have already departed this world.

As to representation in the Bulletin, we have another article by John Tribe in this issue. We have another coming by Bill Edson.

To get more representation, we need more authors to write the articles! It is simple as that!
The Silent Majority
by Stan Guzy

BOSDET, RHODA LEE, 70 – of Gardena, CA, passed away peacefully surrounded by her family on September 24, 2006 in Torrance, CA. She was a great fan of Frank Sinatra, Willie Nelson and Kenny Rogers. Rhoda worked for many years at LAD in the Materials section and then transferred to Engineering. She retired from LAD in 1990 with 35 years of service. She is survived by her devoted husband Charles. She was a “Lost Sheep” in our last issue but now she is found.

CLARK, GEORGE M., 61 – of Northridge, CA, died on June 2, 2008. George earned his engineering degree from UC Berkeley in 1967. After post-graduate study at the Rensselaer Polytechnic Institute, he joined Rockwell where he was a mainstay in the Thermodynamics Group of the Aircraft Division. He is survived by his wife Kathy.

COFFEY, JAMES M., 78 – of Bainbridge Island, WA died in Carmel, CA on June 23, 2008. Jim worked on several projects at LAD, including the Sabreliner, Apollo and B-1, before he retired in 1989 after 35 years of service. He is survived by his wife Virginia.

ELWELL, MARGARET A., 77 – of Bullhead City, AZ, died on February 14, 2008 in Honolulu, HI. She served for 20 years at Autonetics. She is survived by her husband of 58 years, Roy Elwell Jr. and an extended family.

FEWELL, RICHARD O., 83 – of Murrieta, CA passed away on June 11, 2008 of undisclosed causes. After serving in the Navy, he joined NAA at the Space Division in Downey. Dick was very proud of his contributions to the Apollo and Space Shuttle programs. He retired in 1985 and is survived by his wife of 29 years, Claudette.

FORSYTHE, DONALD J., 69 – passed away at home in Corona, CA from undisclosed causes on June 8, 2008. He was active in community and youth sports activities. Don was a Manufacturing Manager at Autonetics. He is survived by his wife of forty years, Phyllis, and his extended family.

GALLOWAY, LESTER L. “LES”, 86 – passed away on February 26, 2008 in Banning, CA of complications due to congestive heart failure. Les retired in 1973 after serving as Vice President of Manufacturing at LAD and as Manufacturing Manager of the Sabreliner Division. He is survived by his devoted wife Vicky.

GYSEN, ELMER, 85 – from Grass Valley, CA, passed away on July 20, 2008. Elmer began his NAA career in Downey, CA in Manufacturing and worked on all the major prototypes from the X-15 to the Space Shuttle. He retired in 1985 after 37 years of service. He is survived by his wife June.

KAHELIN, PAUL H., 87 – passed away on October 7, 2007 at home in El Cajon, CA of complications from prostate cancer. Paul was employed as an engineer by several aerospace companies and worked on the AC-130 Gunship, KC-135, the Scorpio, L-1011, and Atlas-Mercury projects. He retired from the B-1 Division in 1989 with 13 years of service.

LAMBERT, RALPH W., 91 – passed away peacefully on June 28, 2008 at his home in Santa Ana, CA after becoming incapacitated with Alzheimer’s disease for the past six years. Ralph went to work at NAA in Los Angeles and Fresno and eventually was assigned to the NAA/RI Rocketdyne Division in Canoga Park, where he built rocket engines until his retirement in 1982. He was considered an exemplary employee his entire career. Ralph is survived by his extended family.

LANE, ROBERT D., 83 – passed away peacefully at home in Vista, CA after suffering a stroke during an angioplasty procedure in February 2008. During WWII, Bob was a P-51 flight instructor in the USAAC. He joined NAA/LAD as a stress engineer on the F-86 and retired as a project manager on the B-1 program in 1984 with 28 years of service. He is survived by his loving wife Mary.

MOHR, RONALD J. “BLACKIE” – bulletin returned, reported deceased on March 16, 2008. Records indicate Blackie retired from the Space Division in 1980 after 33 years of service.

MURPHY, EMMETT D., 74 – died of leukemia at his home in Riverside, CA on July 14, 2008. Emmett had retired from the USAF in 1984 after 28 years of service with the rank of Lieutenant Colonel. His career included flying many types of aircraft and commanding the 728th Military Airlift Squadron at Norton Air Force Base. As an electrical engineer at NAA/RI, Emmett worked on the Apollo Soyuz mission and was lead engineer in the design of the cockpit area for the Space Shuttle. He is survived by his extended family.

MURPHY, DONALD W., 90 – of Torrance, CA passed away peacefully on July 1, 2008 after a two-week battle with pneumonia. Don retired in 1978 as the head of the LAD Art Department with 39 years of meritorious service. Don, an accomplished artist and art instructor, served his community as well as his company in many ways. In 1953, as the Cub Master of Pack 2806 in Manhattan Beach, CA, he created the Pinewood Derby. During the past 55 years, over 100 million scouts have participated in the derby. Don lost his first wife, Anne after 57 years of marriage. He then met and married Muriel Bauer, who he described as the “cutest thing this side of heaven”. They were each others love and companion for the past twelve years. Don is survived by his extended family.

OBENBERGER, WALLACE J. “WALLY”, 81 – of Whittier, CA died on July 5, 2008 of undisclosed causes. Wally joined NAA in 1951 at Downey, CA, was transferred to Autonetics as Director of the Avionics Laboratory and then on to LAD as the head of the B-1B Software Laboratory. Wally retired in 1986 after 35 years of valued service. He is survived by his devoted wife of 55 years, Bernie.

O’TOOLE, MURRAY J., 90 – of Palos Verdes Estates, CA passed away after a short illness on June 29, 2008. Murray graduated from the University of Notre Dame, cum laude, in 1942 and joined North American Aviation as an aeronautical engineer. He worked on a multitude of airplane and space projects at LAD and Downey. He is survived by his loving wife of 40 years, Jary. She is also a NAA retiree. Murray was a gentle soul and our good friend. We shall miss him.

PAGE, SANDFORD N. “SANDY”, 78 – of Norwalk, CA passed away September 16, 2007 as a result of a brain tumor. Sandy retired from Corporate-Information Systems in Seal Beach as an electrical engineer in 1990 after 38 years of service. He is survived by his devoted wife Carol.

SANDERS, HARVEY E., 79 – died on July 17, 2008 at his home in Corona, CA from undisclosed causes. He served in the
Navy in Korea before joining NAA/RI/Boeing as a Computer System Analyst. He is survived by his extended family.

SCHENDEL, RICHARD G., 77 – passed away at home in Santa Ana, CA on November 9, 2007. Dick was Director of Payroll at the Corporate Office in Seal Beach when he retired in 1987 with 33 years of service. He is survived by his loving wife Barbara Sue.

SITLINGTON, FLORENCE P., 84 – passed away on July 25, 2008 in Anaheim, CA from undisclosed causes. She had been a long time resident of Hermosa Beach and Redondo Beach while working at NAA in El Segundo for over twenty years. Flo was preceded in death by two husbands.

SVMONOFF, CONSTANTINE “TIMO”, LT. COL., USAF, 89 – passed away peacefully on July 14, 2008 at his home in Rossmoor, CA. Timo’s family immigrated to America after the Russian Revolution. He earned his masters degree in Aeronautical Engineering from the California Institute of Technology in 1948. He served 24 years in the USAF as a command pilot and on the first USAF Space Program, Project Mercury. His second career began with NAA/RI where he contributed to the Saturn V Program and the B-1 Bomber. Timo retired from NAA/RI in 1985 after 21 plus years of service. He is survived by his beloved wife of 64 years, Maude.

TORREY, GLEN E., 69 – of Merritt Island, FL died on June 5, 2008. Glen started at Downey in 1962 on the Apollo program as a GSE design engineer before transferring to KSC in 1966 as the project engineer for all Apollo fluid and mechanical systems. He returned to Downey in 1972 and was responsible for the integration of all Space Shuttle flight and ground systems. In 1977, he again returned to KSC to head up the Rockwell Shuttle Project Office. From 1984 until 1989, he was the Vehicle Project Manager for the Challenger and Discovery Shuttle orbiters before becoming Manager of Shuttle Configuration Requirements and then Manager of GSE Design until his retirement. He is survived by his loving wife Marian.

TRAVIS, GORDON L., 74 – passed away on June 18, 2008 in Yorba Linda, CA. Cause of death was not disclosed. Gordon had been employed at NAA/RI/Boeing as a mechanical engineer for over 30 years and contributed to the development of the Apollo and Space Shuttle programs. He is survived by his wife, Eva, and his extended family.

VARA, JOSEPH A., 85 – of Galloway, OH died on May 6, 2008. He served in Anaheim and Columbus as a contract negotiator and pricer until he retired in 1994.

WILEY, GEORGE O., 80 – long time South Bay, CA resident and community volunteer, died June 29, 2008. After serving in the Navy, George attended Akron University and Ohio State University. He joined NAA at Columbus and moved to El Segundo in 1962. He retired from NAA/RI after 40 years and continued as a consultant for Boeing. The work ethic that marked his career also characterized his civic and volunteer work. He received many accolades and awards and was widely admired for his quick wit and wry sense of humor. He leaves his wife Violet and extended family.

WRIGHT, BETTY, 85 – passed away at her home in Lake Elsinore, CA from undisclosed causes. Betty retired from NAA/RI in 1988 after serving for 32 years. She is survived by her husband of 65 years, Ted, and her extended family.

YOUNG, RICHARD C., “DICK”, 91 – died on May 17, 2008 in Templeton, CA after a very short illness caused by strep-A bacterial infection. Dick was hired in Dundalk, Maryland in August 1935 as a sheet metal helper. He was rehired in December 1936 in Inglewood as a template maker under H.V. Schwalenberg. He was promoted later to Group Leader of Lines and Dimensions. In 1962 he transferred to the Space Division as Manager of the Apollo Airframe Group staff. He retired to Paso Robles, CA in 1972 after 36 years of service. He is survived by his daughters, four grandchildren, and four great grandchildren.

In this, our final salute to our comrades and colleagues that have embarked on their final journey, only 13 of the 27 were subscribers to this bulletin. With the end of the year coming soon, please consider adding a gift subscription for a friend when you renew your own subscription. If you do, we will send him/her the Winter 2008 issue as an added bonus.
Two North American Aviation Harvard IIs being flight tested for the RAF over the Los Angeles basin as part of the follow-on Order NA-81 for two hundred airplanes in 1940. An original Order NA-66 in 1939 resulted in 598 being delivered and two crashed during flight test. Hundreds more were built as Harvard Is and IIIs for the RAF and RCAF.