Martin-Baker

THE HISTORY AND DEVELOPMENTS OF MARTIN-BAKER AMERICA

SIXTY FIVE YEARS OF EXPERIENCE IN THE UNITED STATES

Martin-Baker America – History and Developments

As World War II drew to a close, the US Navy began to address the need for a means to escape from the new jet aircraft that would soon be entering service.

In 1945, the US Navy turned to Martin-Baker for help. Meetings were held with the Company and a 110 foot high ejection seat test rig was purchased and erected by Martin-Baker specialists in the Philadelphia Navy Yard. The 110 foot test rig was also used to evaluate the forces exerted on the pilot during ejection from the aircraft at a velocity that would ensure the clearance of the aircraft fin at high speed. In early 1946, Commander Gressley USN demonstrated the seat by ejecting up the test rig before a V.I.P. audience including Flag Officers and Sir James Martin.

On 31st October 1946, Lieutenant J/G "Chubby" Furteck USN, a highly experienced Navy test parachutist, made the first live ejection from a specially converted Douglas JD-1 over NAS Lakehurst, New Jersey using one of the Martin-Baker seats.

Following the successful testing of the Martin-Baker seat, the Navy passed the seats and data to Douglas, Grumman, and Chance Vought to produce their own seats based on Martin-Baker concepts. Although these aircraft primes established departments to design and manufacture ejection seats, their priorities were inevitably focused on airframe technology.

US Navy searches for a new seat

By the mid-1950s the US Navy was experiencing a 94% fatality rate in ejections initiated below 1000 feet. Their serious concern was communicated to the prime manufacturers and some effort was made by them to improve seat performance.

By this time, Martin-Baker had perfected an ejection seat which could safely eject a crewmember from an aircraft traveling at 90 knots at ground level. After extensive testing, the seat was demonstrated in September 1955 by John Fifield who ejected from a Meteor test aircraft on the runway. Director of the Bureau of Aeronautics, Flight Equipment Division, Hap Dressel, witnessed a live demonstration of the seat and was convinced that this was the ready-made answer to the Navy's unacceptable fatality rate.

During 1956 detailed discussions were held and engineering proposals produced for the modification of the seat to exactly meet Navy requirements and for the seat to be tailored to fit twelve very different cockpits in nine aircraft types. In August 1957, the first US Navy production ejection seat was ordered. The Martin-Baker ejection seat was equipped into the Grumman AF-9J and TF-9J Cougar, Grumman F11F Tiger, Chance Vought F8U Crusader, McDonnell F-4H Phantom, Lockheed T-1A Sea Star, McDonnell F3H Demon, North American FJ-4 Fury and Douglas F4D Skyray.

Product Support - Martin-Baker becomes part of the Navy team.

In 1960, it could take 5 hours to place a telephone call from the USA to the UK or vice versa. Telegrams were painfully slow and expensive and military message traffic could only be sent to other military establishments. With the number of Martin-Baker seats in Navy service growing rapidly it was felt that closer technical support was required to deal with any technical or support issues that arose. The Navy requested that an officer be located at the Martin-Baker Headquarters at Denham in the UK to which the Company readily agreed. Equipped with Navy communications equipment and telephone lines via the Navy Autovon system brought an immediate improvement in communications. With the Navy staff now able to receive a message, go to the appropriate department or even the Managing Director and Chief Designer for an answer and reply immediately, the new office brought an order of magnitude improvement in support. The Navy Office at Martin-Baker operated for many years but was made redundant by modern communications and the presence of Martin-Baker representatives with the Fleet.

Integrated Technical Representative Support

Despite the presence of the Navy Office at the Company, the operators wanted still closer support and it was decided to locate Company Technical Representatives with the Fleet. In 1961 two senior Martin-Baker specialist engineers were assigned to the Navy, one based at Commander Naval Air Force Atlantic Fleet (ComNavAirLant), NAS Norfolk, Virginia and the other at Commander Naval Air Force Pacific Fleet (ComNavAirPac), NAS North Island, San Diego, California. These Technical Representatives were on Navy orders administered by the Naval Aviation Engineering Service Unit (NAESU) headquartered at the Navy Yard, Philadelphia, Pennsylvania.

Overhaul & Repair (O&R) Depot support.

The Technical Representatives made daily visits to the Overhaul and Repair (O&R) Depots and visited other O&Rs as requested. These depots stripped the aircraft and seats back to their components and refurbished them to an as new condition before reassembly and return to the Fleet. During refurbishment the latest modifications were installed to keep the seats at a state-of-the-art standard.

Command Ejection System.

Cases arose during combat in South East Asia (SEA) where a pilot was wounded and unconscious and, despite frantic calls on the intercom, the Radar Intercept Officer (RIO) had to eject leaving the pilot in the doomed aircraft. To respond to this situation, McDonnell-Douglas (the companies had merged in 1966) and Martin-Baker jointly devised a Command Ejection system that was retrofitted in the Phantom. With this system, should the pilot initiate ejection before he was able to warn the RIO the RIO would be positioned correctly in the seat, the canopy jettisoned and he would be ejected - all automatically. The pilot would then be ejected after a brief delay and both crewmembers would be clear of the aircraft in only 1.7 seconds. The RIO could still eject independently but in the event that the pilot was incapacitated he could operate a Command Selector Valve (CSV) in the rear cockpit and when he ejected, the pilot followed automatically. Soon aircrews came to trust the system to give them the fastest means of escape and CSVs were left on so the either could eject the other. Many lives were saved by this system.

Continental United States (CONUS) Seat manufacturing capability.

There was concern in the Department of the Navy that with aircraft production for the US Navy dependent upon the supply of ejection seats from the UK a serious supply problem could arise if major hostilities broke out, disrupting trans-Atlantic supply lines. It was decided that Martin-Baker would provide the Navy with a full manufacturing data package, including all drawings and procedures that would enable seats to be made in the US if supplies from the UK were not sustainable. To this end the Navy established a seat manufacturing facility in Louisville, Kentucky, which held all the Martin-Baker drawing data packages and produced sample seats to demonstrate its ability to provide a second source of seats in the continental US in the event that supplies from the UK were interrupted. This capability was never needed and the sample seats were used for training purposes only.

Grumman A-6 Intruder joins the Fleet.

Incorporating the very latest design features, Martin-Baker commenced delivery of their Mark GRU5 seats for the new two place Grumman A-6 Intruder strike aircraft. This was the first Martin-Baker seat to be designed for and fitted into a new Navy aircraft rather than being retrofitted into an existing cockpit. The pilot on the left sat slightly higher and a little ahead of the Bombardier/Navigator (B/N). A unique feature was the ability to not only adjust the B/N seat vertically but to also tilt it fore and aft electrically.

This system enabled the B/N to position himself correctly so that he could look into the rubber eye piece of his radar scope while the aircraft was maneuvering violently. The seat also incorporated an automatic safety interlock which prevented the seat being inadvertently initiated during an emergency egress on the ground.

Martin-Baker "Joins" the US Army

In the mid-1960s the Grumman OV-1 Mohawk twin turbo-prop observation aircraft entered service with the US Army. As with the A-6 Intruder, this was a new Martin-Baker seat, the Mark J5 designed for a new aircraft. This programme introduced Martin-Baker to a new customer, the Department of the Army, who had very different needs to the Navy and Marine Corps.

Dedicated Technical Representative for the Army.

Following consultations with the Navy, the Army decided to employ their own dedicated Technical Representative and Martin-Baker sent another specialist who was stationed at Fort Eustis, Virginia. This representative worked with all the OV-1 squadrons and the Aviation community at Fort Rucker, Alabama. The Mohawk provided outstanding service, especially in South East Asia, and the seat was popular with the crews.

50 years of service to the USAF

The McDonnell F-4H fighter was proving so successful with the Navy and Marine Corps that the then Secretary of Defence, Robert MacNamara, directed the Air Force to adopt the Phantom rather than develop a new aircraft. This directive was energetically resisted by the Air Force who demanded numerous changes, including replacement of the ejection seat. However no "Air Force" seat had a comparable performance or a detachable seat bucket which was unique to Martin-Baker. This meant that the complete "Air Force" preferred seat, the North American LW3B, would have to be removed frequently. This would incur an enormous and unacceptable aircraft servicing penalty, as to remove the seat, the aircraft canopy also had to be removed and refitted, a complex and difficult task.

Embedded Dedicated Support for the Air Force.

Noting the success of the Technical Representative programme with the Navy, the Air Force decided to adopt a similar approach and Martin-Baker Technical Reprentatives. Stationed at Eglin AFB, Florida, (To cover the Continental United States) Clark AFB Philippines (To support operations in South East Asia and the Pacific Air Force) and at Ramstein AFB Germany (to support USAF Europe operations)

Proactive, Self-funded Research and Development.

Martin-Baker not only responded to customer inputs, they also maintained a high level of self-funded research into ways of improving their products still further. These improvements were then offered to their customers as Engineering Change Proposals. In this way the operators were able to ensure that their life saving equipment remained state-of-the-art. An example of this proactive approach to safety was the development of a rocket motor which could be fitted to existing seats to provide a step change improvement in performance.

Development of the under seat rocket

Even while the first seats were being installed in Navy aircraft in the late 1950s Martin-Baker was looking for a way to simultaneously reduce ejection forces and improve the seat's lifesaving capability especially in ejections from a descending aircraft at low altitude. More upward velocity was required to overcome the aircraft descent rate. Up to that time, the seat had been ejected from the aircraft by a telescopic ejection catapult mounted vertically behind the seat. The outer of the three ejection catapult tubes was attached to the cockpit rear bulkhead at its base and the inner piston tube was attached to the top of the seat. When the seat occupant pulled the seat firing handle it fired a cartridge in the top of the inner tube. This pressurized the catapult causing the telescopic tubes to begin to extend and as they did so they released the seat from the airplane. Continued extension of the tubes accelerated the seat and occupant up rails attached to the sides of the outer catapult tube. As the tubes extended further, the hot pressurized gas inside the catapult fired two more cartridges in sequence to continue the rapid acceleration of the seat. The problem was that the telescopic catapult could only accelerate the seat for the first six feet of the ejection, once the catapult tubes became fully extended and parted no further acceleration was possible. To eject a heavy occupant in the rear seat (nearest the fin) at 600 knots required a catapult that was so powerful that there was the risk of injury to a small occupant at lower

speeds - where ejection was more likely to occur. It was clear that the ejection catapult had reached the limit of its performance and that a different means of ejection was required.

It was clear that the catapult was the optimum system for the initial phase because it secured the seat to the airplane, guided the seat during ejection and offered a more controlled means of accelerating the seat and occupant while close to the airplane. What was needed was a way to increase and lengthen the acceleration phase without making the catapult longer, which was structurally impractical. Now the thrust of the seat catapult was augmented by the addition of a rocket that continued the acceleration of the seat and occupant after separation of the catapult tubes. At a stroke the acceleration distance had been increased from six feet to 120 feet giving the double benefit of reduced acceleration forces and greatly improved performance. Indeed performance was now so good that a pilot could eject safely while standing still on the ground or while descending rapidly close to the ground. It was another massive order of magnitude improvement in aircrew safety that was demonstrated most convincingly by a zero speed, zero altitude LIVE ejection demonstration on 1 April 1961 - a World‘s first.

Having demonstrated the concept of rocket powered ejection, the Company searched for a practical system that could be fitted to both existing and new production seats. The result was the under seat rocket motor that bolted to the underside of the seat bucket. This was achieved by cutting the reinforcing structure from beneath the seat and fitting side brackets to which the motor was bolted - the motor now providing the reinforcement to the seat bucket. This meant that no seat vertical adjustment was lost and that the seat could still accommodate the full range of aircrew sizes. A new, lower power, set of cartridges were provided for the catapult and changes were made to the time delay mechanisms on the seat to cater for the new form of ejection. Engineering Change Proposals were submitted to the Navy who immediately saw the benefit that the rocket seat provided especially in ejections during launch or recovery from the carrier or during weapons delivery diving close to the ground. The Technical Representatives were recalled to Martin-Baker in mid 1967 for retraining on the upgrade of the seats to rocket propulsion and modification kits were supplied to the Overhaul & Repair (O&R) depots. Work began almost immediately to convert the seats in the F-4B Phantom, F- 8 Crusader and A-6 Intruder and the conversion of the TF-9J Cougar followed on. The F-11F Tiger, F-3H Demon, and Douglas F-4D Skyray had by now been retired from service. The T-1A Sea Star was not converted as the ballistic catapult powered Mark L5 seat was considered adequate for the aircraft in its land based communications role. This conversion programme changed the seat designations to Mark 7 to indicate that the seat was rocket powered so that, for example, the Mark H5 seat in the Phantom became the Mark H7.

Inclined track demonstration for the Air Force.

The same Engineering Change Proposal was offered to the Air Force but they were not convinced that it was justified given their shore based operating environment. Even the provision of test data and film failed to convince them. Martin-Baker therefore embarked on a fully Company funded demonstration of the lifesaving potential of the upgraded rocket seat in the Phantom.

A large inclined test ramp was built at the Company’s test airfield near Oxford, UK. The track was angled downward 20 degrees to simulate the flight path of an aircraft diving close to the ground. A rocket powered sled was mounted on the track on which was installed a Mark H5AF ejection seat identical to that in the Air Force F-4 Phantom. The seat was occupied by a test dummy wearing Air Force flight clothing. Air Force specialists were invited to the test establishment and they inspected the seat and test dummy to confirm that everything was fully representative. The sled and seats were armed and, with telemetry and cameras running, the rocket sled was propelled at speed down the track. When the speeding sled reached the half-way point, at about 35 feet above the ground, the seat was ejected. Although the seat performed perfectly it and the test dummy struck the ground before the parachute could be released. Had this been a real ejection the seat occupant would most certainly have died.

The test was then repeated although this time a rocket powered Mark H7AF ejection seat was used. Again the Air Force representatives inspected and approved everything. This time when the seat ejected it soared upward on the rocket and there was more than enough time for the parachute to open, the seat to fall clear and the dummy make a safe landing. Martin-Baker had spent a great deal of their own money to prove the point and the Air Force could not fail to appreciate what a major improvement the rocket seat provided - especially as the Phantom was being used increasingly for low altitude bombing.

An order was soon placed and the Air Force began the conversion of all of their Phantoms to the rocket ejection seat.

F-14A Tomcat fighter enters service.

Martin-Baker and Grumman teamed to produce an optimised version of the Mark GRU7 seat in the A-6 Intruder for the F-14A Tomcat. This seat, the Mark GRU7A, optimised crew rearward visibility for air combat and was truly state-of-the-art for crew escape while still retaining a high proportion of spares and maintenance commonality with the Intruder. From the early 1970s the F-14A began to replace the Phantom in the Fleet Defence role although the Phantom continued to provide outstanding air to ground weapons delivery.

Four Place EA6B Prowler enters service. First to have four ejection seats.

In the late 1960s Grumman developed a four seat version of the A-6B Intruder the EA-6B Prowler. This aircraft was dedicated to electronic counter measures to disrupt and confuse enemy radar and communications during an attack. The Prowler was unique at that time in accommodating four crewmembers sitting in pairs under rearward opening clamshell canopies. The crew consisted of a pilot in the front left seat next to the first electronics counter measures operator ECMO1 in the front right seat. ECMO2 sat behind the pilot and ECMO3 behind ECMO1. Each crewmember was seated in a Martin-Baker Mark GRUEA7 rocket ejection seat similar to that installed in the Intruder. Having four crewmembers in close proximity introduced a risk that the seats could collide during multiple simultaneous ejections it could also take several seconds for the crew to abandon the aircraft by initiating individual ejections in turn.

A second is a long time in crew escape and can mean the difference between life and death. Martin-Baker therefore designed and developed an inter-seat sequence system to permit the abandonment of the aircraft in the shortest possible safe time. The rear crewmembers could eject individually but could eject no one else. ECMO1 in the front seat could initiate the ejection of himself and the two rear crew members. If the pilot was incapacitated ECMO1 could turn a handle so that when all three ECMOs had ejected, the pilot would be ejected automatically. If the pilot initiated ejection all four crew would be ejected in the sequence ECMO3, EcMO2, ECMO1 and the pilot - all were clear of the aircraft in only 1.2 seconds. The sequence was the same regardless of whether ECMO1 or the pilot initiated the escape sequence. The seats were designed to penetrate the canopy transparency and the rocket on each seat was angled very slightly so that the seats spread apart slightly during rocket burn and were separated from each other by about 70 feet when the parachutes opened. This outstanding escape system has saved many crews including the 5597, 5598, 5599 and 6000th aircrew members to save their lives with a Martin-Baker ejection seat, when the arrestor wire broke and a Prowler fell off the bow of the carrier. The pilot initiated a sequenced ejection immediately the wire broke and all four crew were clear before the Prowler left the bow.

Prowlers have also been used by the US Air Force to fill a capability gap caused by the retirement of their F-111 Raven aircraft.

F/A-18 Hornet Programme introduces Mark 10 ejection seat

As always, Martin-Baker had proactively self-funded the development of new generations of ejection seat to further improve their life saving capability, simplify maintenance, increase reliability and enhance serviceability. In Europe, Panavia, a consortium of the UK, Germany and Italy, was developing the Multi Role Combat Aircraft which was later named Tornado. This low level high speed strike aircraft placed new demands on the escape system which was required to save the crew in an ejection at 800 knots at ground level although later the requirement was reduced to 650 knots. As usual this was a competitive acquisition and the then new Mark10 Martin-Baker escape system was selected. The Mark 10 was also selected for the BAE Hawk and several other high performance aircraft then being developed.
In 1976 McDonnell Douglas issued a request for proposals for their new Strike Fighter the F/A-18 Hornet for the US Navy. Competitive proposals were submitted by at least two acceptable bidders one of which was Martin-Baker proposing their Mark US10 seat. This seat retained all of the features of the earlier generation seats which the Company had developed and supplied to the Navy but they were integrated into this new state-of-the art escape system. After an extended and hard fought competition Martin-Baker was selected by McDonnell-Douglas and confirmed by the Navy.

Designated the SJU-5/A by Naval Air Systems Command (NavAir) the seat was further refined during the prototype Hornet flight test program. The upper part of the seat bucket was made narrower to enable easier access to controls to the rear of the instrument side consoles and a seat safety handle was introduced to make the seat safe for ingress, egress and parking - gone were the separate safety pins used on earlier seats. High reliability, low maintenance was a fundamental driver for the F/A-18 programme as the Navy sought to achieve a quantum improvement in aircraft serviceability and availability. For example, the seat was redesigned into four easily detachable sub-assemblies consisting of the parachute and drogue container assembly, the rigid seat survival kit, seat bucket, and seat main beam structure and catapult. It was now possible to quickly and easily disassemble the seat in the cockpit and to carry the components down passageways and ladders to the seat servicing bay. Martin-Baker was a key team player in achieving this ambitious goal and the Department of the Navy and the operators are still benefiting from this farsighted improvement program. The pilots loved the seat too, it was comfortable, user friendly, and 100% successful in the first 50 emergency ejections. It was only when a pilot initiated ejection milliseconds before striking a mountain top that this incredible run of success was broken, but then nothing would have saved that unfortunate pilot. The Navy and Marine Corps had a very high regard for the SJU5/A seat in both the single and two place variants of the Hornet.

Navy Aircrew Common Ejection Seat (NACES).

In 1983, with cost saving in mind, Congress directed the Navy to follow the Air Force example and to embark on a programme to select a new seat that would be common to the F-14D Tomcat, F/A-18C/D Hornet, F/A-18E/F Super Hornet, T-45A Goshawk and Grumman A-6F Intruder (an upgrade of the existing A-6E). The Super Hornet and Goshawk were in development at that time and it was later decided not to proceed with the A-6F program but instead withdraw all the Intruders from active service. This new seat programme was to be called the Navy Aircrew Common Ejection Seat (NACES). Martin-Baker Mark 7 seats were already installed in A-6E and the F-14D Tomcat and their Mark 10 seat was flying in the F/A-18C/D Hornet and the British version of the Goshawk, the Hawk and was planned for the Super Hornet. If unsuccessful, Martin-Baker would have been replaced in five aircraft types, a major blow.

A request for proposal (RFP) for the NACES was issued by NavAir in April 1984 and the contract was awarded to Martin-Baker on 3 May 1985, 13 months after the RFP was issued. Although Martin-Baker had intentionally based their proposed seat on the SJU-5/A seat which the Navy knew and loved in the F/A-18 Hornet, the NACES programme incorporated some radically new requirements.

Helicopter Crashworthy Seats

In the 1960s Martin-Baker was one of the first companies to consider the need to protect crews during helicopter crashes. The greatly increased use of helicopters in the conflict in South East Asia brought with it increased loss rates and casualties. Given the Company's experience with ejection seats it was not surprising that their initial thought was to install ejection seats but the presence of the whirling rotor blades in the ejection path was an all too obvious problem. Early studies tried ejecting the seats sideways, or sideways and upward or rotating the seat and occupant on to the side ejecting and then using rockets to curve the trajectory upward once clear of the rotor disk. Unfortunately when a helicopter becomes uncontrollable, the rotor disk can become so distorted that blades can impact the underside of the cabin - there was clearly no future in trying to avoid the rotors. A practical system was developed for the NASA/Sikorsky X Wing research helicopter but there was no other interest in crew escape and this research work was abandoned.

Crashworthy Seats

Not to be deterred by the lack of interest in helicopter escape systems, Martin-Baker sought other ways of protecting the occupants in a helicopter crash. Research had shown that in the majority of helicopter crashes the aircraft was descending rapidly in an essentially level attitude. The subsequent violent crash deceleration resulted in serious injury or death. The solution adopted was to produce a special crashworthy seat that could attenuate the crash loads to an acceptable level that would minimize the risk of deceleration injury to the seat occupant. Martin-Baker developed a rigid seat frame attached to the aircraft to which was attached a cushioned seat bucket for the occupant. Normal adjustment was provided and a five point harness held the occupant safely and securely. In the event of a crash, the seat bucket and occupant would slide down vertical tubes on the fixed structure. As this happened, units fitted in the seat deformed metal in a controlled way limiting the loads transmitted to the occupant. The system

was light, simple and efficient and versions were available incorporating armor protection for the occupant. Martin-Baker found a ready market for their crashworthy seats which are now used in a wide variety of civil and military helicopters around the world.

In the US, operators include the US Army and Marine Corps who have the seats in the Black Hawk and Sea Stallion and others. These crashworthy seats are produced by Martin-Baker America Inc. in Johnstown, Pennsylvania. Over 20,000 Martin-Baker crashworthy seats have been ordered or delivered.

XV-22 Osprey.

When Boeing and the DoD started development of the radically different V-22 Osprey tilt rotor troop transport and attack aircraft they decided that the first five prototypes that would explore the unique tilt rotor flight characteristics would be fitted with ejection seats for the two pilots. The Osprey is a large aircraft with a shoulder mounted wing. At the tip of each wing is a very powerful turboprop engine driving a large diameter airscrew not unlike a helicopter rotor. With the engines pointed upward the two airscrews do indeed become rotors and can lift the aircraft vertically. Once airborne the engines can be swivelled forward directing the thrust from the “rotors” increasingly rearward causing the Osprey to accelerate forward. As speed increases the wings take the weight of the aircraft and the rotors become large propellers allowing the Osprey to fly at speeds unattainable by a helicopter.

Martin-Baker was selected to provide the 10 ejection seats for the high risk prototype flight test phase and a satisfactory test programme from the Osprey cleared the seats for flight. The program was a great success and this new technology was perfected with Martin-Baker safeguarding the lives of the test pilots.

Introducing the Mark 16 Series ejection seat.

NACES had been the fourteenth mark of ejection seat and the Mark 15 was a very specialized ultra light seat for low speed training aircraft. As early as1988 Martin-Baker proactively, and at their own expense, started studying a next generation ejection seat which would embody all the features of NACES, and more, but which would be substantially lighter. The quest to reduce seat weight was driven by the new generation of lightweight fighters, the Eurofighter Typhoon, being designed by a consortium comprising the UK, Germany, Italy and Spain, and the Dassault Rafale being designed in France. Both aircraft would incorporate relaxed stability and be controlled by computer to maximize their maneuverability. To achieve this, Eurofighter and Dassault needed to keep the forward fuselages of their aircraft as light as possible and specified a very light ejection seat which nevertheless retained a lifesaving capability equal to, or better than NACES. Both companies issued Requests for Proposals (RFPs) to US and UK companies and Martin-Baker and at least two US companies responded. After a meticulously conducted acquisition process by both teams, Martin-Baker was selected to provide their Mark 16 ejection seat for both aircraft.

Joint Primary Aircraft Training System (JPATS).

In the1990s the Department of Defense (DoD) directed the Navy and Air Force to cooperate in the joint procurement of a new primary training aircraft that would replace the T-37 in the Air Force and the T-34C Turbo Mentor and T-2J Buckeye in the Navy. This was to be a total training package that would provide a ground based education syllabus with simulators, together with a training aircraft for flight training. Low acquisition and total life cycle costs were a major driver.

Neither ACES II nor NACES were suitable for use in a lightweight low speed trainer and it was clear that a different seat would be needed. During the program planning phase Congress directed that the airplane selected for JPATS be able to accommodate a much wider range of both male and female aircrew sizes as women had now been cleared to fly combat aircraft and training would be required. Until then, aircraft crew stations and escape systems had been designed to accommodate and eject an all-male 1950s pilot population ranging in size from 5 feet 5 inches to 6 feet 1 inch and weighing between 130 and 211 pounds nude. Now the minimum size would be 4 feet 10 inches and the maximum 6 feet 5 inches and the weight would range from 100 to 245 pounds nude.

Martin-Baker developed a simplified lighter version of the Mark 16 seat optimised for a light primary training aircraft. This seat was competitively selected for all but one of the competing trainer aircraft types. The turboprop T-6A Texan II incorporating the Martin-Baker Mark US16LA seat was selected.

Considerable research and development was required before Martin-Baker developed and qualified a new ejection cartridge that could ensure a safe ejection with similar performance for any occupant irrespective of size or weight. This concept was then further developed so that NACES could be upgraded to accommodate the expanded aircrew size range.

T-6A Texan II in USAF and USN service

The US Air Force and US Navy/US Marine Corps have replaced their obsolete trainers with the modern T-6A turboprop trainer fitted with the Martin-Baker US16LA ejection seats. The seat has proved very popular with aircrew and maintainers alike and there have been several ejections all of which have been successful.

NASA T-38 Upgrade Programme.

The National Aeronautics and Space Administration, NASA operates a fleet of some 35 Northrop T-38Ns for astronaut training and communications. They had become concerned about the obsolescence the ejection seats and the fact that they could only accommodate a restricted pilot size range. NASA had approached the Air Force T-38 community with the proposal that they jointly upgrade the T-38 escape system but there was no budget available and the Air Force felt that they had higher priorities for funding. This attitude by the Air Force was driven by practical considerations and the need to refurbish the airframe ahead of changing the seat. Despite its unofficial name of “The pocket Rocket”, the T-38 also had an excellent safety record and there had been few ejections and most had been successful.

NASA had other priorities as the loss of a highly trained and valuable astronaut was a major concern as was the limited accommodation, given NASA’s female astronaut corps. NASA therefore decided to press ahead on their own with the acquisition and upgrade programme. A formal Request for Proposal (RfP) was issued and send to Boeing (then the owner of the ACES II seat), UpCo and Martin-Baker. As later with the air Force evaluation, the ACES II quickly encountered accommodation problems and a down select was made to UpCo and Martin-Baker. Several trial installations were conducted in a T-38 at Ellington Field, Houston, Texas and detailed assessments were made of the ability of the seats to accommodate the newly expanded male and female pilot population. Both seats were deemed to be technically acceptable and a series of best and final offers were then held to select a winner on the basis of cost and technical or program risk. After a very professionally run acquisition process Martin-Baker mark US10LN escape system was selected.

After an extensive qualification programme, Martin-Baker undertook the conversion of the NASA T-38N Talon fleet and the new seat was welcomed by maintainers and astronauts alike.

US Air Force Northrop T-38 Talon

Although the twin engine Northrop T-38 first flew over 50 years ago, it is still delivering valuable supersonic advanced flight training for Air Force student pilots. Various upgrades and refurbishments to the engines and airframe had kept the aircraft current and a new digital “glass” cockpit would bring the instrument displays up to date. Congress then mandated that the expanded male a female aircrew size range be accommodated and the T-38 could only accommodate the 1956 all male range of pilot sizes. Initially the new accommodation requirement was only mandated for the T-6A Texan II Primary Trainer which had been designed from the outset to accommodate both men and women pilots over the new increased size range. This situation meant that student pilots who graduated from the T-6A but were too tall or heavy or were too small or light for the T-38 and front line fighters were re-directed into transport aircraft or helicopter training even if they had been found to be fast jet suitable. This caused considerable resentment amongst rejected students and several raised the matter with their Congressmen/women and questions were asked but with little result.

Then the ACES II seats in the fast jet combat aircraft were modified to accommodate the expanded size range of male and female pilots. Now the T-38 had become a choke point preventing student pilots from progressing from the T-6A to the fast jet community. When Congress became aware of this situation it appropriated and allocated a budget and directed the Air Force to upgrade the ejection seats in their T-38 aircraft so that student pilots could graduate from the T-6A through the T-38 and onto the combat squadrons.

Evaluating ACES II.

As in the past 40 years, the Air Force initially considered the ACES II seat for the T-38 but immediately encountered a major problem. Vertical sitting height adjustment in all ACES II seat is achieved by electrically raising or lowering the entire seat. This means that the top of the seat also moves up and down. A trial installation of the ACES II in the T-38 cockpit at Wright-Pattison AFB revealed that upward adjustment immediately brought the top of the seat into contact with the inside of the canopy transparency. Consideration was given to modifying the seat but this represented a major redesign and was outside the time and budget constraints. The only other option was a redesign of the aircraft canopies. This was dismissed out of hand and it was clear that ACES II would not fit the T-38 and was therefore eliminated from the competition.

The competition.

Two companies were left in the competition, Universal Propulsion Corporation UpCo offering a version of their seat in the AV-8B Harrier and Martin-Baker. Both companies seats used the “Navy” style of sitting height adjustment where the seat structure is fixed and only the seat bucket and pilot move up and down. With this system the top of the seat remains fixed. This method of adjustment is also used by every other operator in the world (except where they had purchased ACES II equipped aircraft). Both seats were trial installed in the T-38 by the Air Force specialists at Wright-Patterson AFB and both were found to be acceptable.

Having already successfully converted the NASA T-38’s gave Martin-Baker a significant advantage as their proposal clearly possessed virtually no technical or programme risk. After a very detailed assessment of the technical proposals and the installations, together with repeatedly revised cost proposals Martin-Baker was selected to upgrade the Air Force T-38 fleet.

While undergoing an extensive test programme, company engineers worked with the Air Force to establish the best means of converting the 350 or so T-38s located at different bases around America. Conversion had to be accomplished without impacting the pilot training schedule. Hangars at the various bases were set aside for a Martin-Baker team to induct, convert and return to service aircraft as efficiently as possible. Other teams would provide escape system training and Air Force T-38 manuals were to be amended as the new systems enter the T-38 Fleet.

Martin-Baker Mk 16L ejection seats were now flying in both the USAF/USN T-6A Texan II and in the USAF T-38 Talon while the Navy advanced trainer, the T-45 Goshawk has the Martin-Baker NACES.

In all cases Martin-Baker had been selected competitively.

The Joint Strike Fighter - from the beginning.

The Joint Strike Fighter (JSF) programme was placed on a formal footing in the mid 1990s. As the name implies, this was to be an aircraft procured jointly by the Air Force and the US Navy with the British Ministry of Defence as a major partner who would procure the aircraft for the Royal Navy and Royal Air Force.
Although there would be a high degree of airframe component and systems commonality there would be three distinct variants of the aircraft produced.

The USAF version would be optimized for land based operation from long paved runways. The Navy version would have a larger wing and be equipped for launch and recovery from CVN fleet aircraft carriers. The Version for the US Marine Corps and British Services would be capable of short take off and vertical landing (STOVL) on an amphibious assault ship or smaller carrier at sea or be able to operate in the STOVL mode on land.

The technology demonstration programme.

Lockheed Martin and Boeing were selected to build technology demonstration prototypes designated the X-35 and X-36 respectively. Because Lockheed Martin was utilizing an AV-8B Harrier forward fuselage and cockpit in their demonstrator they decided to retain the UpCo SIIIS seat with which it was fitted in order to save cost and obviate the need to re-test. Boeing had an all new airframe and competitively selected a Martin-Baker Mk 16 seat similar to that in service in the Eurofighter Typhoon but modified to meet JSF requirements.

Both contractors were required to submit very detailed proposals for their production aircraft and both competitively, and entirely independently, selected Martin-Baker as their escape system supplier. After an extensive flight test program and technical and commercial proposal evaluation, Lockheed Martin and their X-35 was selected.

The F-35 Lightning II Program

With the contract now awarded, the production aircraft became the F-35 and was named the Lightning II. The three variants for the US Air Force, US Marine Corps/UK and US Navy were designated the F-35A, F-35B and F-35C respectively.

Martin-Baker immediately established a dedicated team who has worked with Lockheed Martin to produce a common seat, the Mk US16E that exactly meets the requirements of this major new programme.

Martin-Baker America Incorporated.

Having been based in the UK for the 65 years that they had worked with the US military, Martin-Baker decided to establish a presence in the continental US to still better serve their US customers. With their new generation of seats entering service with the USAF, USN and USMC it was considered appropriate to establish a stronger support and manufacturing base in country.

After much deliberation a plant was established in Johnstown, Pennsylvania, an area that had seen its traditional engineering jobs migrate to the Far East. There was a desperate need for quality engineering jobs and the very supportive Johnstown Area Regional Industries (JARI) organization would help the new Company find accommodation and aid in the recruitment process.

Martin-Baker America was incorporated in 2000 and their Johnstown plant was opened by State Governor, Tom Ridge, and local US Congressman John P Murtha.
Early the next year Martin-Baker America opened a product support and training facility in Boothwyn, near Philadelphia which was opened by local US Congressman Curt Weldon. After several years in operation this separate facility was closed and amalgamated with a new and much larger manufacturing plant in Johnstown.

Today Martin-Baker America is providing over 150 high grade manufacturing jobs in Pennsylvania and the Company is a fully integrated part of the manufacturing and support team serving Martin-Baker programmes in the United States.