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A brief history of Martin Baker ejection seats - Bang! And then you're out

During my service career in the RAF and also having conversations with members of the SA Aviation Museum the escape systems employed on the majority of aircraft are a mystery and that not many people are familiar with such an important piece of equipment. With these articles, I will endeavour to give you all a brief history of Martin Baker ejection seats and how they operated.

History

A bungee-assisted escape from an aircraft took place in 1910. In 1916 Everard Calthrop, an early inventor of parachutes, patented an ejector seat using compressed air.

The modern layout for an ejection seat was first proposed by Romanian inventor Anastase Dragomir in the late 1920s and patented in October 1929. The design was perfected during World War II.

Prior to this, the only means of escape from an incapacitated aircraft was to jump clear and, in many cases,, this was difficult due to injury, the difficulty of an escape from a confined space, *g* forces, the airflow past the aircraft and other factors.

In 1944 a Meteor achieved a top speed of just over 600mph in level flight and suddenly people were questioning the ability of a pilot even to be able to open his canopy, let alone survive a bail out. The British firm Martin Baker had been working on ejection seats since 1934 and James Martin took a personal interest after Captain Valentine Baker was killed testing a plane in 1942. In 1945, they began to live-test their revolutionary new seat that blew the canopy, restrained the pilot and automatically deployed a parachute.

The first live flight test of the Martin-Baker system took place on 24 July 1946, when Bernard Lynch ejected from a Gloster Meteor Mk III jet. Shortly afterwards, on 17 August 1946, Larry Lambert was the first person to eject in the US. Martin-Baker ejector seats were fitted to prototype and production aircraft from the late 1940s, and the first emergency use of such a seat occurred in 1949 during testing of the jet-powered Armstrong Whitworth AW.52 experimental flying wing.

With a history spanning over 80 years, Martin-Baker is still run by the late Sir James Martin's descendants to this day. Originating as an aircraft manufacturer, Martin-Baker's passion has evolved over the decades, now focusing on an issue very close to both their and the founders' hearts. From that day until now, Martin-Baker has saved the lives of more than 7,500 aircrew.

MK 1 Seat

In this article, I am only going to cover the Martin Baker seats as they are the seats I worked on and they may be the most familiar to you, the reader. There are other manufacturers in the world and American and Russia both have their own types.

The MK 1 Seat

In June 1947, the authorities had decided to standardise the Martin-Baker ejection seat for installation in all new service jet aircraft, and the work of production and installation was put in hand for Meteor, Attacker, Wyvern, Canberra and later the Sea Hawk and Venom aircraft.

These seats were provided with a seat pan capable of being raised and lowered to accommodate pilots of varying stature without increasing the height of the seat. The dinghy pack was connected to the chute by clips and a lanyard was attached to the pilot's Mae West.

The seats also included adjustable foot rests, and integral thigh guards to prevent the occupant's legs being forced apart by air blast.

The seat was guided during ejection by four rollers running in a guide rail assembly, bolted to the aircraft structure. A considerable number of emergency escapes were made with these manually operated seats, which fully justified their introduction in service aircraft. The pilot had to first Jettison the canopy, then operate the seat with the face blind firing handle. On firing, the seat left the aircraft at 60ft/sec.

Travelling up the rail, the oxygen bottle is triggered and the drogue lanyard deployed, which fires the drogue gun after 24ft of travel. The drogue chutes are deployed to stabilize the seat.

After the seat has been stabilized, the occupant then pulls his first 'D' ring on his parachute harness, which disconnects him from the seat. He then releases the seat harness, free falls and pull the second 'D' ring to open his chute! This worked quite well if you had the height, which was at a minimum of 1,000 feet. The limitations of this type of seat, however, were already obvious and the idea of making the whole sequence of events automatic began to take shape.

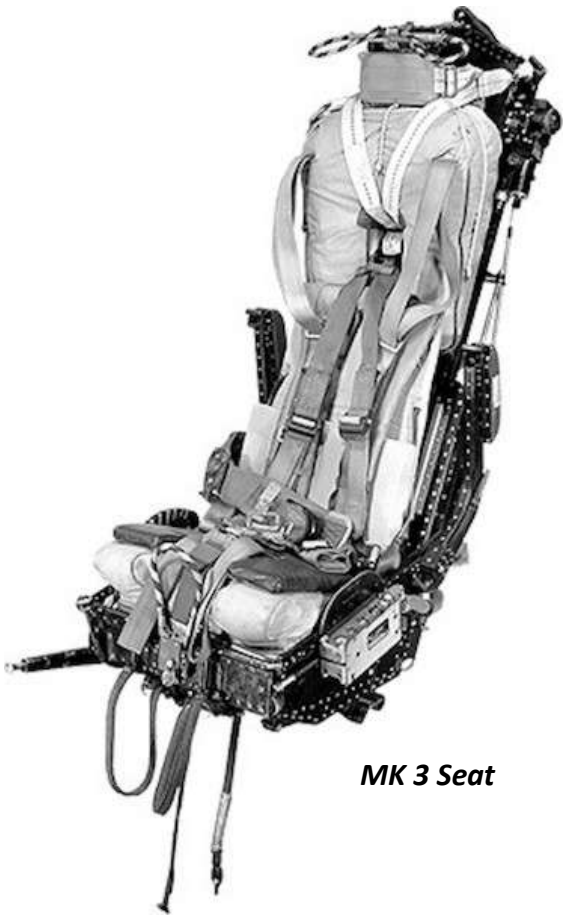
MK 2 Seat

The MK 2 Seat

In the design of the first automatic seat, it was decided to house the personal parachute in a container in the back of the seat and the dinghy pack in the seat pan, The dinghy pack was connected to the chute by clips and a lanyard was attached to the pilot's Mae West.
To facilitate the use of the drogue to effect deployment of the parachute. It was also necessary to devise some means of disconnecting the drogue from the seat at the correct time and transferring its pull to the parachute, and simultaneously a means of releasing the occupant complete with his parachute and dinghy pack from the seat.

On the Mk1 seats, the drogue had been attached to the top of the seat by a solid shackle. This was now replaced by a "Scissor Shackle", capable of being opened automatically at a pre-determined time.
The MK 2 was basically the same as the MK 1 but with additional features. It still had only one firing handle which was the face blind firing handle There was a drogue gun which fired when the seat had travelled up the rail a short distance and a barometric time delay unit was also triggered. If the ejection had taken place above 10,000ft the barometric time delay unit prevented the seat release mechanism from operating. When reaching that height, the unit operated and released the pilot from the seat. This then released the 'scissor' shackle and the drogue 'chutes which enabled the seat to fall away and operate the rip-chord, thus deploying the chute. There was still a safe height restriction. Some of these seats were later modified with increased operating speed to 80ft/sec.

The Mk2 automatic seats were successful in providing safe escape from the aircraft in service at the period, but there was still room for improvement at very low altitudes and very high speeds. In addition, the advent of aircraft such as the Javelin and the V bombers with their high-fin projections and higher operating speeds made it necessary to increase the height of the ejection trajectory, any increase also improving the chance of a successful



MK 3 Seat

ejection at low altitudes.

The Mk 3 Seat

The improvements to this type of seat over the MK 2 enabled the occupant to eject at runway level as long as the aircraft was travelling at 90 knots. A faster acceleration time from 60ft/sec to 80ft/sec gave more height and time for the full automatics to work. An alternative firing handle was fitted on the seat pan between the pilot's legs and leg restraints also were also fitted. Aircrew services included a personal equipment connector (PEC) providing connections for main oxygen, emergency oxygen, air ventilated suit, anti-g suit, microphone/telecommunications connections. Canopy jettison: which was optional, depending on the aircraft variant.

Operation Sequence

- The pilot pulls the face screen seat firing handle and the canopy jettison is initiated (if fitted);
- Ejection gun fires and the seat moves up the guide rails;
- Emergency oxygen tripped, as seat rises, static line initiates time-delay which fires drogue gun after 0.5 seconds;
- This deploys 22-inch diameter then 5-foot diameter drogues that stabilize and slow the seat down 1.5 sec (3 seconds on earlier Mk3 seats);
- As seat rises, static line initiates time-release unit; after initiation of time-release unit the plunger releases a scissor shackle to transfer pull of the drogue to lifting lines of parachute, releasing it from seat;
- Releases the face blind firing handle;
- Drogues deploy the main parachute and pilot separates from seat;
- Normal descent.
- In the event of failure of time-release unit, aircrew pulls D ring on parachute harness. This pulls slide disconnect pin which disconnects the withdrawal line from the parachute. Pulling the D ring also removes the canvas flap from the second D Ring, Pilot pulls a second D ring to operate the parachute.

The MK 4 Seat

With the advent of a new type of aircraft known as the "light fighter", it became increasingly important to reduce the weight of the ejection seat. At the same time, it was essential that the reduction in weight should not impair the operation and efficiency of the seat in any way.

MK 4 Seat

The construction of the Mk4 seat, although retaining the essential components of its predecessors, was therefore considerably modified.

The basic 80 feet per second ejection gun was retained, having been proved to be sufficient for all current requirements, as was the Duplex Drogue system deployed by the half second time-delay drogue gun, together with a 1½ second time-release unit.

The conventional type of guide rail was eliminated and superseded by channel members mounted on the sides of the ejection gun. Steel slipper pads mounted on the seat beams located the seat in position in the channels and guided it out of the aircraft on ejection. The seat structure consisted of a framework of two side beams bridged by three cross members, this framework supporting the seat pan and the drogue container; the drogue gun and the time-release unit being mounted on the side beams. The top cross beam took the full thrust of the ejection gun and contained the seat latch mechanism for locking the seat to the ejection gun. The centre cross member served as the attachment point for the shoulder harness whilst the lower member provided an anchorage for the seat height adjusting mechanism.

Although fitted primarily with the face screen firing control, an alternative firing handle was fitted in the leading face of the seat pan. This enabled the occupant to eject when conditions precluded the use of the face screen control. The comfort of the seat was considerably improved by the design of the parachute pack and dinghy pack alongside that of the seat, instead of trying to use the existing safety equipment. The parachute pack was a back-type, horseshoe in shape, and mounted high up on the back of the seat in the best position for automatic deployment, together with a high degree of comfort. The parachute harness was redesigned to combine with it the safety harness all in one, with only one quick-release fitting which was fastened by the occupant when strapping in the seat and remained fastened throughout any subsequent ejection until released by the occupant at the conclusion of the parachute descent.

This combined harness was attached to the seat by two locks in the rear of the seat pan and another lock in the back of the seat at shoulder height, the locks being released by a redesigned time-release unit at the correct instant after ejection, through a linkage system installed in the seat. The locks could also be operated manually in the event of failure of the time-release unit by a manual separation lever on the seat. This arrangement of the parachute and harness was also fitted to some of the later Mk 3 seats.

Seats where fitted: -

Type	Lives Saved	Aircraft fitted
MK 1	69	Meteor, Valiant, Venom, AW52 and Westland Wyvern
MK 2	332	Meteor, Swift, Venom, Sea hawk and Canberra
Mk 3	255	Vulcan, Victor, Valiant, Vampire, Javelin, Hunter, Canberra and FD 2.
Mk 4	1,200	Jet Provost, Strike Master, Jaguar, HP 1127, Sea Vixen, Mystère, Buccaneer and Lightning

This list of aircraft types is not the full list where these seats were fitted, but of the most commonly known ones.

Martin Baker seats have saved over 7,500 lives up to the time of writing.

The ejection seat's role in aviation history is as important as the development of the weapons systems used on aircraft

Finally, I would like to acknowledge the help and permission of the Martin Baker Company and Sarah Jeffery in assistance with this article. I hope these few words will give you, our members an insight into another area of aviation history you would not otherwise have known about.

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