



Martin-Baker

Martin-Baker Aircraft Co Ltd

**Evolution of MBA
Crashworthy Seating**

SAFE Europe, Prague, April 2009

M Hughes, Project Manager

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AGENDA

- ▼ MBA – Company Overview
- ▼ Crashworthy Seats – History
- ▼ Evolution of MBA Crashworthy Seats
- ▼ MBA Specialist Crashworthy Seat Technologies



MBA – Company Overview

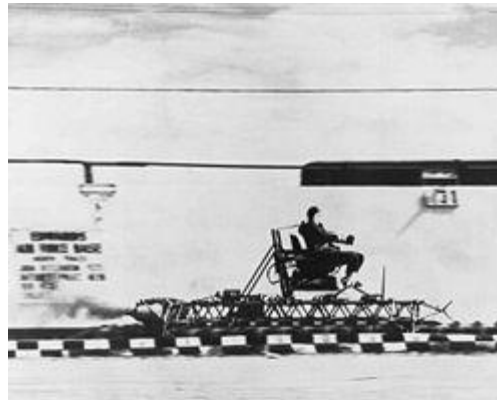


- ▼ MBA
 - ▼ Company founded in 1929
 - ▼ HQ based in Higher Denham, UK
 - ▼ Manufacturing locations in France, Italy & USA
 - ▼ Worldwide support network
 - ▼ Over 60 years of experience in aircrew protection
 - ▼ First life saved by ejection 1949
 - ▼ To date:
 - ▼ 71,000+ ejection seats produced
 - ▼ 7,274 aircrew lives saved
 - ▼ 10,000+ crashworthy seats produced



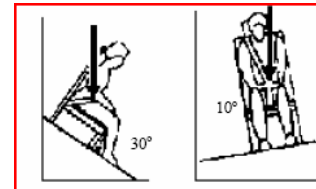
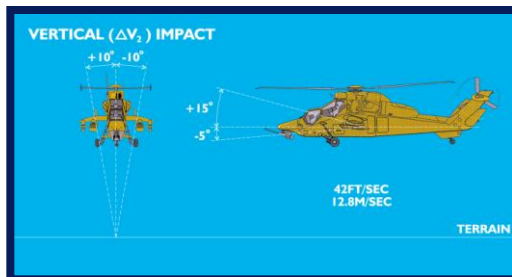
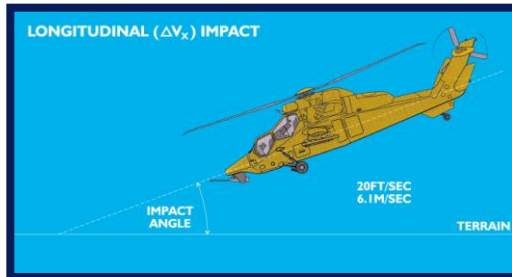
Crashworthy Seating - Research

- ▼ 1940-1960's
 - ▼ Research into human physiological limitations
 - ▼ Col J Stapp, US Army
 - ▼ Investigated human tolerance to deceleration
 - ▼ Prior to these experiments assumed human resistance to deceleration was 18g
 - ▼ First rocket sled run 1947
 - ▼ 70+ human trials by 1951
 - ▼ Demonstrated human body can withstand >32g
 - ▼ Stapp later demonstrated survival can be achieved up to 45g when properly restrained
- ▼ Derived documents include
 - ▼ MIL-STD-1290(AV)
 - ▼ USARTL-TR-79-22D (1977)
 - ▼ Car industry crash test requirements
 - ▼ FAA civilian aircraft seat requirements
- ▼ Ongoing release and investigation of civil and military seat requirements
 - ▼ i.e. FAA side facing seats

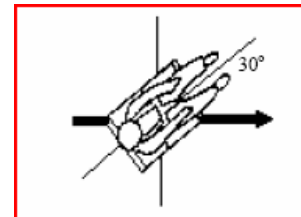


Crashworthy Seating – Test Types

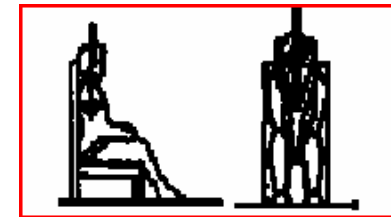
- ▼ Examples - Military Standards
 - ▼ MIL-S-85510(AS)
 - ▼ MIL-S-58095A(AV)
 - ▼ JSSG-2010-7 (Design Guide)
- ▼ Examples - Civilian Standards
 - ▼ FAR23/25/29
 - ▼ ETSO/TSO C127a
 - ▼ ETSO C39b / TSO C39c
- ▼ Flight Critical Tests
 - ▼ Static loads
 - ▼ Dynamic impact
 - ▼ Flammability
- ▼ Other
 - ▼ Environmental tests



Test 1. Combined



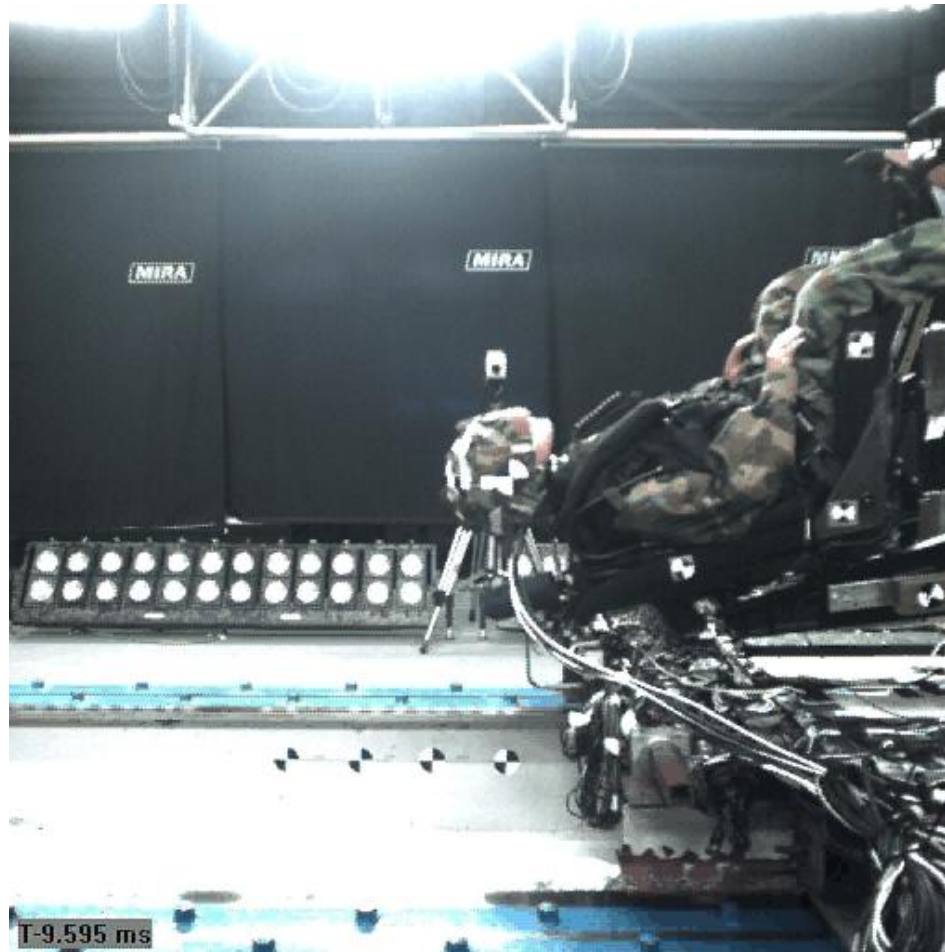
Test 2. Structural



Tests 3 & 4. Attenuation

Crashworthy Seating – Test Types

- ▼ 28g Dynamic Attenuation Test - Military



Test 2. Structural

Tests 3 & 4. Attenuation

Crashworthy Seating – Test Types

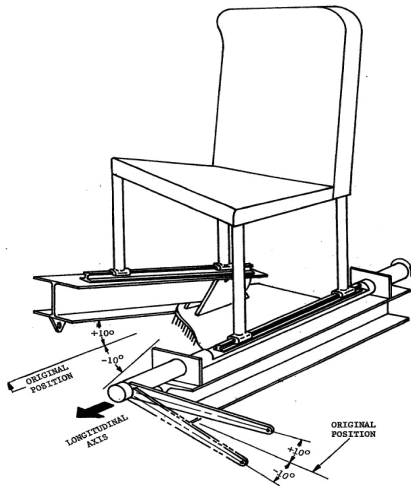
- ▼ TSO C127a Structural Test (18.4g)



Crashworthy Seating – Survival Solutions



- ▼ Survival Solutions
 - ▼ Ejection Seat
 - ▼ Escape from aircraft during mission / flight
 - ▼ Relies on having time to eject
 - ▼ Crashworthy Seat
 - ▼ Remain with aircraft, relying on aircraft structural strength
 - ▼ Now a more realistic solution with increased aircraft cabin strength
 - ▼ Seats supplement the crashworthiness of the aircraft fuselage and landing gear
 - ▼ For high impact levels an attenuation system is integrated into the seat
 - ▼ Reduces spinal compression load
 - ▼ Reduces acceleration endured by occupant
 - ▼ Safely restrains the occupant during survivable impact
 - ▼ Designed to perform even with severe floor or bulkhead deformation
 - ▼ MBA select the worst case combination when testing



MBA – First Rotorcraft Project

- ▼ Late 1960's
 - ▼ Design patent filed for sideward firing ejection seat for Westland Wessex
 - ▼ Separate system required to remove blades
 - ▼ Risk to other aircraft / personnel in vicinity
 - ▼ High cost and weight penalty



Rotorcraft Ejection Seats

- ▼ Small number of rotorcraft are fitted with ejection seats
 - ▼ V22 Osprey demonstrator (MBA SJU-5 Mk10 seats)
 - ▼ Ka-50 / 52 Black Shark / Alligator
 - ▼ NASA RSRA X Wing technology demonstrator
- ▼ Benefits
 - ▼ Escape during flight
 - ▼ Normally used where risk is greater than would normally be expected
 - ▼ i.e. flight demonstrators, extreme attack helicopters
- ▼ Disadvantages
 - ▼ High mass
 - ▼ Purchase and maintenance cost
 - ▼ Not practical for transport craft
 - ▼ Require complex integrated sub-systems
 - ▼ Canopy fracturing / removal
 - ▼ Disposal of rotor blades
 - ▼ Systems require time to operate
 - ▼ Not principally designed to offer crash protection



MBA Crashworthy Seats



- ▼ Latest Generation Attenuation System
 - ▼ Uses include
 - ▼ CH53E CATSS seat / Utility Seat
 - ▼ S92 / EC145 Passenger Seats
 - ▼ S92 Enhanced Comfort Crew Seat
 - ▼ UH60M Troop and Gunner seats
 - ▼ H92 MPACS
 - ▼ MFOS



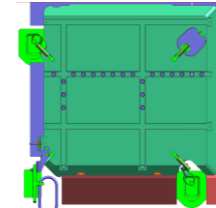
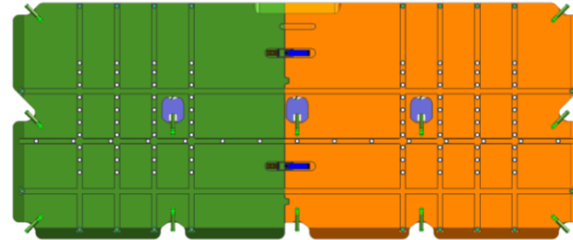
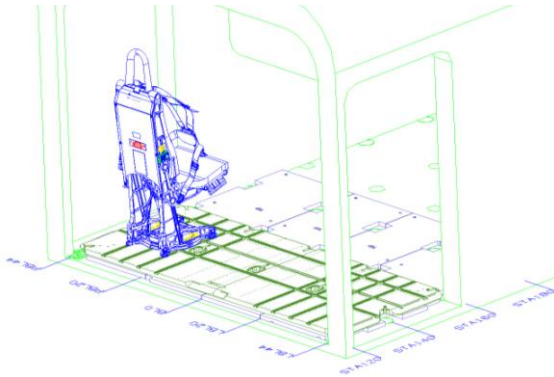
1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009

Specialist Solutions



▼ Interface Kits for Retrofit....

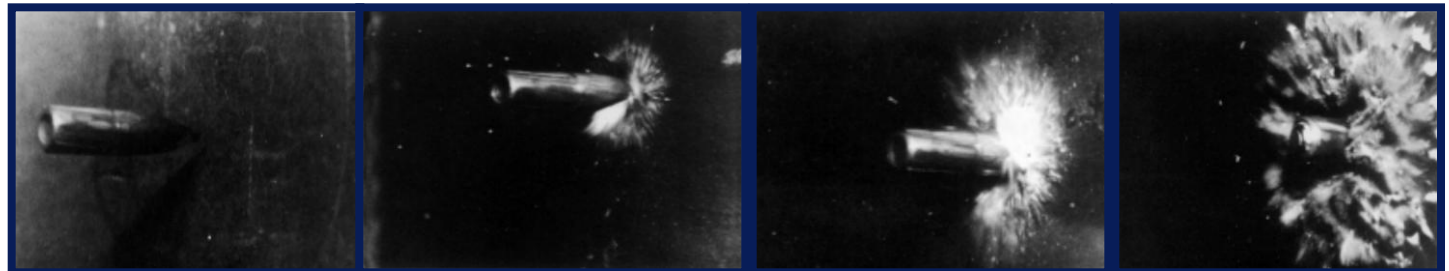
- ▼ MBA have developed and qualified installation kits for applications for which no crashworthy solution was previously available
 - ▼ CH47 crewmember
 - ▼ CH47 loadmaster
 - ▼ KingAir 350
- ▼ Simple attachment, integrates directly with existing equipment
- ▼ Allows for multi-mission capability
 - ▼ Design tailored to suit end-user requirements



1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
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Specialist Solutions

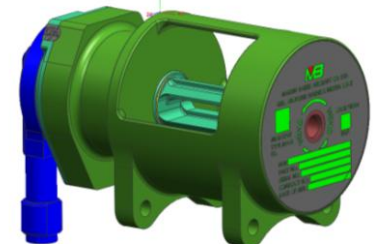
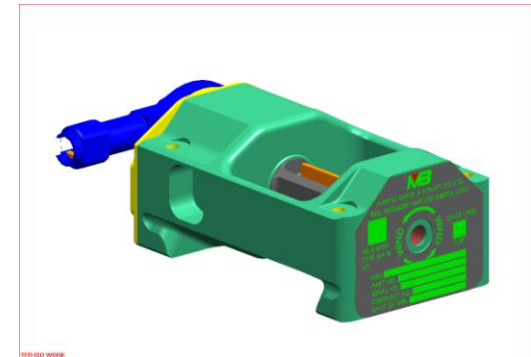
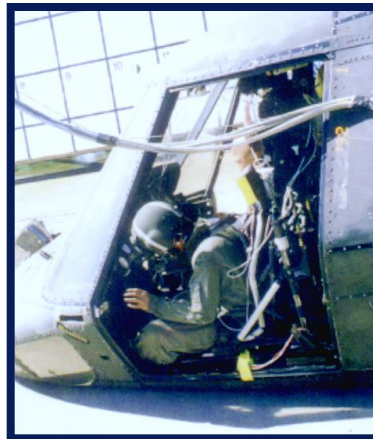
- ▼ **Armour Technology....**
 - ▼ Fifth generation MBA armoured seat MPACS Safety of Flight qualified
 - ▼ Significant experience of armour types
 - ▼ Aluminium Oxide
 - ▼ Silicon Carbide
 - ▼ Boron Carbide
 - ▼ Type driven by cost / mass / performance buy-off
 - ▼ Current MPACS bucket defeats highest small-arms threat requirement
 - ▼ Bucket shape designed to suit customer requirement
 - ▼ MPACS bucket structurally qualified to MIL-S-58095A(AV) req'ts
 - ▼ 250lb occupant
 - ▼ Static tests incl. combined Static Test, 25g fwd, 9g lat + down
 - ▼ 28g structural dynamic test
 - ▼ 46g combined and attenuation dynamic tests
 - ▼ Wing armour options



Specialist Solutions

▼ Restraint Technology....

- ▼ MBA strives to use modern restraint system solutions to maximise crashworthy safety
 - ▼ Adequate restraint is key to survival
 - ▼ Occupant motion must be minimised to reduce:
 - ▼ Body and head acceleration
 - ▼ Contact with aircraft interior components
 - ▼ Flailing injuries
- ▼ MBA work closely in partnership with restraint system suppliers
 - ▼ Developing new solutions to satisfy end-user requirements
 - ▼ Recent developments
 - ▼ Low mass / high strength harness for H92 MPACS in partnership with Schroth Safety Products / BAE Systems
 - ▼ MA16 type inertia reel
 - ▼ Crew and gunner versions
 - ▼ MBA developed unique ATP fixture
 - ▼ New lead-in webbing strap developed
 - ▼ US Army AWR approved for Blackhawk
 - ▼ Full QPL programme in progress



The Future

▼ MBA will continue to innovate, evolve and develop crashworthy protection solutions

▼ Goals

▼ Increased occupant protection

▼ Increased mission capability

▼ Improved technical performance

60 Years of Saving Lives

