CABS
Cockpit Air Bag System

The Cockpit Air Bag System (CABS) is the first application of air bag technology in any aircraft cockpit worldwide. CABS is the culmination of years of research into aircrew survivability. It is now possible to bring the proven protection of supplemental inflatable restraints into the aircraft cockpit. The BAE Systems-developed Electronic Crash Sensor Unit (ECSU) is the key component providing the reliability and crash discrimination required for cockpit use. CABS protects the aircrew during a crash by cushioning the head and upper torso and preventing strikes against the cockpit interior.

The Need for CABS – Human Tolerance to Injury

A crash that exceeds human tolerance deceleration limits and maintains 85% of the cabin height is defined as "survivable." [1]

– About 80% of helicopter accidents are "survivable," [2] but…

– About 30% of all fatalities occur in these "survivable" accidents. [2]

– More than 50% of fatalities in these "survivable" accidents are caused by head strikes. [2]

– CABS will mitigate most of these preventable head and neck injuries.

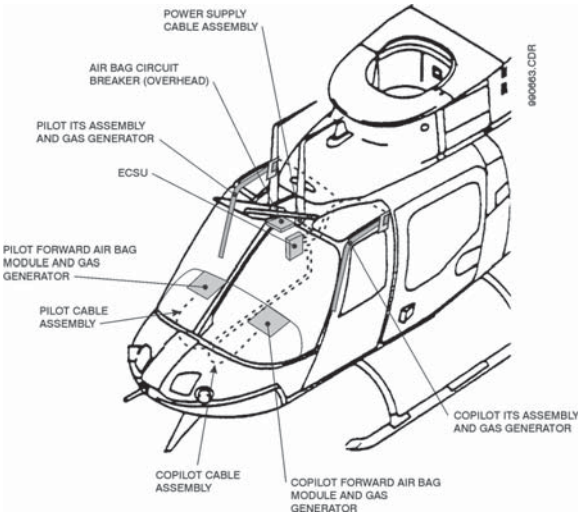
KEY FEATURES

Inflatable Restraint System Technology Makes a Life-Saving Difference in Aircraft Cockpits

In the Field: 782 Black Hawk Systems and 364 Kiowa Systems

1. MIL-STD-1290A, Mar 31, 1986
2. "Injury in U.S. Army Helicopter Crashes October 1979-September 1985", COL Shanahan, MD, 1989

CABS for OH-58: System Overview



Unlike an automotive air bag, the CABS stays inflated for at least 3 sec to protect against multiple impacts.

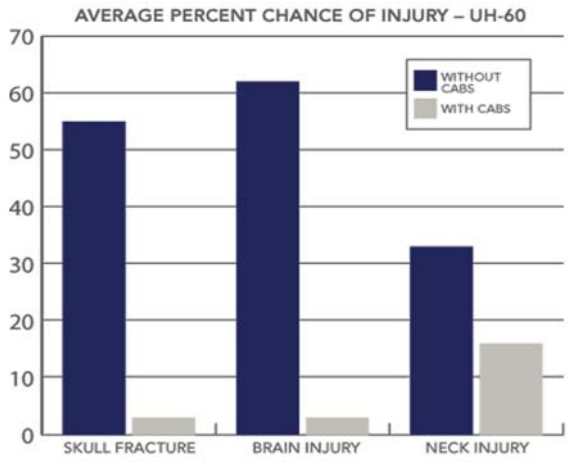
Keeping the occupant away from strike hazards through flail reduction is the most important function of CABS.

Without CABS – a potentially fatal cyclic head strike

With CABS – reduced flail protects against head strike

Black Hawk Testing Summary

A series of dynamic drop tests (50 ft/sec (15.2 m/sec) velocity, 50 G peak deceleration) has confirmed a reduction in flail and a reduction in the percent chance of injury.



Still photos from high-speed film of a dynamic test showing the hazard of an aviator striking the cyclic stick. The second frame is 46 msec into the crash event and the last frame is 76 msec into the crash event.

The Cockpit Air Bag System is credited with saving several lives in crashes that would be considered non-survivable.

Safety Evaluation Results

In a series of meetings concluding in December 2000, an independent panel of seven crashworthiness experts scrutinized data from 22 dynamic CABS tests and asked the question:

"Would you want this system in your aircraft?"

These experts represented:

– U.S. Air Force Research Laboratory, Human Effectiveness Directorate
– U.S. Navy Naval Air Warfare Center, Aircraft Division
– Federal Aviation Administration, Aircraft Certification Directorate
– U.S. Army Aeromedical Research Laboratory (USAARL)
– U.S. Army Aviation Applied Technology Directorate (AATD)

No system can protect all pilots all of the time, but the overwhelming opinion was for the inclusion of the CABS system.

Overhead view of a lateral dynamic test

Each individual had one vote for each test; and the results were:

103 votes "Yes".....93%
5 votes "Maybe"..... 5%
3 votes "No".....2%

Human Benefits of CABS

– "Survivable" conditions (based on test dummy measurements) demonstrated increased
  - From 720 ft/min [3] (220 m/min) up to 1,800 ft/min (549 m/min) for OH-58 [5]
  - From 2,280 ft/min [4] (695 m/min) up to 2,520 ft/min (768 m/min) for UH-60 [5]
– Projected reductions in aviation pilot fatalities
  - 30% for light helicopters [6]
  - 15% for the UH-60A/L [6]

30 - 40% fewer major injuries on average [2,3]

Reduced personal suffering and increased confidence and morale will help aviator retention and force conservation.

Items of Interest to Pilots and Crewmembers

Inadvertent Deployment

– Air bag system is designed to not interfere with cyclic or collective stick during normal operations
– On the ground and inflight deployment tests were conducted to ensure aircraft control could be maintained

Here are the results of the test:

– Insignificant "startle" effect
– No influence on aircraft control
– Test pilot's quote: "No big deal"

Water Impact and Egress

– Tests were done both on dry land and underwater in a helicopter egress simulator to determine the effect of deployed bags on egress
– No significant impediments were noted by either untrained occupants or safety divers

Inverted underwater testing

2. "Injury in U.S. Army Helicopter Crashes October 1979-September 1985", COL Shanahan, MD, 1989
3. "Engineering Analysis of Crash Injury in Army OH-58A Aircraft", U.S. Army Safety Center Technical Report TR 79-1
4. Black Hawk design limits
5. BAE Systems Qualification Test Reports
6. "Projected Effectiveness of Airbag Supplemental Restraint Systems in U.S. Army Helicopter Cockpits", COL Shanahan, MD, 1994, AHS Forum

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CABS Features

Cockpit Air Bag System

The complete system consists of two forward and two lateral air bag modules plus the Electronic Crash Sensor Unit (ECSU), weighing approximately 23 lb (10.4 kg) total per aircraft.

Air Bag Modules

May be tailored for any aircraft installation

Electronic Crash Sensor Unit (ECSU)

– Senses crash dynamics in three axes

– Fail-safe, fault-tolerant design

– Programmable deployment thresholds for up to 25 different aircraft

– Can activate additional safety systems

– Built-in test/fault isolation

– Maintenance-free internal backup power source

– Software designed and verified in accordance with DO178

– Data recording capability (acceleration versus time): 60 sec total at 2000 Hz

– Predicted maintenance ratio (maintenance man hours/flight hour): 0.0004

– Windows™ operator interface

SYSTEM PERFORMANCE

Environmental: MIL-STD-810

EMI: MIL-STD-461

ESD, EMV, EMC: ADS-37A-PRF

HERO: MIL-STD-464

Temperature (operating):
-25.6° F to 131° F (-32° C to 55° C)

Temperature (non-operating):
-65.2° F to 230° F (-54° C to 110° C)

Power: MIL-STD-704

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