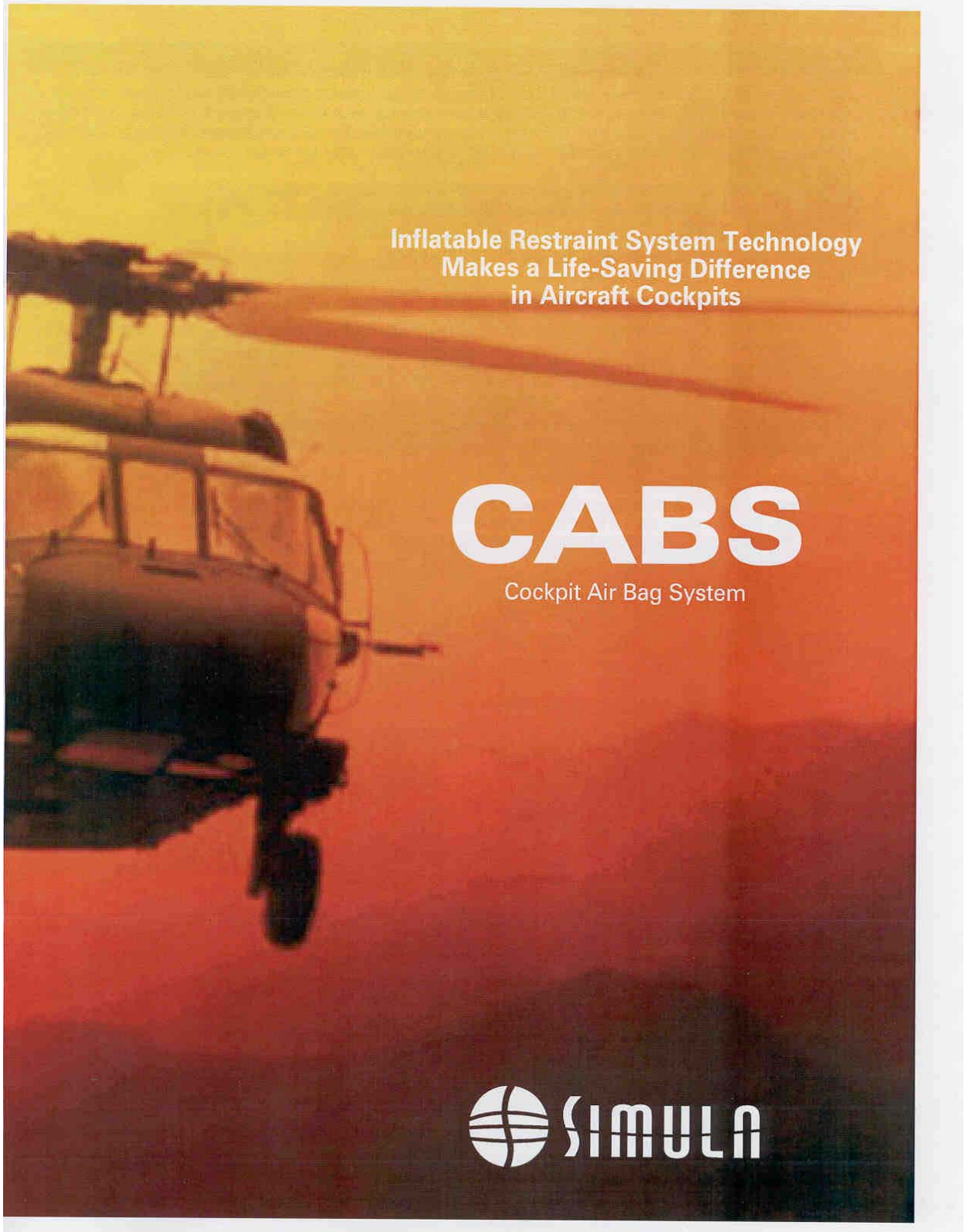

Inflatable Restraint System Technology
Makes a Life-Saving Difference
in Aircraft Cockpits
CABS
Cockpit Air Bag System
SIMULA

Simula's Cockpit Air Bag System (CABS) is the first application of air bag technology in any aircraft cockpit, world-wide. The 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 CABS protects the aircrew during a crash by cushioning the head and upper torso and preventing strikes against the cockpit interior. The Simula-developed Electronic Crash Sensor Unit (ECSU) is the key component providing the reliability and crash discrimination required for cockpit use.

The Need for CABS – Human Tolerance to Injury

A crash which does not exceed 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.

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

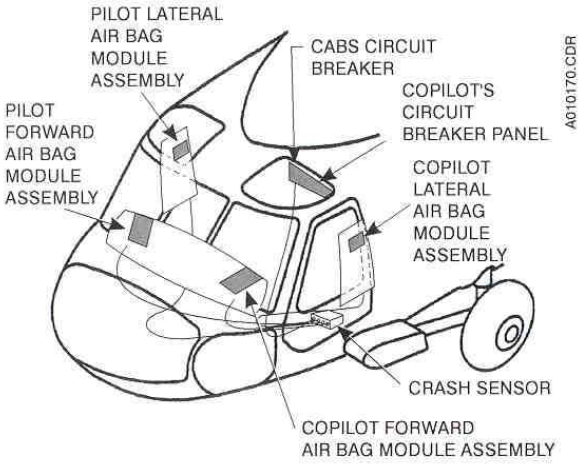
Still photos from high-speed film of a dynamic test showing the hazard of an aviator striking the cyclic stick. The second frame from the top is 46 msec into the crash event and the last frame is 76 msec into the crash event.

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

Without CABS – a potentially fatal cyclic head strike

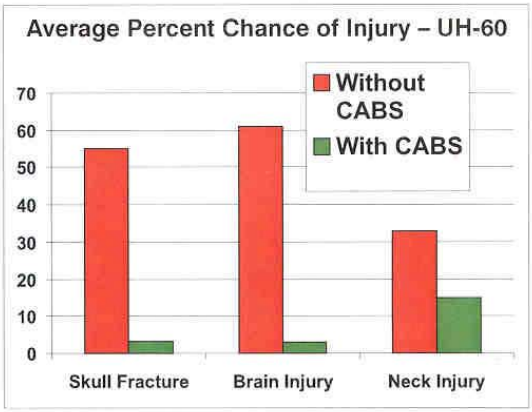
With CABS – reduced flail protects against head strike

CABS for UH-60A/L: System Overview



Black Hawk Testing Summary

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



[1] MIL-STD-1290A, Mar 31, 1986
[2] "Injury in US Army Helicopter Crashes October 1979-September 1985"; COL Shanahan, MD.; The Journal of Trauma, 1989

Safety Evaluation Results

In a series of meetings concluding in December 2000, an independent panel of 7 crashworthiness experts scrutinized data from 22 dynamic CABS tests and asked the question:

"Would you want this system in your aircraft?"

These experts represented:

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

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%

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

Items of Interest to Pilots and Crewmembers

Inadvertent Deployment

- The chance of an inadvertent deployment is calculated to be 1 in 20+ million flight hours.
- Even so, an in-flight deployment test was conducted to ensure aircraft control could be maintained. Here are the results of the test:
  - ✔ No injuries
  - ✔ 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.

Test was done inverted underwater

Human Benefits of CABS

- "Survivable" conditions (based on test dummy measurements) demonstrated at increased descent rates
  - From 720 ft/min[3] up to 1,800 ft/min for OH-58[4]
  - From 2,280 ft/min[5] up to 2,520 ft/min for UH-60[4]
- 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.

Based on these demonstrated benefits, the US Army has awarded Simula a production contract for CABS.

③ "Engineering Analysis of Crash Injury in Army OH-58A Aircraft"; US Army Safety Center Technical Report TR 79-1
④ Black Hawk design limits
⑤ Simula Qualification Test Reports
⑥ "Projected Effectiveness of Airbag Supplemental Restraint Systems in US Army Helicopter Cockpits", COL Shanahan, MD., 1994; AHS Forum

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)

Air Bag Modules

May be tailored for any aircraft installation

System Performance

Environmental: MIL-STD-810

EMI: MIL-STD-461

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

HERO: MIL-STD-464

Temperature (operating) -32 °C to 55 °C

Temperature (non-operating) -54 °C to 110 °C

Power: MIL-STD-704

Electronic Crash Sensor Unit (ESCU)

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

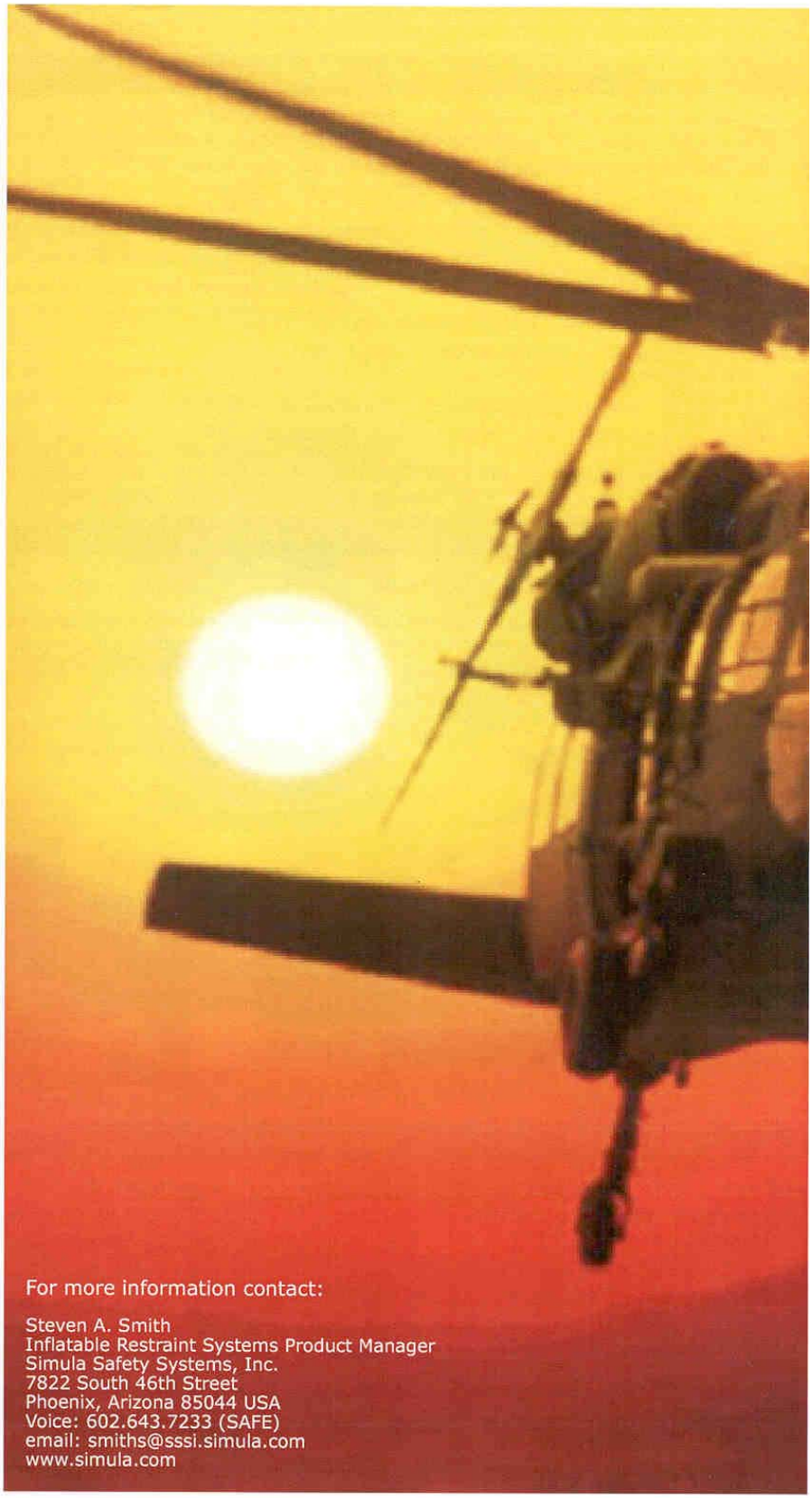
Software designed and verified in accordance with DO178

Weighs just slightly over 3 lb

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



COCKPIT AIR BAG SYSTEMS

CABS

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