

# INTEGRATED COCKPIT SENSING



Developed to improve pilot safety and performance, the Integrated Cockpit Sensing (ICS) system provides real-time monitoring and analysis of pilot health, the cabin environment and life support systems. The system is designed to help detect, mitigate and provide insight into in-flight Physiological Episodes (PE) that adversely impact the physical and cognitive abilities of pilots, risking their ability to return home safely.



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## OVERVIEW

The combination of high G-forces, altitude and mission tasking can be hazardous for pilots in both training and combat situations, leading to what's known as Unexplained Physiological Episodes (UPE). Non-combat aviation incidents, including UPE, resulted in 244 lost lives, 186 lost aircraft and \$11.6 billion lost between FY2013 and FY2018. Preventing these episodes is a top priority for the Department of Defense.

To explain the previously unexplainable, Ball Aerospace partnered with the Air Force Research Laboratory (AFRL) to develop the Integrated Cockpit Sensing system. The ICS system collects and analyzes data from multiple sensors in real time. By uncovering the root causes of UPE, this integrated sensor suite will improve training, help pilots make better decisions and provide the insight to develop enhanced life support systems.

## SENSING CAPABILITIES



### PILOT PHYSIOLOGY

- Blood oxygen saturation
- Blood perfusion
- Heart and pulse rate
- Heart and pulse rate variability
- Estimated core temperature
- Skin temperature



### FLIGHT ENVIRONMENT

- Acceleration
- Altitude
- Cabin pressure/altitude
- Cabin temperature
- Time synchronization



### AIR QUALITY

- Oxygen partial pressure
- Carbon dioxide partial pressure
- Air flow
- Air pressure
- Air humidity
- Mask pressure



### RESPIRATORY FUNCTION

- Respiration rate
- Work of breathing



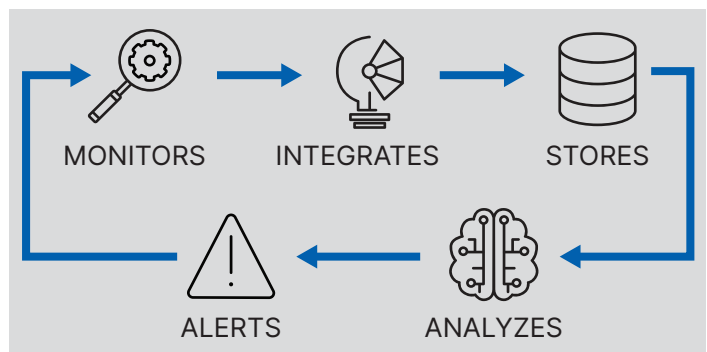
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## Quick Facts

### THE ICS SYSTEM:

- Provides onboard real-time analytics and alerts related to pilot vital signs, air quality, cabin environment and respiratory function without additional pilot workload
- Supports evaluation of cockpit conditions, including:
  - Breathing air system performance and oxygen levels
  - Cabin pressurization
  - G-forces
  - Ambient temperature
- Provides post-flight analysis to gain root-cause understanding, reduce aircraft grounding and improve after-action reviews and pilot training

## ONBOARD ANALYTICS



## OUTCOMES & APPLICATIONS



**DEFINE**  
the "Unexplainable"  
Reducing number of physiological mishaps



**INCREASE**  
Mission Effectiveness  
Reduce groundings, keep planes in the air



**REDUCE**  
Logistics Cost  
Fewer aircraft tear downs



**IMPROVE**  
Training  
Better after-action reviews