National Transportation Safety Board

Safety Study Report: Introduction of Glass Cockpit Avionics into Light Aircraft

Loren Groff

Safety Research Division

Why Did NTSB Study Glass Cockpits?

At the time…

- New and emerging technology issue
- Investigators saw an increase in accidents with glass cockpit airplanes
- Limited information about the effects of advanced technology in GA applications

“Conventional” Cockpit

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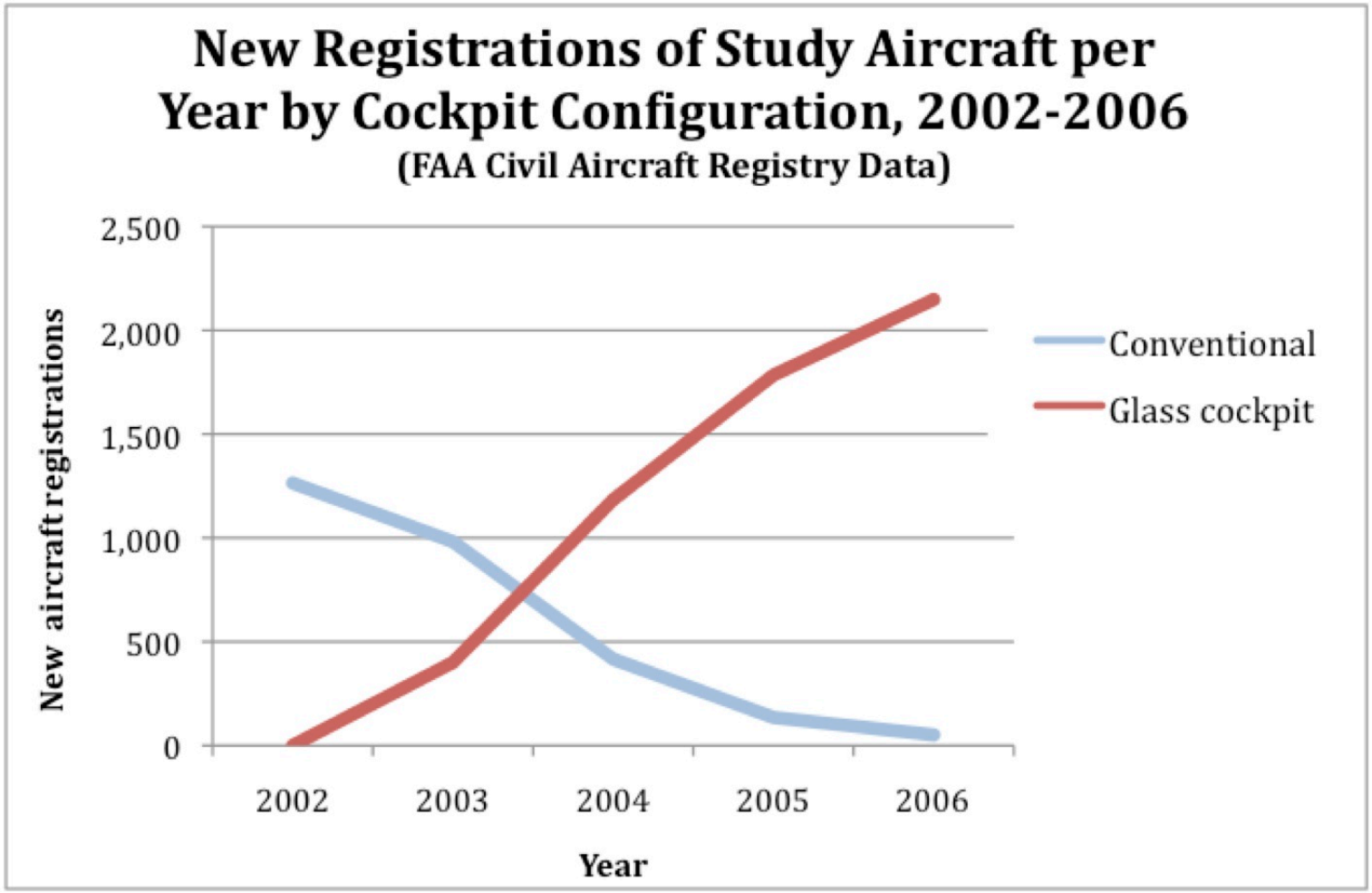
“Glass” Cockpit

Window of Research Opportunity



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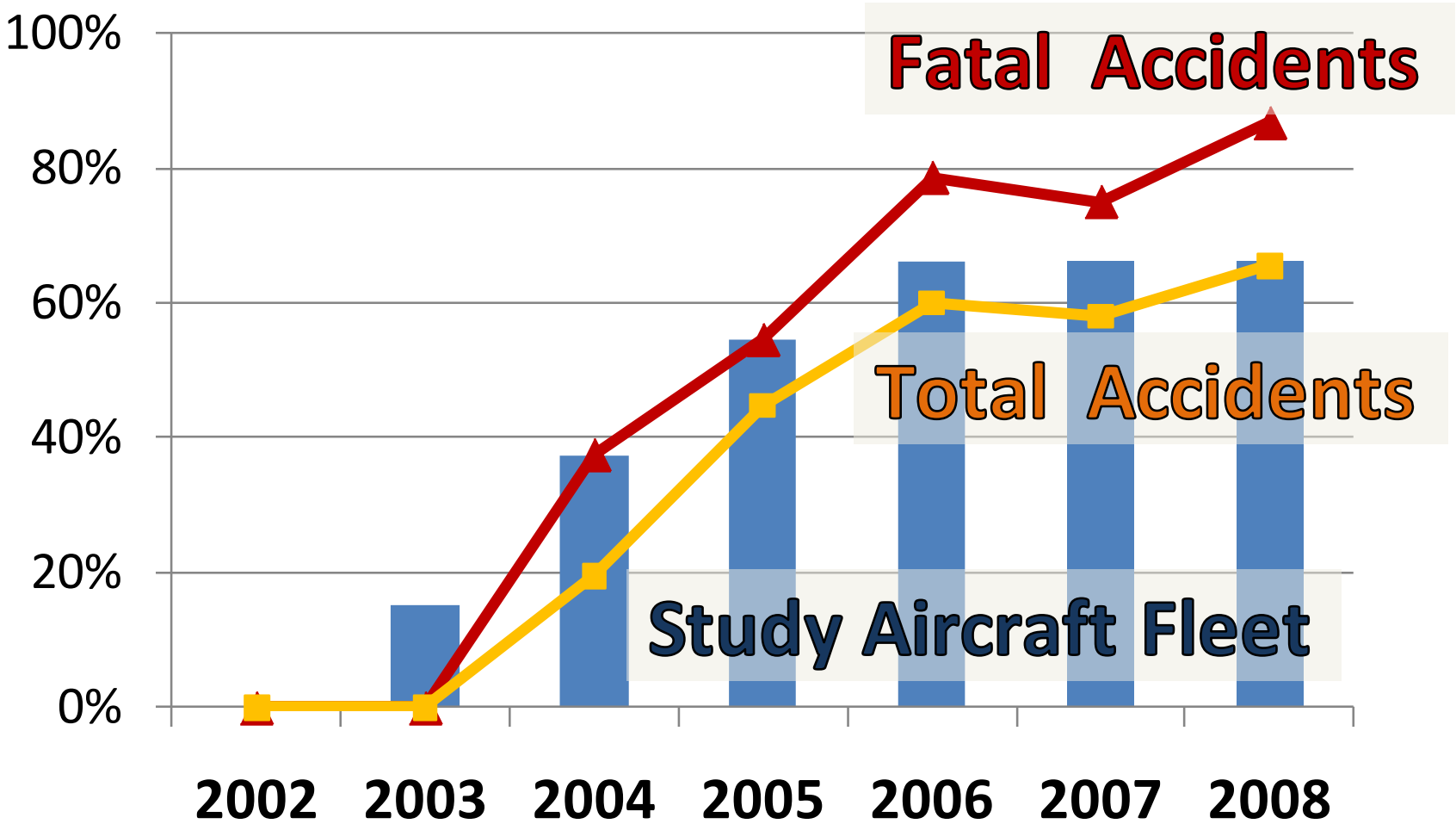
Study Aircraft

- Single-engine piston airplane models, built 2002-2006 with both conventional and glass cockpits
- Aircraft groups identified by serial number in manufacturer records and aircraft registry
  - Conventional (2,848 aircraft)
  - Glass Cockpit (5,516 aircraft)

Study Aircraft Makes/Models

- Cessna Aircraft Corporation - 172, 182, and 206 series
- Cirrus Design Corporation - SR20 and SR22
- Diamond Aircraft - DA40
- Lancair/Columbia Aircraft/Cessna Aircraft Company
  - 300/350, and 400
- Mooney - M20 series
- Piper Aircraft Inc.
  - PA-28-161, PA-28-181, PA-28-201, PA-32-301 series, and PA-46-350P
- Hawker Beechcraft Corporation - 36 series

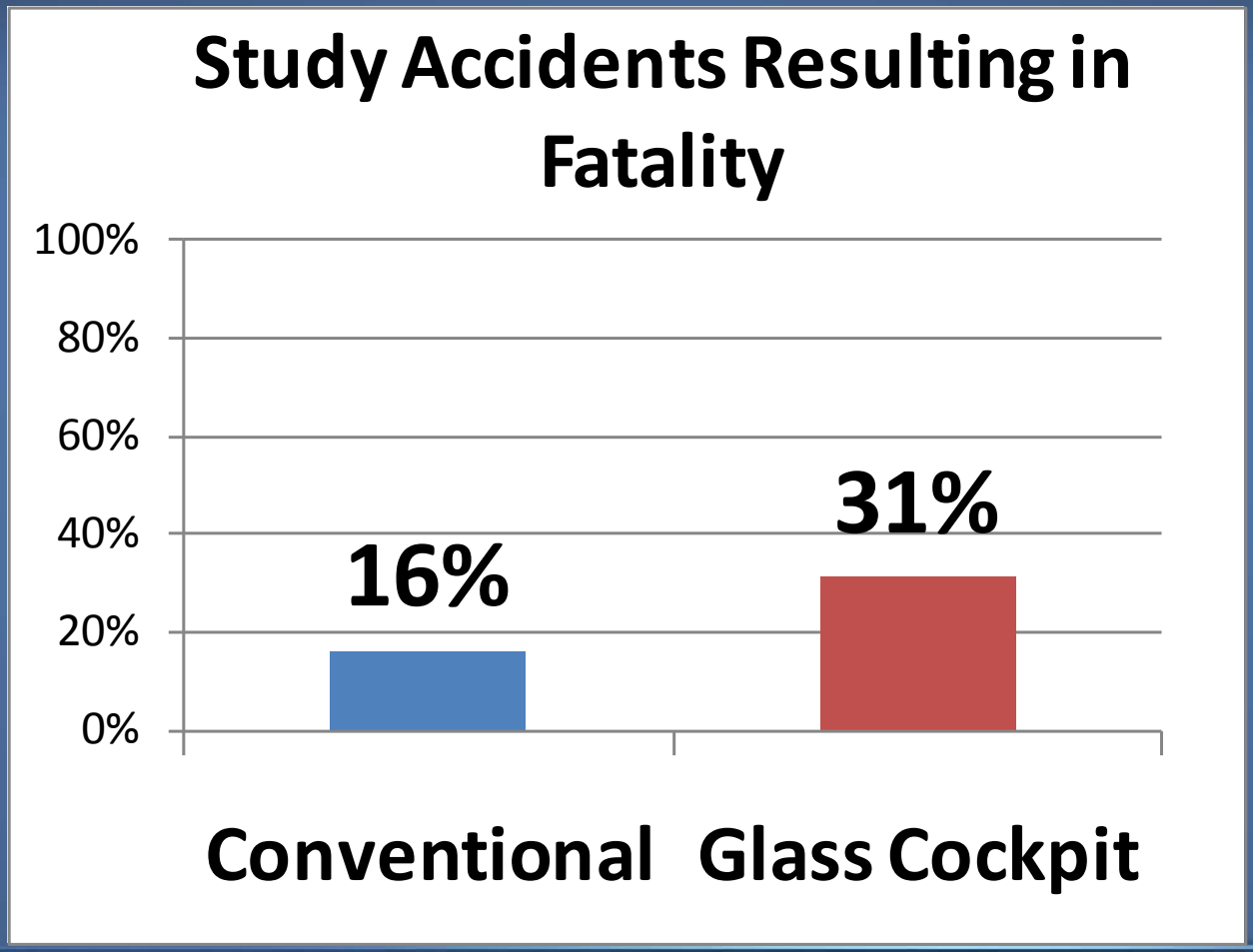
Glass Cockpit Cohort, 2002-2008



2002-2008 Accident Data

- 266 total accidents, 62 fatal
  - Conventional = 141 total, 23 fatal
  - Glass Cockpit = 125 total, 39 fatal
- Study included statistical comparisons and case study reviews

2002-2008 Accident Data



2002-2008 Accident Data

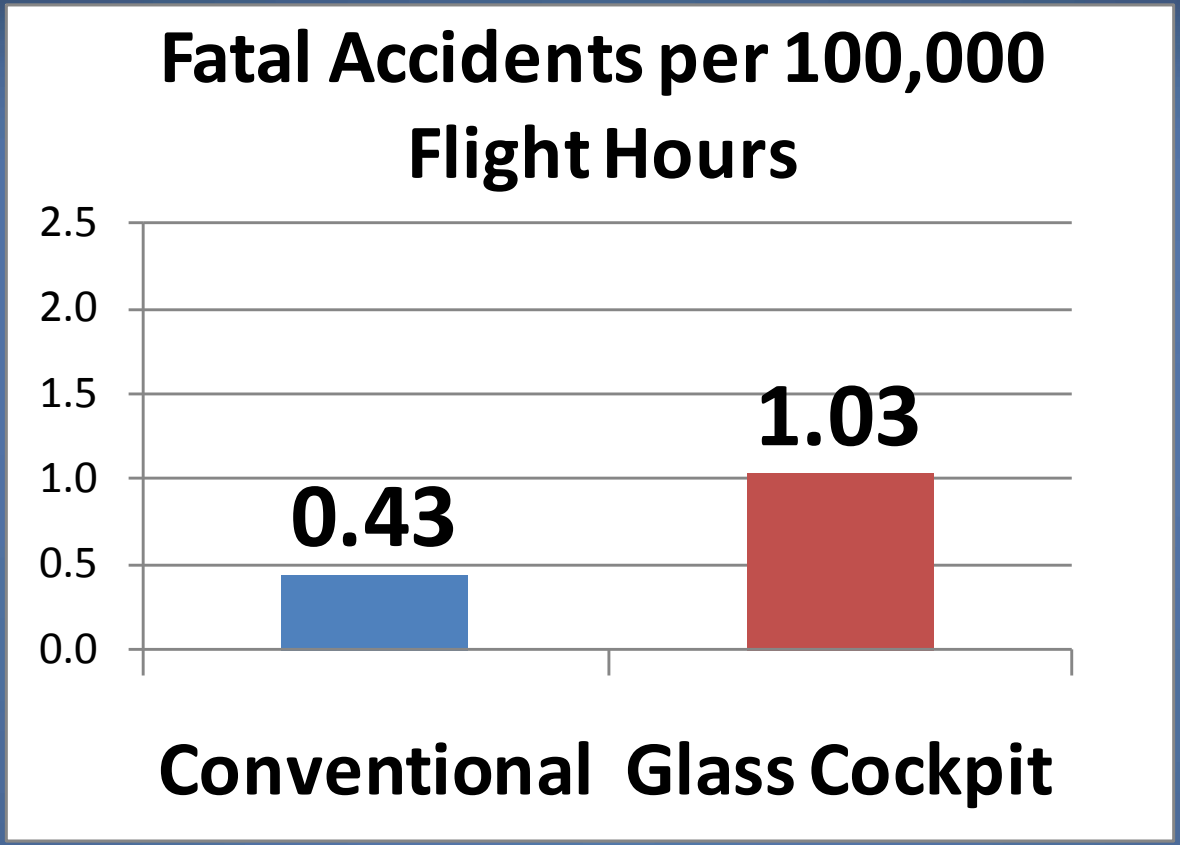
On average, glass cockpit aircraft

- More accidents during climb, cruise, and approach
- More loss of control in flight, collision with terrain, and weather encounters
- More personal/business flights
- Longer flights
- More IFR
- Accident pilots were older, with more flight hours and higher certificates/ratings

2006-2007 Activity Data

- Aircraft-specific activity data generated from FAA GA survey
- Aircraft in the glass cockpit group had:
  - Fewer total hours flown per aircraft
  - More personal/business flying and fewer instructional flight hours
  - Higher percentage of hours flown in IMC

2006-2007 Accident Rates



2006-2007 Accident Rates

	Total		Fatal	
	Conventional	Glass Cockpit	Conventional	Glass Cockpit
IMC	1.63	**2.68**	1.63	**2.34**
VMC	3.86	**3.94**	0.29	**0.67**

Accidents per 100,000 flight hours

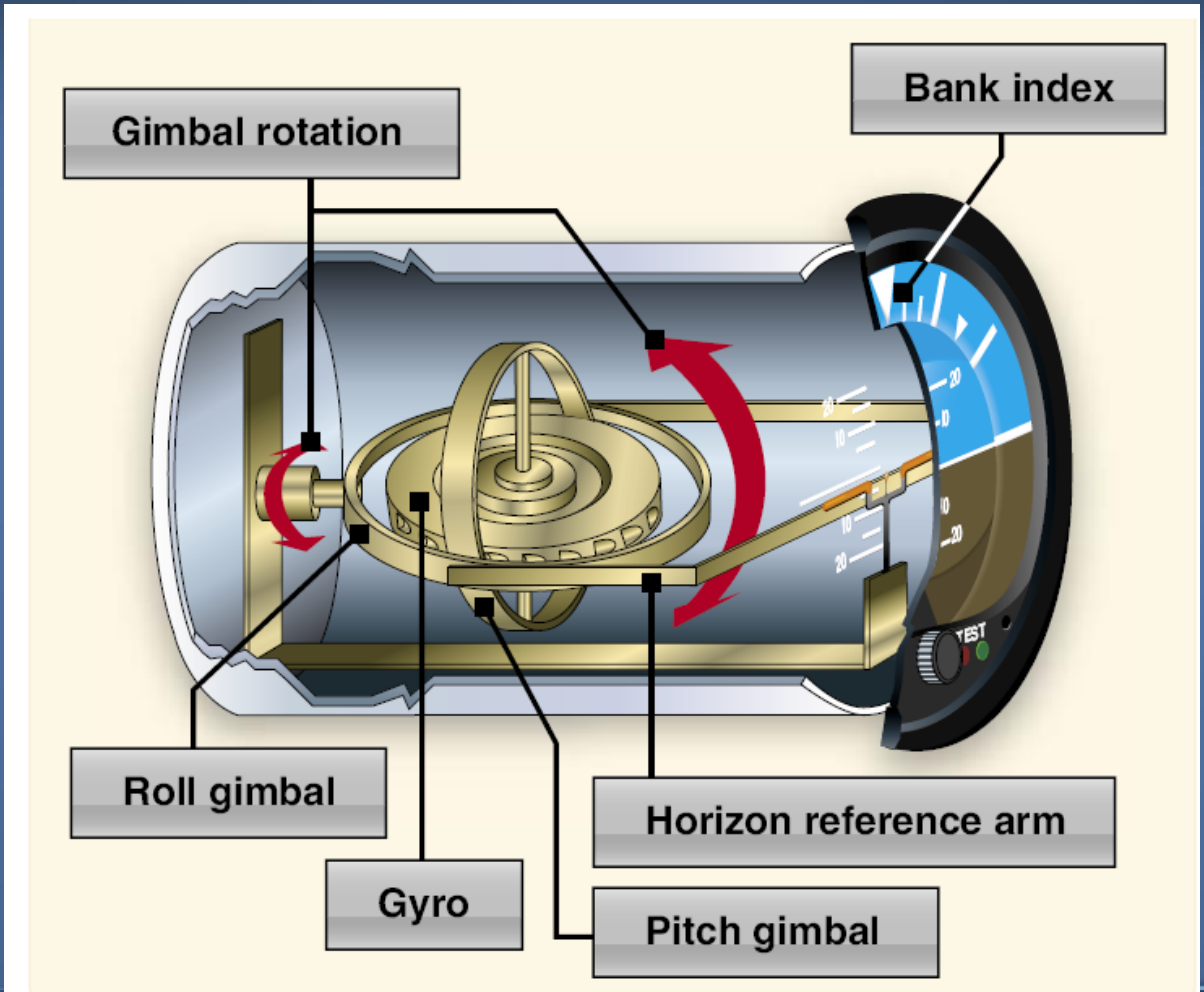
Summary of Data Analysis Results

- Same or lower total accident rates, but higher fatal accident rates for glass cockpit aircraft
- Accidents reflect differences in aircraft use
- Pattern of results during the studied time period did not show expected safety benefit

Safety Issues Identified

- Information to pilots about system failure modes
- Equipment-specific training and resources
- Equipment malfunction and service difficulty reporting

Conventional Attitude Indicator



Attitude and Heading Reference System (AHRS)

Accident Example

Luna, NM - April 9, 2007

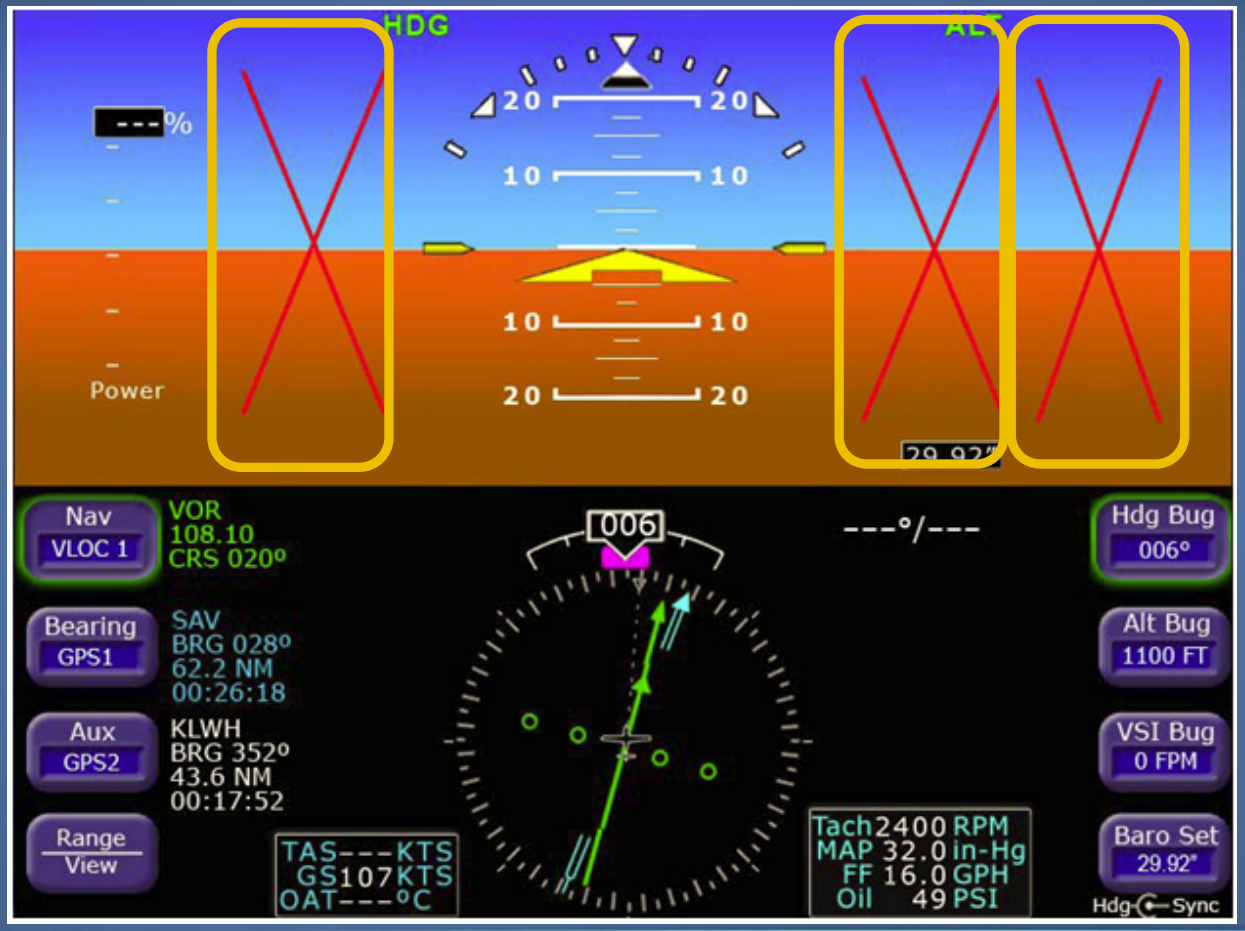
- Pilot reported loss of airspeed and altimeter readouts on PFD
- Subsequent loss of control
- Ballistic parachute recovery

Conventional Failure Mode

Airspeed

PFD Failure Mode

Airspeed **Altitude Vertical speed**



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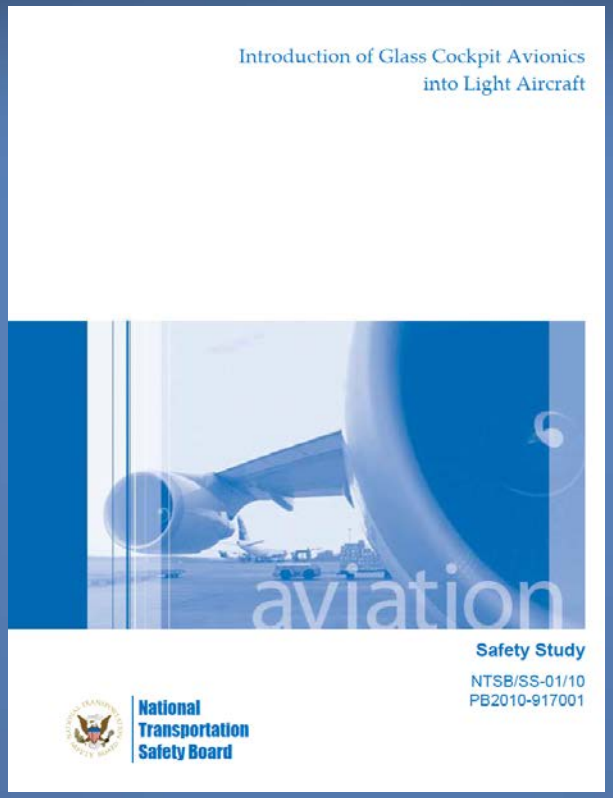
Safety Recommendations

- Revise knowledge tests
- Include subsystem failures in AFM
- Include PFDs in training materials
- Include PFDs in initial and recurrent training requirements
- Develop guidance for procedural trainers
- Encourage technicians to make malfunction and defect reports for electronic displays

Safety Study Report



www.ntsb.gov/doclib/safetystudies/SS1001.pdf

Not a New Issue

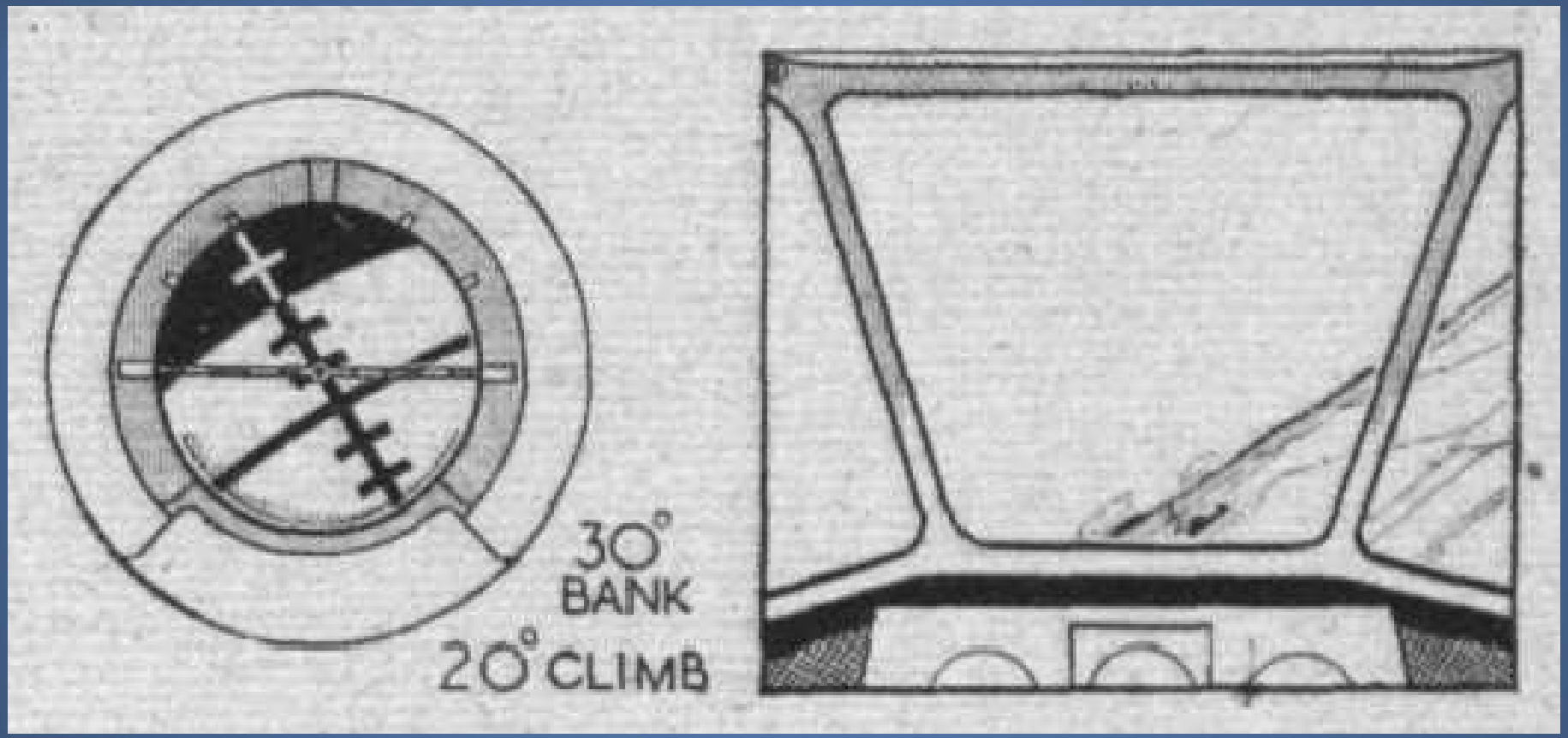
-Impacted terrain shortly after departure

-Approximately 90 degree bank, nose-down attitude

-Dark night, degrading weather, snow showers

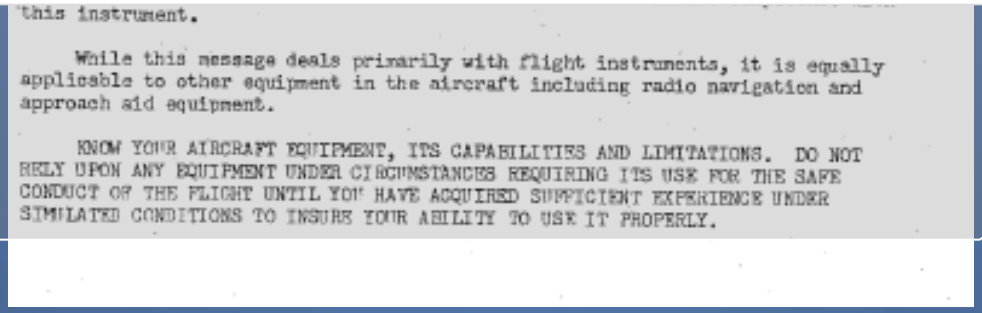
Mason City, IA - Feb. 3, 1959

Sperry F3 Attitude Gyro



A Safety Message for Pilots

KNOW YOUR AIRCRAFT EQUIPMENT, ITS CAPABILITIES AND LIMITATIONS. DO NOT RELY UPON ANY EQUIPMENT UNDER CIRCUMSTANCES REQUIRING ITS USE FOR THE SAFE CONDUCT OF THE FLIGHT UNTIL YOU HAVE ACQUIRED SUFFICIENT EXPERIENCE UNDER SIMULATED CONDITIONS TO INSURE YOUR ABILITY TO USE IT PROPERLY.



this instrument.

While this message deals primarily with flight instruments, it is equally applicable to other equipment in the aircraft including radio navigation and approach aid equipment.

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