



Flight Data Monitoring Conference 2009

Avidyne Investment in Data Recording



- Avidyne has been investing in data recording capabilities on the over 5000 PFD and MFD products for over eight years.
- The capability has matured over multiple product development cycles and with the introduction of the next generation IFD5000 Integrated Flight Display system in mid 2009 we will improve both the data capture capabilities and probability of retrieving the data after a crash with a target of 100% recovery and reconstruction of accident information.
- Avidyne has forged a relationship with the NTSB based on the ability of Avidyne equipment to assist in their accident investigation process.
 - NTSB investigators proactively engage with Avidyne to extract the data from the memory components.

Avidyne Data Recording Capabilities

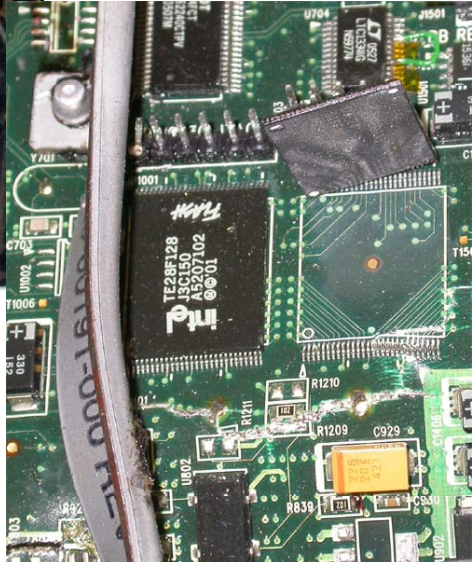
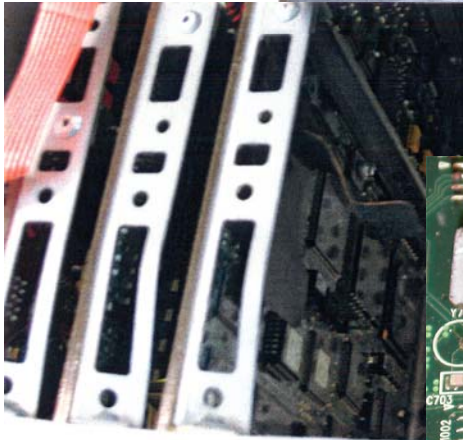
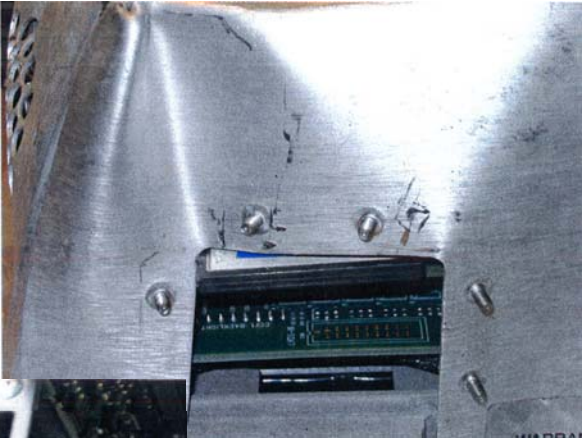
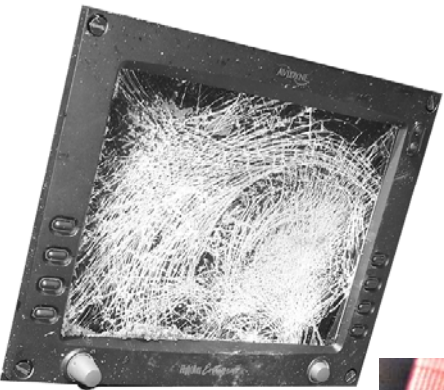
Avidyne Primary Flight Display

- Records critical parameters used by a pilot to control and navigate aircraft
 - Stores aircraft attitude (pitch, roll, heading) five times per second
 - Stores air data (airspeed, altitude, rate of climb), autopilot modes and system health indications once per second
 - Stores navigational data (current latitude, longitude, waypoint, deviations from intended flight path) every four seconds
 - Stores pilot inputs when they are made
 - Logs cover most recent 15+ hours of flight
- In nearly every respect, NTSB says that our data are at least as good as the best available on airliners

Avidyne Multi Function Display

- Records additional parameters used by a pilot to monitor engines and manage the flight
 - Stores engine operating parameters (RPM, manifold pressure, EGT, CHT, oil temperature, oil pressure, electrical system performance), pressure altitude and density altitude every six seconds, tagged by time and location (lat/long)
 - Stores record of datalink weather information (signal quality and message type) received by the aircraft
 - Logs cover approximately 25 flights
- Engine parameters supplement PFD data to give clear indications of pilot intent

Avidyne Data Recovery Capabilities



While the data recording memory is not a hardened flight data recorder designed to survive a crash, we have been successful in recovering data from the memory chips even in cases of fire and severe damage to the PFD or MFD components. Out of 30 NTSB cases, both PFD and MFD were destroyed in only five and we've failed to recover data only once.

Avidyne Data Recovery Case Study #1



NTSB file CHI08FA027 – Piper Seminole N327ND – Browerville, MN

- Night VFR instructional flight conducted by University of North Dakota
- Two fatalities
- From the NTSB report:

“The Avidyne avionics normally retain flight parameters in non-volatile memory within the Primary Flight Display (PFD) and Multifunction Display (MFD) units. The PFD data indicated that the airplane was in stable flight on a 320-degree magnetic heading, at 4,500 feet msl, and approximately 160 knots true airspeed prior to the accident. About 2211:46, the airplane abruptly departed from controlled flight. It rolled approximately 20 degrees left wing down, yawed to the left about 30 degrees, and simultaneously pitched nose down about 40 degrees. The airplane then reversed and immediately entered a descending, right roll for the duration of the flight. The recorded data ended about 2212:10.

“A section of upper wing skin was taken from near the left wing tip, at a point about mid-chord. The post accident examination noted the presence of material on the inside surface of the wing skin inconsistent with those used in the construction of an aircraft. The wing skin section was along a tear in the skin, adjacent to the spar. This portion of the airplane was submerged in the bog after the accident until recovery of the airplane.

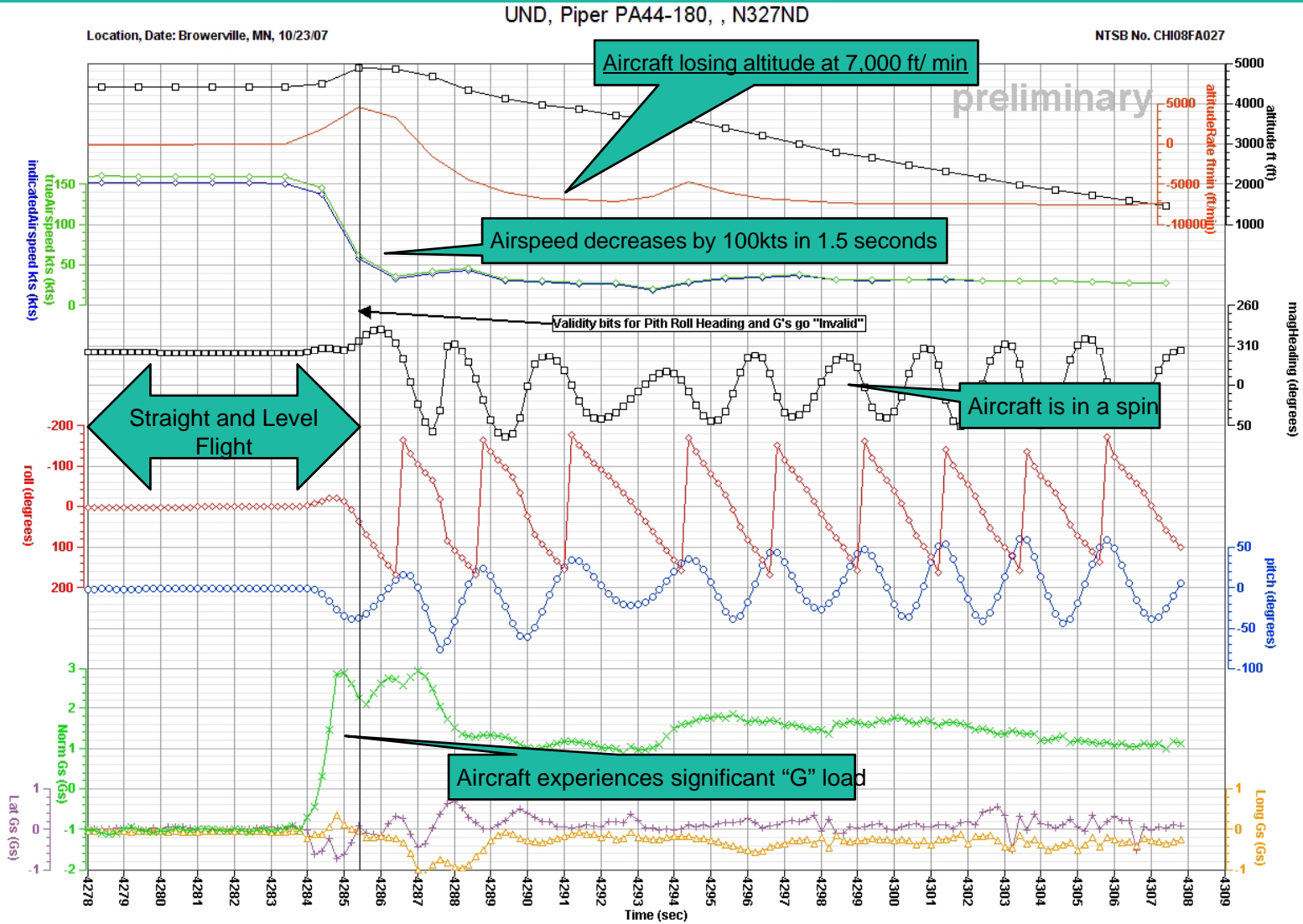
“Microscopic examination and DNA testing by forensic ornithologists identified the material on the wing skin section as remains of a Canada goose. The ornithologists further noted that the natural history of this species was consistent with the location, time and date of the accident.

“The National Transportation Safety Board determines the probable cause(s) of this accident as follows: An in-flight collision with at least one Canada goose, and the resulting damage to the left stabilator that caused the airplane to become uncontrollable. Contributing to the accident was the night lighting condition, which precluded any possibility of the flight crew seeing the bird(s) prior to impact.”

- The data from this case allowed the investigators to come to conclusion much faster based on the conclusions drawn from the recovered data.

Avidyne Data Recovery Case Study #1

Data Provides Insight into Accident and Proof that Equipment was Operating Properly



Avidyne Data Recovery Case Study #2



NTSB file ATL06LA134 – Cirrus SR22 N518SR– McRae, GA

- VFR personal flight conducted by the owner of the airplane
- No injuries
- From the NTSB report:

“The pilot stated that ‘we encountered clear air turbulence at approximately 2:00 pm. Bounced once and then after losing altitude hit a very hard bounce of severe turbulence. After stabilizing the airplane my son noticed some thin lines of paint were missing from the top of the right wing, after which I noticed thin lines of paint missing about 6 inches in from the fuel filler cap on the left wing. I slowed the plane down to about 90 knots and landed at the nearest airport’, which was Telfair-Wheeler Airport, (MQW) Mc Rae, Georgia. ‘The plane handled with no abnormalities and we landed with no issues.’

“A subsequent telephone interview with the pilot revealed that during the flight, he did not use oxygen. The pilot stated that he believed that his peak altitude was ‘close to 13,000 feet.’

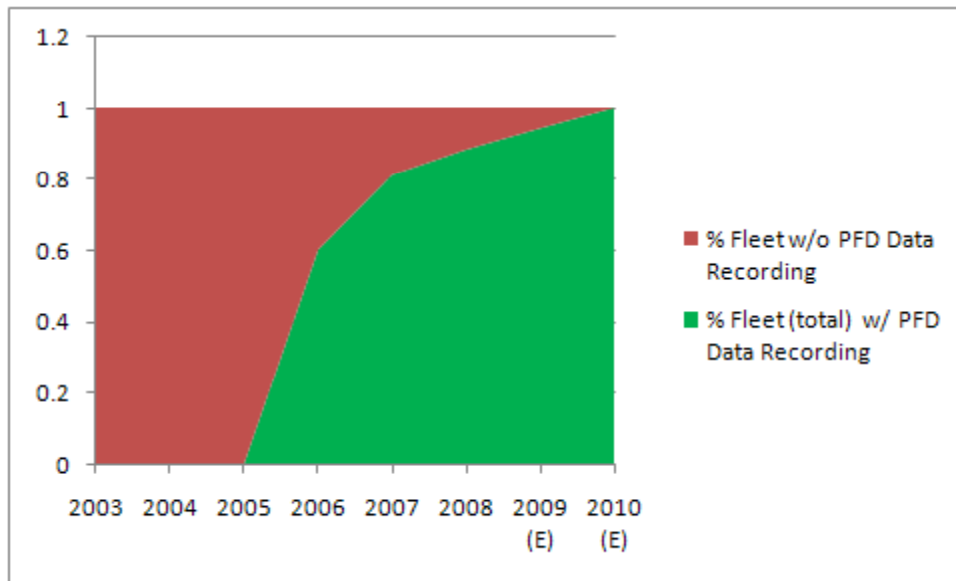
“Data recovered from the Primary Flight Display (PFD) and the internal compact flash memory card from the Multi-Function Display (MFD) were sent to the Safety Board's Vehicle Recorder Laboratory in Washington, D.C., for examination. The data revealed in summary the following about the flight:

“The airplane continued climbing at this rate until 1340 when the airplane leveled off at about 15,400 feet. During the climb the indicated airspeed again started to decrease from 130 knots to about 83 knots at level off. The airplane remained at this altitude but continued to lose airspeed. About 1341 at an indicated airspeed of about 72 knots the airplane pitched down and started into a steep dive. The airplane pitched down to a pitch attitude of about negative 80 degrees. During the dive the airplane rolled to the right about its longitudinal axis through two complete 360 degree revolutions and had started a third revolution, but only attained a +130 degrees of left bank prior to the recovery to straight-and-level flight. The airspeed increased from a low of 72 knots at the start of the dive to a maximum of about 336 knots indicated.

“During the recovery, the airplane sustained a positive G loading of 4.733 vertical Gs. (The PFD unit is limited to recording a vertical G-loading of 4.733 Gs even though the actual Gs loading may have been higher). After several positive and negative pitch (+50 degrees nose up to -80 degrees nose down) excursions the airplane ultimately recovered to a straight-and-level flight about 1343. After the initial recovery, the airspeed fluctuated to more than 200 knots after a low of about 120 knots. During the recovery to 2,500 feet, the airplane had lost about 13,000 feet of altitude in about 40 seconds, obtained a maximum airspeed of about 336 knots, and sustained two positive G loadings of at least 4.773 Gs. During the recovery, the recorded data averaged more than 4 Gs for a period of 21 seconds.

“The National Transportation Safety Board determines the probable cause(s) of this accident as follows: The pilot's failure to use supplemental oxygen where required, and his failure to maintain sufficient airspeed to avoid a stall.”

PFD Installed Base with Data Collection



- Avidyne has been aggressively upgrading the fleet to incorporate the data recording capabilities in the PFD.
- The data recording was enabled with software release 6.2.2 introduced in 2005.
- By the end of 2009, we expect to have 94% of the fleet to have data recording capabilities.
- By the end of 2009, the probability that a US-registered aircraft involved in a fatal or serious accident has data recording capabilities approaches 100%

Avidyne Data Recovery History



Year	2001	2002	2003	2004	2005	2006	2007	2008
Serious accidents with Avidyne flight critical equipment	3	4	3	6	8	15	16	11
Serious accidents with Avidyne data recovered	0	0	0	0	1	6	8	5*

Data recovery increasing significantly as the field has been equipped / upgraded over time.

Data recovery efforts can be either lead by the NTSB or Avidyne.

* Data recovery efforts are underway in active investigations

Avidyne Avionics Drive Safety



Cirrus Configuration	Total occurrences per 1000 airplane years	Injury accidents per 1000 airplane years	Loss of hull per 1000 airplane years	Fatal accidents per 1000 airplane years
Pre-Avidyne 520 Airplane Years	7.7	7.7	5.8	5.8
Entegra pre-R9 14,410 Airplane Years	7.8	4.3	3.4	3.1
Entegra R9 & beyond (target)		<1.0	<1.0	<1.0

- The above data normalizes the Cirrus fleet to accurately compare incidents per 1000 airplane years.
- Data retrieved from can be utilized in FOQA analysis for accident reductions.
- Avidyne is committed to making easier to operate avionics (Entegra R9). This concept was proven during development and could be substantiated by installed systems.
- The data supports the following conclusions:
 - Avidyne equipped aircraft have 51% fewer fatal accidents than non-Avidyne equipped aircraft.
 - Avidyne equipped aircraft have 53% fewer injuries than non-Avidyne equipped aircraft.

Release 9 Additional Data Collection



- **25+ Hours of data storage**
- **5 Hz – 0.25 Hz rates**
- **Export from front panel via USB**
- **Maintenance and pilot useful information**



MOQA

- Data for more efficient and preventative maintenance
- Pilot and Maintenance accessible logs
- Logging of Continuous Built in Tests (CBIT) of the avionics
 - Radio, GPS, ADAHRS, I/O, displays
 - Temperatures, exceedences, altitudes, lapse rates
- Engine, Electrical and Fuel
- ADAHRS, GPS, velocities and accelerations of the airframe

FOQA

- Data for improving pilot performance by teaching from experience
- Logging of all pilot interactions
- Flight plans (active and stored) and legs flown
- Deviations to the flight plan, including to the approaches
- Autopilot states and bug selections
- Com frequencies used
- Engine and fuel management
- Aircraft maneuver data from the GPS and ADAHRS

Conclusion



- Avidyne has the broadest fleet of aircraft recording data (5000+ aircraft)
- Flight data recovery from accidents has demonstrated that NTSB can use the data to come up with conclusions much quicker.
- Data recovery can potentially lead to other conclusions not obvious from the pilot or initial witnessing.
- Even in non-hardened data monitoring accidents, 90% of the time the data has been recovered. Fire is the only case where data was non-recoverable.
- MOQA data is available to the pilot, maintenance crew and others upon request.
- FOQA data is available to the pilot or 3rd party FOQA product for pilot proficiency and improvements.

❖ **Avidyne is committed to advancing GA flight data monitoring**