Aviation Recorders

L-3 AVIATION RECORDERS

About Us

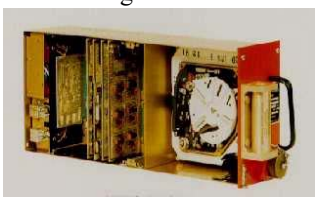
History of Flight Recorders

One of the greatest safety inventions for the commercial airline industry has been the crash protected flight recorder, more commonly called the "Black Box." Today, flight recorders for accident investigation are mandatory pieces of equipment in civil aircraft. Flight recorders have changed in design and airline usefulness over the past 40 years.

First Generation Foil Recorders -- Efforts to require crash-protected flight recorders date back to the 1940s. The introduction of Flight Data Recorders (FDR), however, experienced many delays. That's because technology could not match the design requirements of a unit that could survive the forces of an aircraft crash and the resulting fire exposure until 1958, when the world authorities approved a minimum operating requirements for an FDR. This was about the beginning of the so -called "Jet Age," with the introduction of such aircraft as the Boeing 707, Douglas DC-8 and the Caravelle. The initial requirement of these newly mandated data recorders was to record the actual flight conditions of the aircraft, i.e., heading, altitude, airspeed, vertical accelerations, and time. These early devices had very limited recording capabilities. The five analog parameters mentioned above were embossed onto a metal foil (Incanol Steel), which was used only once. The foil was believed to be nearly indestructible; however, crash survival remained a serious problem. Eventually, in 1965, the recorders were upgraded from their original specification of 100g impact to 1,000gs. With just five parameters, however, there were not enough recorded data for meaningful accident investigation. Consequently, in 1987, these recorders became unacceptable to most government regulatory authorities and additional parameters were required.

Although most major airlines replaced these old-technology recorders long before required by law, many of these first-generation recorders are still flying in older model aircraft. The remainder of these foil recorders will soon be unusable, since the industry supply of the lncanol steel recording medium has been depleted.

Second Generation Tape Recorders -- Flight data alone could not provide all accident information needed by the investigators. An advanced technology covering the recording of sounds in the cockpit, crews' conversation, air traffic control communications and aircraft noises was needed. This started a second generation of recorders that used magnetic tape as the recording medium. The first product to use this new technology was the cockpit voice recorder (CVR). In 1965, all commercial operators were mandated to install a CVR, which would retain the last 30 minutes of crew voice communications and noise within the cockpit environment. Magnetic tape required very complex fire and crash protection.



The Fairchild CVR, Models A100 and A100A, manufactured by L-3 Communications Aviation Recorders, were part of this second generation of recorders. They became the most widely used CVR in the world and have now been in service for more than 30 years. During this time, more than 800 aircraft's have been destroyed in accidents, but the recorders have survived.

This same "tape" technology (recording data in a digital format) was expanded to the FDR. This second-generation FDR allowed a manufacturer to build products that would record many additional flight parameters while meeting higher crash and fire protection requirements. In the late 1960s and early 1970s, the introduction of sophisticated aircraft such as the B-747, DC-10, L-1011 and A300 required new recorders that could retain information about the engines, flight controls, flaps, etc., the fully assist accident investigators.

Third Generation Solid State Recorders -- The Solid State Flight Data Recorder (SSFDR) became commercially practical in 1990. "Solid State" refers to storage of data in semiconductor memories or integrated circuits, rather than using the older technology of electromechanical methods of data retention. Since the solid state memory does not require scheduled maintenance or overhaul, there are potential cost savings to the operator. Additionally, the data is easier to retrieve, and is readily available to assist in monitoring the performance of the aircraft, or during scheduled maintenance inspections.

Using the technology of third-generation recorders, operators can extract stored data in a matter of minutes. This data can show how the aircraft has performed in flight, or if a monitored device needs maintenance. Now, the operators of newer generation aircraft can fly with greater safety and reliability. The SSFDR, Model F1000, was the first certified flight recorder to use this new technology.

The Solid State CVR (SSCVR) evolved later than the SSFDR because of the need for more memory capacity. The 30-minute SSCVR became available in 1992, and a two-hour version became available in 1995.

Why Crash-Protected Recorders are in the Tail of the Aircraft

Original requirements were for a unit to be able to withstand a 100g impact and be installed in the forward avionics bay with the rest of the avionics boxes. After several accidents with aircraft equipped with FDRs, it soon became evident that the 100g specification was inadequate. To correct the situation, the Federal Aviation Administration made a specification change which increased the impact requirements to 1000gs and relocated the recorder to the rear of the aircraft. The reasoning for the change was that, following initial impact, the rear of the aircraft would be moving at a slower speed, thus, more recorders would survive.

Need for Additional Parameters

In the late 1960's, England's Civil Aviation Authority required that additional parameters to be recorded. Several version of FDRs were available with multiple metal styli that allowed marking on both sides of the foil. This allowed for the recording of pitch, roll and flaps. While this provided additional information for the accident investigator, it generated much more work for the shops and resulted in lower reliability of the unit. Moreover, this additional information was very difficult to read and even harder to interpret.

In the late 1960s, the introduction of the new wide body series of aircraft (B-747, DC-10, L-1011) created new problems for accident investigators. Their concern was the potential for a high -density passenger accident, without sufficient information to properly identify the cause. By installing a Flight Data Acquisition Unit (FDAU), these analog aircraft could provide much more data. The new specification required a new digital type recorder that would record 64 12-bit words each second for 25 hours, which represented the round-trip time between New York City and Japan or between Los Angeles and Europe.

The FDAU would take in all of the analog signals, convert them, and then send a single digital data stream to the crash-protected "tape" unit. In the late 1970s and early 1980s the International Civil Aviation Organization (ICAO) began recommending that digital aircraft record 32 parameters. As the ICAO had no enforcement capabilities, each country continued to follow its own existing regulations; however, their goals were to eventually meet the ICAO recommendations.

More Parameters for Older Aircraft

By the mid 1980s, all newly Type Certified (TC) aircraft were being fitted with recorders that could capture between 17 to 32 parameters. At the same time, new production of older model aircraft were still being delivered with old foil recorders. A loophole in the regulations required only newly TC aircraft to meet the larger parameter requirements.

The NTSB and other investigators made several attempts to require additional parameters on older aircraft. The most successful approach was a study of past accidents, which showed that, where foil recorders were involved, they were not functioning in 48 percent of the accidents. A tremendous amount of time and effort was required to read out these recorders with limited success. Additionally, the recorders themselves were becoming a major problem, as the individual replacement parts were very hard to product and many vendors were no longer in business. The FAA therefore produced a notice enforcing the removal of foil recorders, with the installation of digital recorders by May 1989, and the recording of five additional parameters by May 1994.

Fire Protection and Impact

Through the years, Fairchild recorders have survived the most horrible accidents. To ensure their survivability, a series of tests needs to be accomplished, and the test must be done in sequence.

Crash Impact Test -- It has been agreed that 3400gs for 6.5 ms would be required to meet most

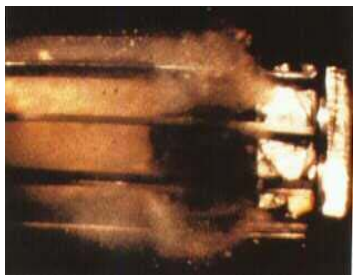
accident scenarios. This test is actually performed with a cannon. A Fairchild CVR has survived a crash that was estimated to be more than 6000 gs.

Static Crush -- In this test, 5,000-pound pressure is applied against all six axis points.

Pierce Test -- A pierce test employs a 500-lb. weight dropped from 10 feet. It has been modified to be performed with a hardened steel pin.

Fire Test -- The devices are subjected to 1100 degrees Centigrade for 60 minutes, then undergo 10 hours at 260 degrees Centigrade. Because of its outstanding fire survival record, the Fairchild Model A100CVR was used as the model to insure mandated standards could be obtained. The very latest FAA standards require the fire test to be expanded to 1 hour at 1100 degrees Centigrade. which all solid state models of L-3 Recorders meet or exceed.





The Future of Flight Recorders

The FDR and CVR are two of the greatest safety inventions of the commercial airline industry. What improvements are on the horizon? Within the next few years, some form of cockpit video recorder that can store video images in solid-state memory and in conjunction with voice recording will be developed. L-3 Communications is working on this and other technological enhancements that will help in investigations of devastating aircraft accidents and prevent their future occurrence.