

Flight Data Recorder & Cockpit Voice Recorder

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Introduction

The Black Box is a flight recorder used to record specific aircraft performance parameters.

The original black box was designed by David Warren

In 1953, Warren came up with the idea of an onboard flight-data recorder

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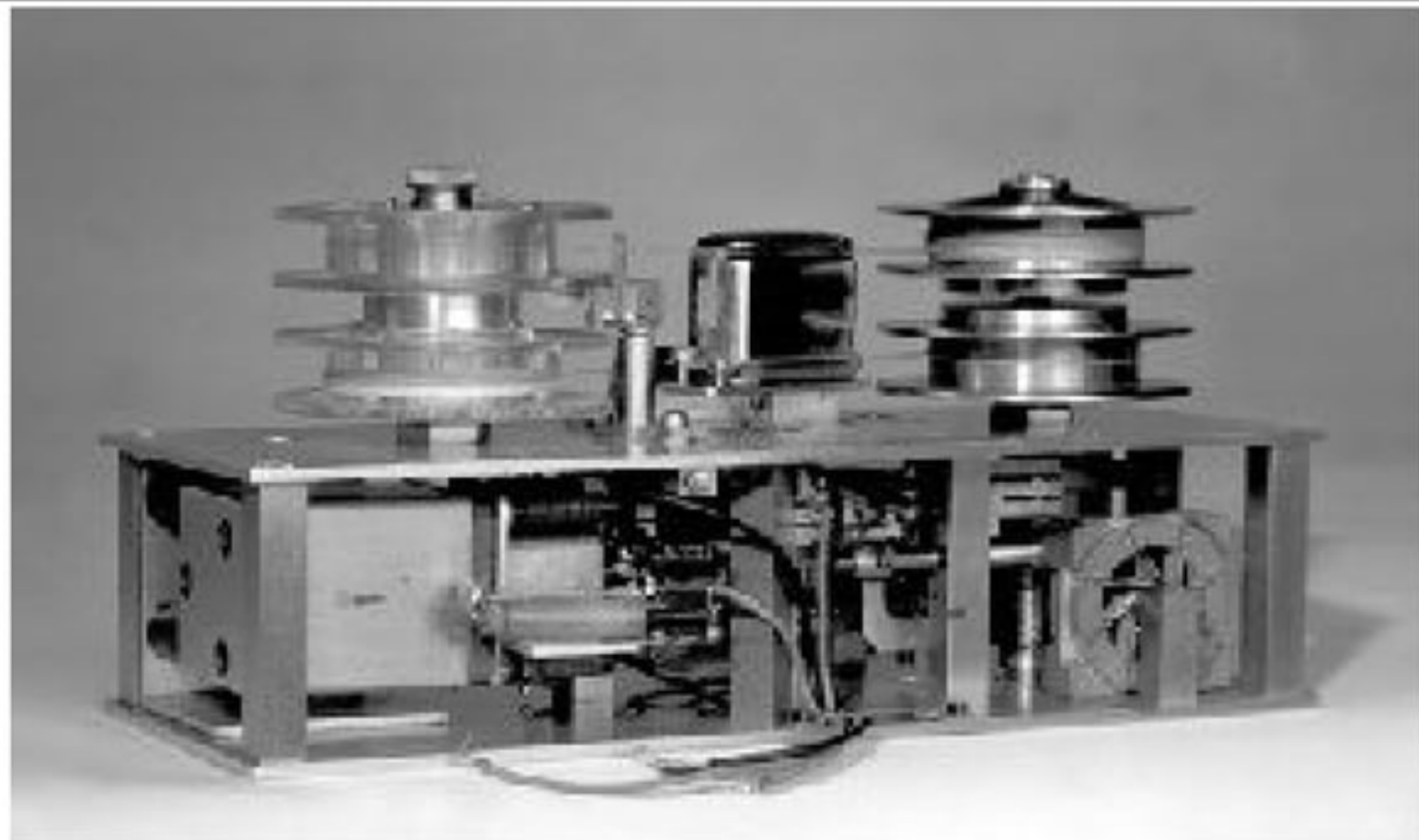
History

The first prototype FDR was produced in 1956 by Dr. David Warren

He built the world's first cockpit-voice and flight-data recorder in 1958

In 1960 Australia became the first country in the world to make the Black Box mandatory for all commercial aircraft

Flight Data Recorder & Cockpit Voice Recorder



The first flight recorder

Flight Data Recorder & Cockpit Voice Recorder

INSIDE BLACK BOX

Flight Data Recorder (FDR)

Cockpit Voice Recorder (CVR)



**The two Black-Boxes :Flight Data Recorder &
Cockpit Voice Recorder**

Flight Data Recorder & Cockpit Voice Recorder

Flight Data Recorder (FDR) is a device which records information about the flight of the airplane.

The data recorded on the Flight Data Recorder is used for accident investigations; the data may also be used for monitoring airplane systems.

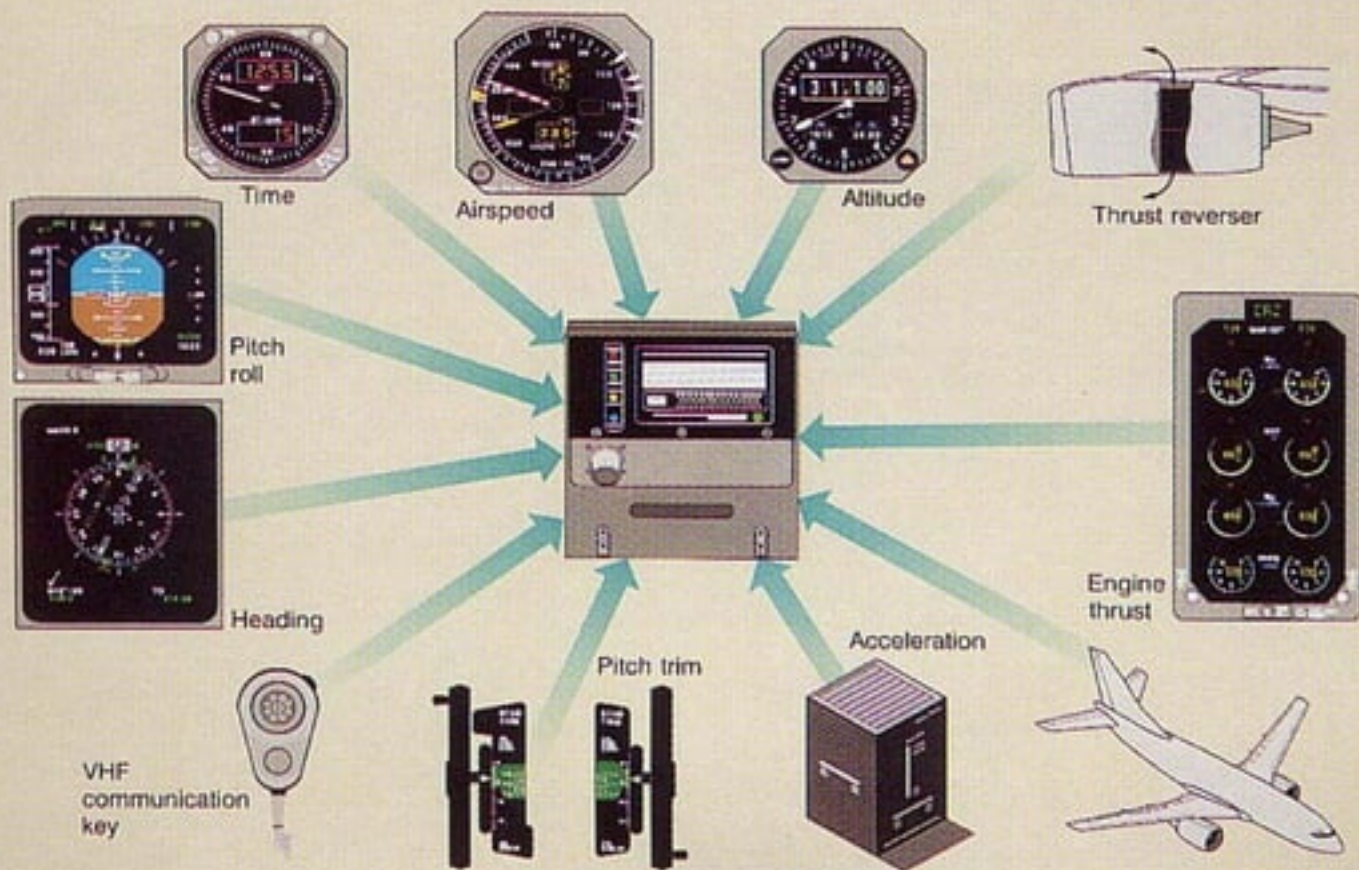
All transport aircraft above 5,700 kg must be fitted with a flight data recorder.

The flight recorder system will automatically record airplane airspeed, attitude, altitude, engine performance and other data from engine start-up to engine shut-down.

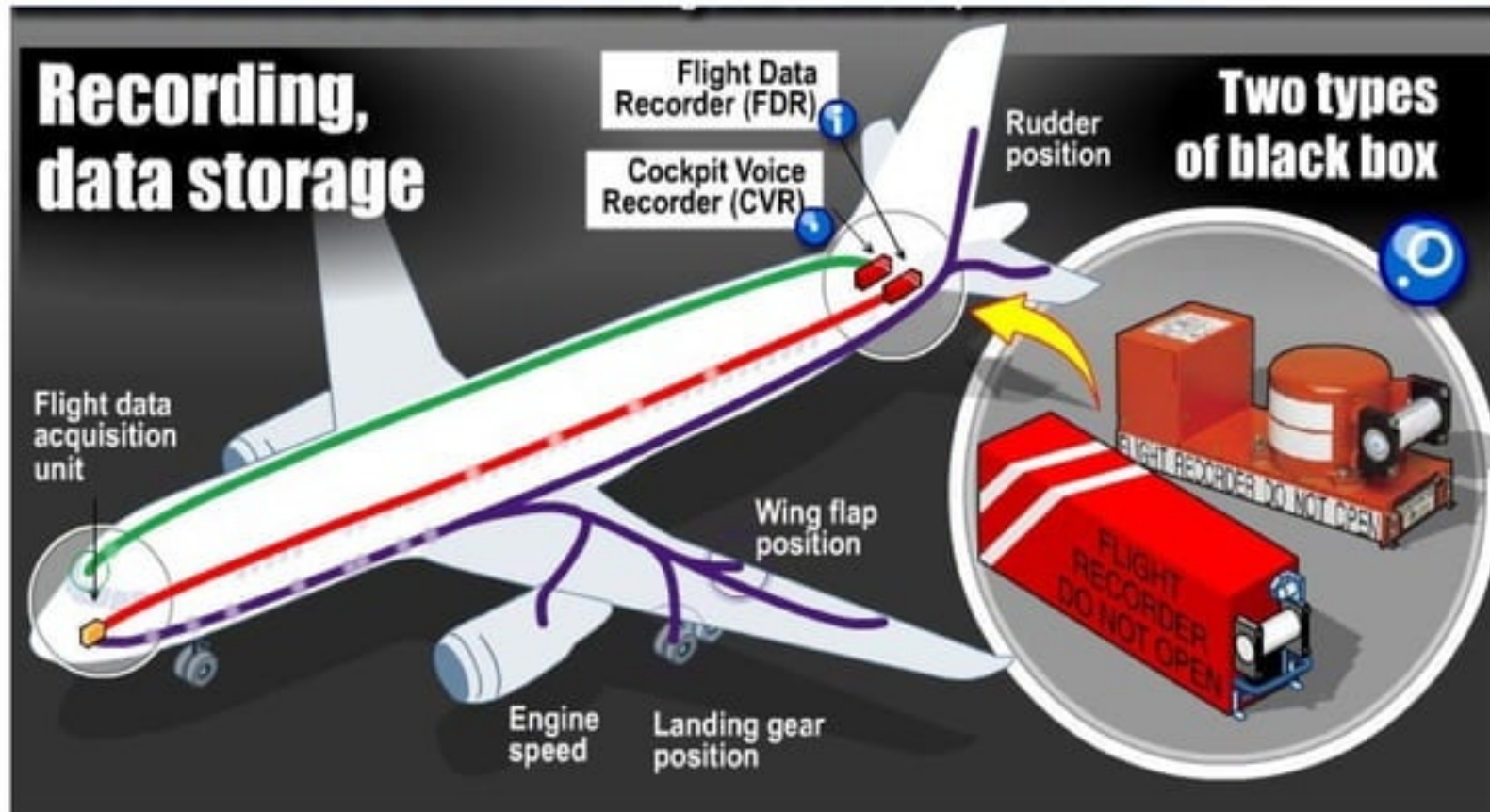
Flight Data Recorder & Cockpit Voice Recorder

Operation of the FDR must be **fully automatic** and not require pilot switching.

Most importantly, pilots are not able to turn the FDR off in flight or erase data after landing, to ensure data that may be relevant to an accident or incident is protected for use by accident investigation officers.



Flight Data Recorder & Cockpit Voice Recorder

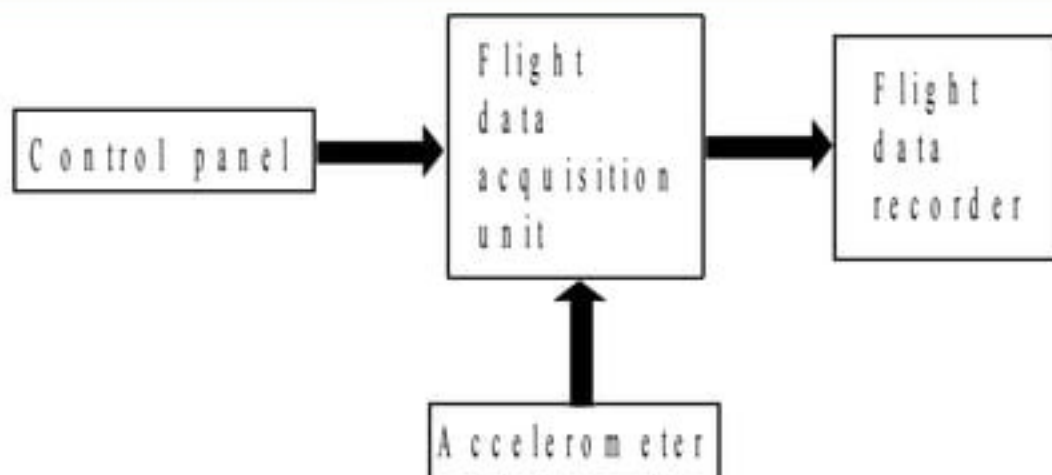


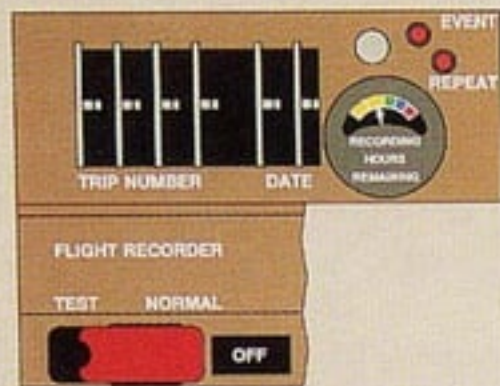
The unit is usually mounted in the aircraft's empennage
(tail section)

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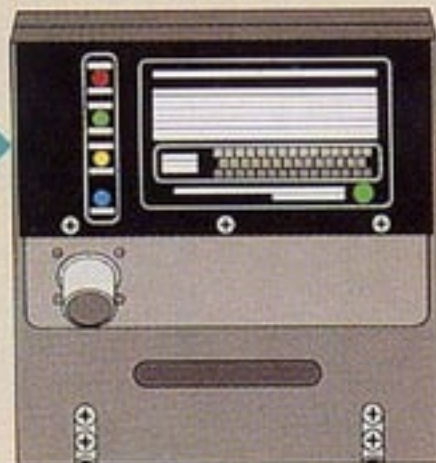
Flight Recorder System

On Model 737,757,and 767 airplanes the flight recording system consists of a Flight Data Recorder, Flight Data Acquisition Unit (FDAU), accelerometer and a control panel.





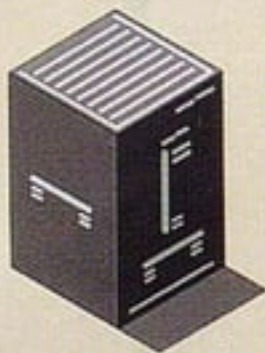
Control panel



Flight data acquisition unit



Flight data recorder



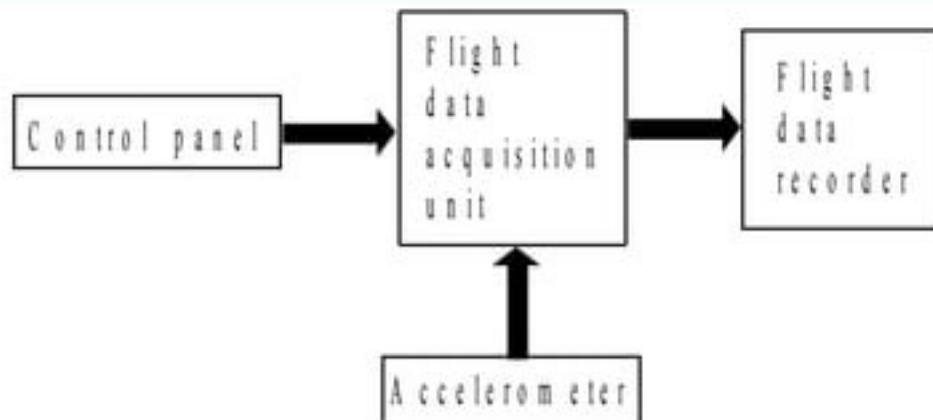
Accelerometer

Flight Data Recorder & Cockpit Voice Recorder

The purpose of flight data recorder is to record the data passed to it by the FDAU.

At its core, the recorder consists of a container that records twenty-five hours of data on a continuous tape

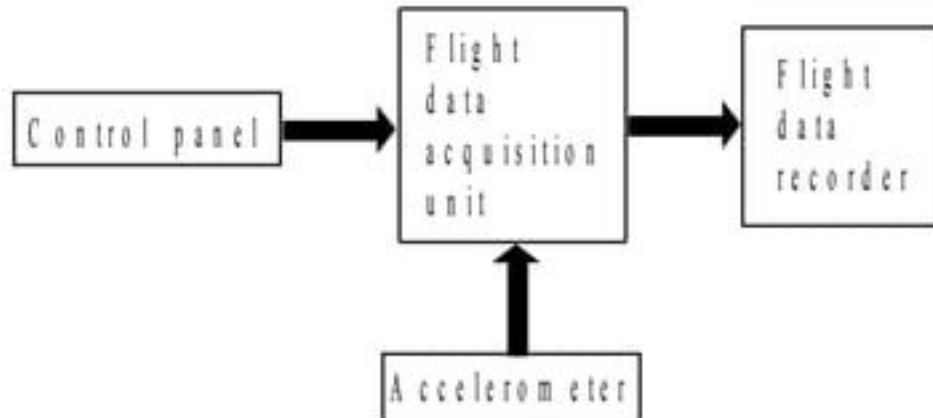
To protect the tape in the event of an accident, the recorder is housed in a sealed



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The FDR is normally located in a part of the airframe that is likely to suffer least in the event of an impact. Consequently, they are normally installed in the tail or roof of the aircraft.

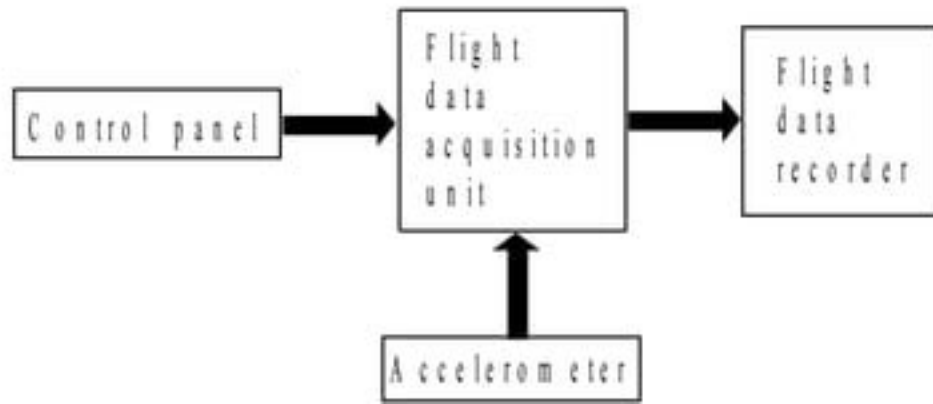
Digital Flight Data Recorders (DFDR) are fitted to many modern transport aircraft, and have the capacity to record as many as 300 parameters, including control positions and systems performance.



Flight Data Recorder & Cockpit Voice Recorder

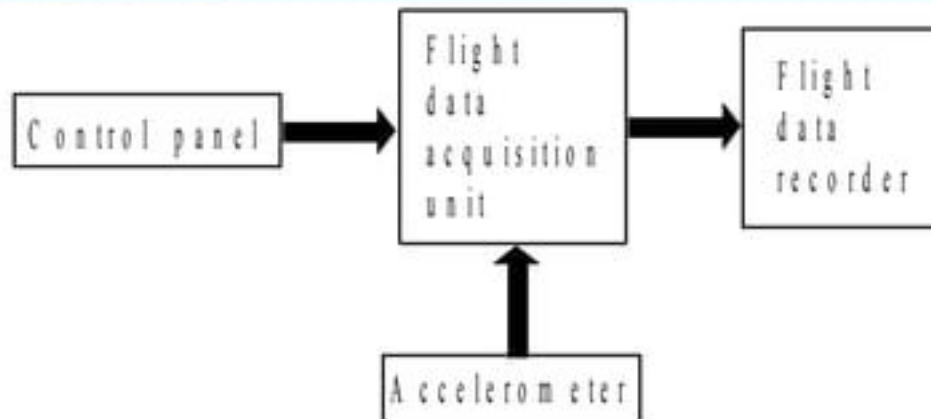
An **under water locator beacon**, which emits an ultrasonic signal when immersed in water, is attached to the front of the FDR. The beacon is turned on automatically when immersed in water, to assist in locating the recorder when under water.

The FDAU gathers data from the airplane's systems. Data sent from the FDAU to the FDR is recorded on magnetic tape. The data collected by the FDAU specifically for the FDR are called mandatory data



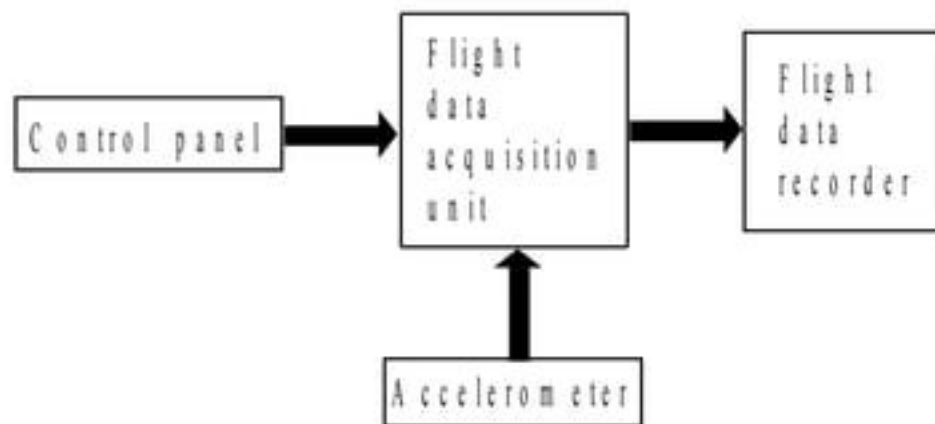
Flight Data Recorder & Cockpit Voice Recorder

On Model 737, 757, and 767 airplanes the FDAU acquires airplane performance data for the Airplane Condition Monitoring System (ACMS). These data are for maintenance purpose. Airline personnel retrieve the ACMS data collected by the FDAU and use it to check the operation of airplane systems and engines. The engine data is particularly useful for identifying engine performance trends.



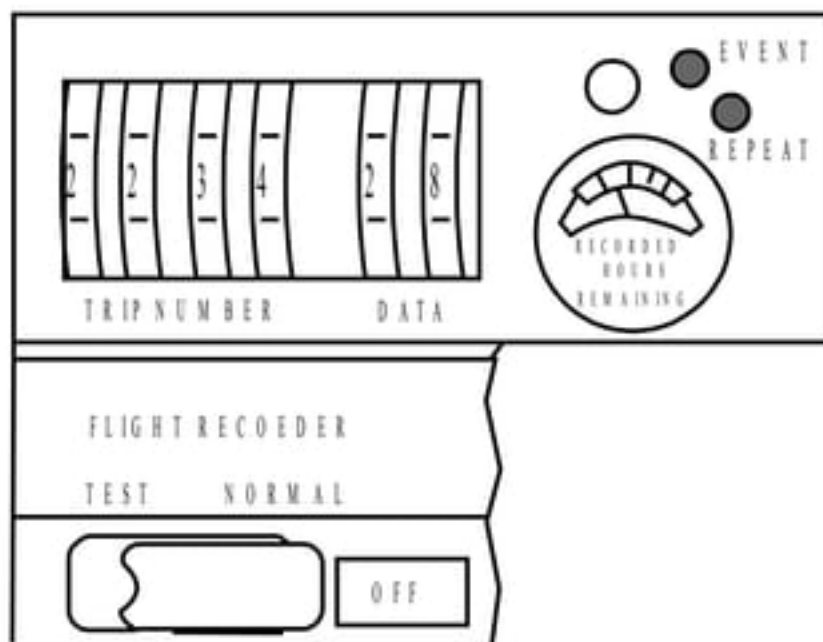
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A triaxial **accelerometer** is an integral part of the flight recorder system. Accelerometer measure accelerations along the airplane lateral , longitudinal and vertical axes of the airplane and send them to the



Flight Data Recorder & Cockpit Voice Recorder

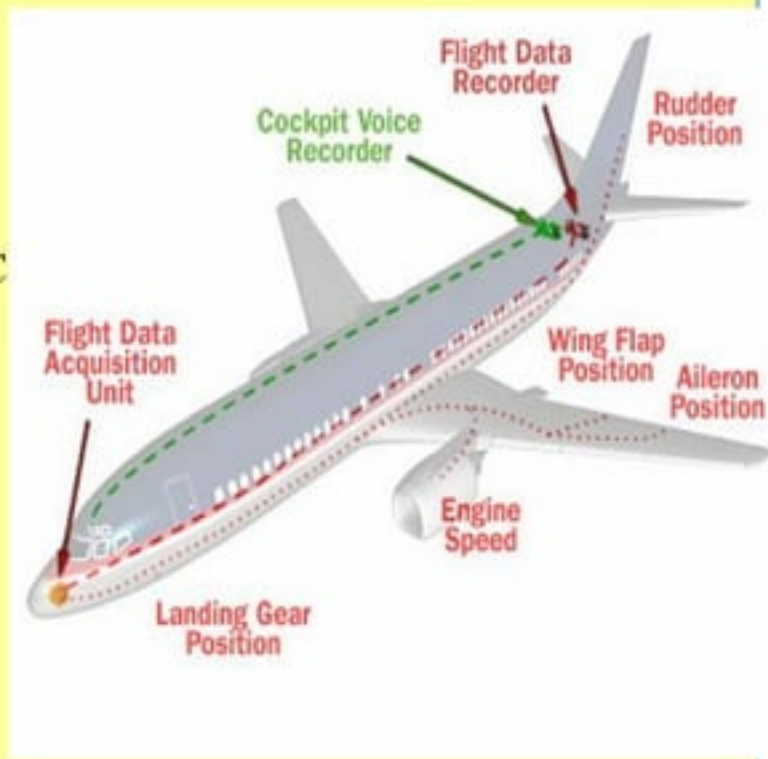
Cockpit controls for the FDR are limited to a warning light which illuminates in the event of FDR failure, and a test switch for use only on the ground.



Flight Data Recorder & Cockpit Voice Recorder

Federal Airworthiness Regulation (FAR) 121.343 requires that 17 parameters are recorded by the FDR. The seventeen parameters currently required by the FAR are:

- Time
- Altitude
- Airspeed
- Vertical acceleration
- Heading
- Time of each radio transmission to or from ATC
- Pitch attitude
- Roll attitude
- Longitudinal acceleration
- Control column or elevator position
- Pitch trim position
- Control wheel or aileron position
- Rudder pedal or rudder position
- Thrust of each engine
- Position of each thrust reverser
- Trailing edge flap or flap handle control position
- Leading edge flap or flap handle control position



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The October 1991, amendment to FAR 121.343 will require that parameters in addition to the seventeen listed above are recorded. The additionally required parameters are:

- Ground spoiler position or speed brake selection
- Marker beacon passage
- Autopilot engagement
- Lateral acceleration
- Glideslope deviation
- Localizer deviation
- Automatic flight control system modes and engagement status
- Radio altitude
- Master warning
- Main gear squat switch status
- Angle of attack
- Outside air temperature
- Hydraulic system low pressure
- Groundspeed

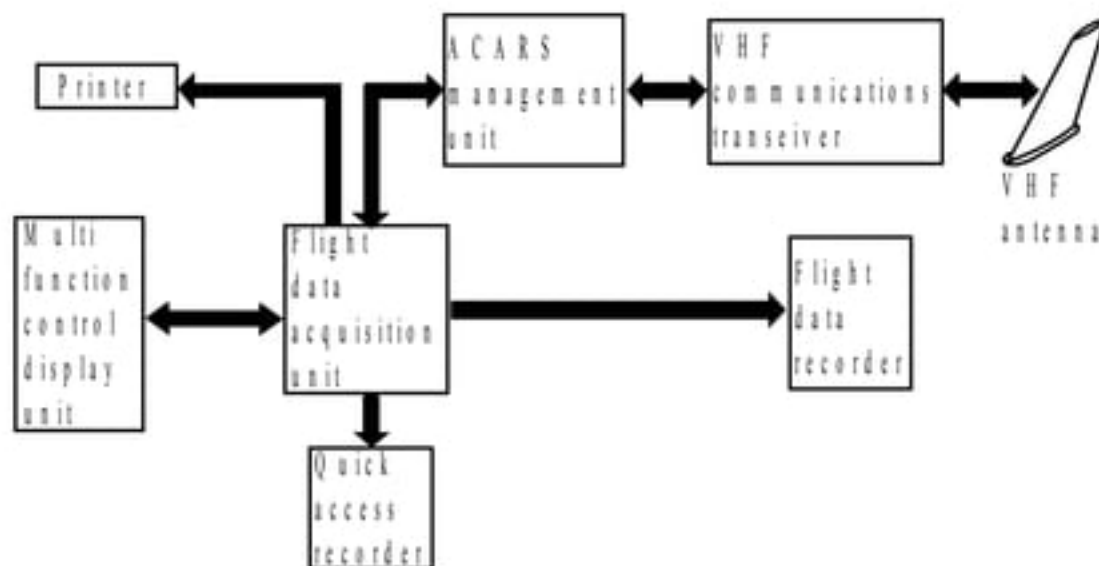
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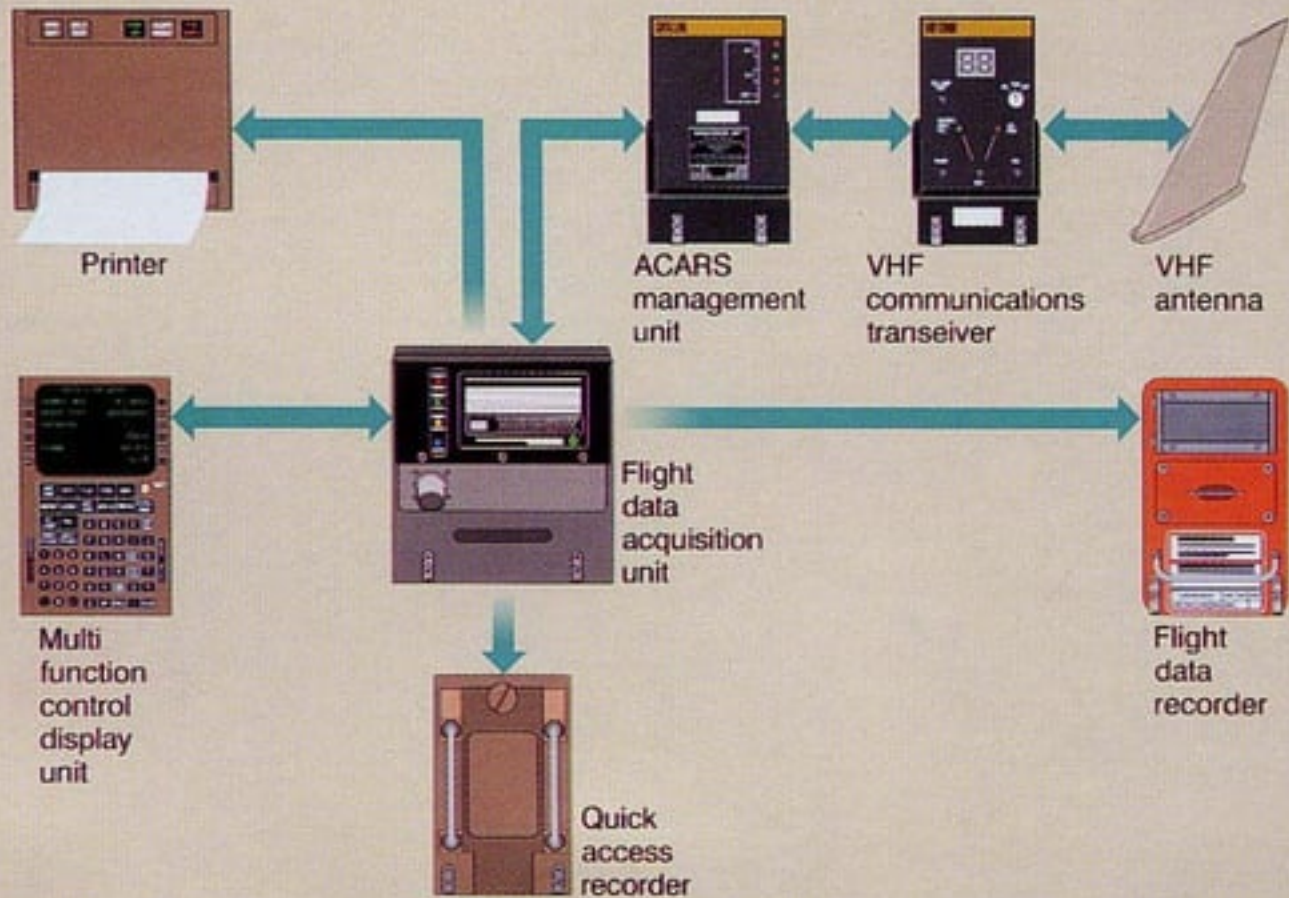
FAR 124.343 goes on to recommend that additional parameters are recorded if recording capacity is available. These parameters are:

- Drift angle
- Wind speed and direction
- Latitude and longitude
- Brake pressure/brake pedal position
- Engine parameters
- Engine Pressure Ratio (EPR)
- N1 compressor
- N2 compressor
- Exhaust Gas Temperature (EGT)
- Thrust lever position
- Fuel Flow
- Traffic Collision Avoidance System (TCAS)
- Traffic advisory
- Resolution advisory
- Sensitivity level (as selected by the crew)
- Ground Proximity Warning System (GPWS)
- Landing gear or landing gear selector position
- DME 1 and DME 2 distance
- Navigation 1 and navigation 2 radio frequency selection

Flight Data Recorder & Cockpit Voice Recorder

The FDAU collects ACMS data from the airplanes sensors





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The FDAU may be connected, for example, to:

- Engines
- Flight controls
- Pneumatic System
- Flaps and slats
- Auto flight control equipment
- Navigation equipment
- Communication equipment
- Air conditioning and pressurization controls
- Auxiliary Power Unit
- Warning and Caution System

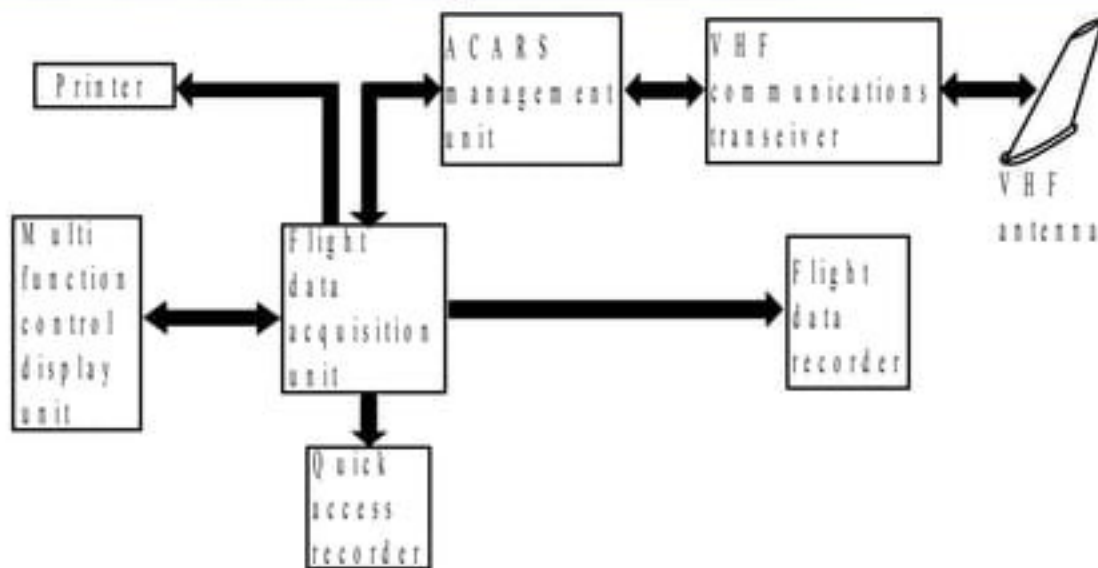
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Sensor data received by the FDAU input circuitry is checked to ensure that it is good data. After processing, the data is sent to the output circuitry which will send the data electronically to the flight recorder.

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ACMS data, which contains some of the same data as sent to the flight recorder data, is sent to a **data storage device**.

The data storage device may be a **disk** drive installed in the FDAU itself or a Quick Access Recorder (QAR). A QAR is a tape recorder similar to a flight recorder but without the crash protection features.



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Some FDAUs can store the data in memory and then write the data to a storage device called an airborne data loader after the airplane has landed.

Airplane maintenance personnel will periodically remove the tapes from the QAR for analysis. The tape is taken from the airplane and read by the ACMS

A QAR can store much more data than can a disk drive installed in the FDAU.

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In some FDAUs, data from many airplane sensors is analyzed and reports are generated.

An example of this may be an engine exceedance report.

Exhaust Gas Temperature (EGT) data and total air temperature data are analyzed in the FDAU. An EGT exceedance report is generated if the EGT exceeds a preset level. The reports generated by the ACMS may be printed on the flight deck or they may be sent to the airline offices over an ACARS (Aircraft Communications addressing and Reporting System) communication data link.

COCKPIT VOICE RECORDERS

CVR is designed to track the conversations of the flight crew.

The Exterior of the FDR & CVR is coated with heat-resistant **Bright Red or Orange Paint**

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THE POSITIONS OF THE FOUR MICROPHONES

Pilot's headset

Co-pilot's headset

Headset of a third crew member (if there is a third crew member)

Near the center of the cockpit, where it can pick up audio alerts and other sounds

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TECHNOLOGY USED FOR RECORDING AND STORAGE:

Magnetic Tape

Solid-State Technology

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COMPARISON OF TAPE RECORDER

Magnetic tape recorder	Solid state recorder
Introduced in the 1960s.	Introduced in the 1990s
It can track about 100 parameters.	It can track more than 700 parameters in larger aircraft.
Magnetic-Tape CVRs store the last 30 minutes of sound.	CVRs that used solid-state storage can record 2 hours of audio.

Flight Data Recorder & Cockpit Voice Recorder



Magnetic tape recorder



Solid state recorder

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BUILT TO SURVIVE:

Crash-survivable memory units (CSMUs) of FDR and CVR



UNDERWATER LOCATOR BEACON (ULB)

Submergence sensor on the side of the beacon

Pulses at 37.5 kilohertz (kHz)

Sound as deep as 14,000 feet (4,267 m)

Once the beacon begins "pinging", it pings once per second for 30 days



Flight Data Recorder & Cockpit Voice Recorder

RETRIEVING INFORMATION

Portable interface device

Retrieval of FDR

Retrieval of CVR

