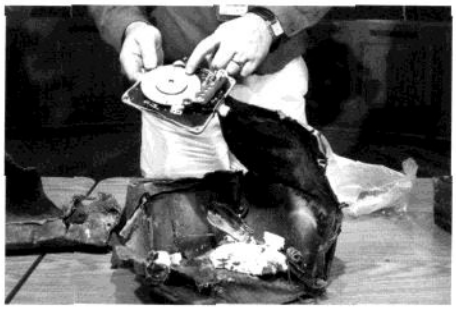


RECORDING DISASTERS IN THE AIR ▲
Damage belies the resilience of flight recorders. This one, recovered from Flight 587, which crashed into Queens, New York, in 2001, revealed that turbulence ripped the tail from the aircraft.

DISASTER SCENE PROTOCOL:

1. *Rescue trapped crew and passengers.*
2. *Make the disaster area safe and secure as quickly as possible.*
3. *Check bodies for evidence, then remove to morgue for identification.*
4. *Document and record remainder of scene, and search for evidence.*
5. *Interview witnesses.*
6. *Selectively remove vehicle parts for forensic analysis.*

Major incidents

When ships sink and trains or planes crash, forensic investigators work in harrowing scenes of carnage to locate the cause. Their findings may prevent a repetition of the disaster. They help in prosecutions of negligence or sabotage. And they bring comfort to bereaved families who need to know how—and why—their loved ones died.

Transportation disasters bring death and destruction on an unimaginable scale. Whereas a homicide crime scene may feature several bodies, an air crash can mean hundreds, sometimes scattered over a vast area. The work of investigating such a major incident is often indivisible from the task of locating and identifying victims, since the bodies may themselves be the evidence that pinpoints the cause, or identifies those responsible.

Cooperation and leadership

Many agencies are involved in these traumatic investigations. There may be specialist police, representatives of the transportation company, accident and safety investigators, and many others. To avoid chaos, the interested parties decide early on which of them will lead the inquiry. If there is any suspicion of criminal activity, the police will take charge.

Regardless of who is leading, the task of investigators is the same: they look for evidence that the incident was caused by human error, by mechanical failure on the vehicle, by the failure of external systems such as signaling, or by deliberate sabotage. Their methodology is determined by the usual imperatives of preserving evidence—except that here, the sheer scale

ESCHEDE TRAIN CRASH
A high-speed train hit a bridge at Eschede, Germany, in 1998 when a wheel failed. The crash killed more than 100 passengers.

of the disaster imposes its own rigor. You cannot just "bag and tag" a car ferry.

Specialists at the scene

Because of the technical nature of transportation investigations, specialists invariably play a major part. In the case of a plane crash, individual experts will be responsible for different factors such as the engines, air traffic control, weather, crew performance, and the aircraft's operational record, among others.

HERALD OF FREE ENTERPRISE ▲
Nearly 200 died in 1987 when waves swamped this ferry in Belgium's Zeebrugge Harbor. Investigators learned that, under pressure to sail on time, a tired crew set sail before the bow doors were closed.

Capturing ephemeral evidence

Once paramedics have evacuated or treated survivors, investigators may urgently need to carry out time-dependent tests, such as measuring engine part temperatures, or carrying out procedures to test braking efficiency.

Investigators then use video and photography to record evidence that cannot be preserved, such as damaged track that must be replaced to restore a train service. Where possible, elements that will prove crucial to a subsequent enquiry, such as locomotive cabs, are removed intact. Air disasters follow a well-established routine: every remaining scrap of debris is recovered, and the aircraft is reconstructed in a hangar to try to determine the cause of the accident.

Mute witnesses

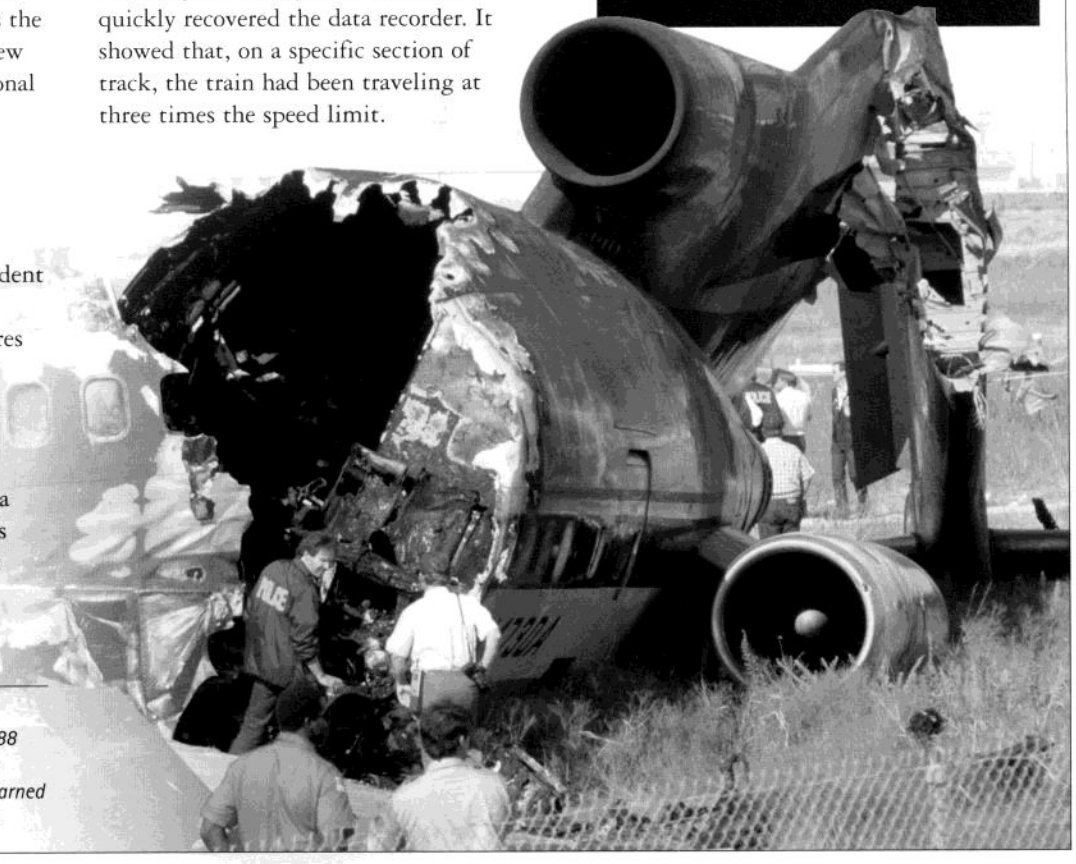
Air crashes are often so destructive that the only witnesses are the data and cockpit voice recorders, and locating them is famously a priority for accident investigators. Commonplace on aircraft since 1960, these boxes are painted high-visibility orange, rather than the eponymous black. Inside are specially toughened tape recorders or solid-state computer data stores. They are capable of withstanding the huge forces of a crash, followed by fire and immersion in water. Those on aircraft record at least 88 parameters each second, including altitude, direction, and condition of the engines, and are capable of storing 25 hours' worth of data. The cockpit recorder stores up to two hours' of speech.

Data recorders are not confined to aircraft: modern trains and some ships also carry them. At the Eschede train crash in Germany, for example, investigators quickly recovered the data recorder. It showed that, on a specific section of track, the train had been traveling at three times the speed limit.

CASE STUDY

The crew of *Estonia* were used to violent storms on their journeys across the Baltic sea, so they were unconcerned when 20-ft (6-m) waves buffeted their ship on September 28, 1994. But, by 1:15 AM, the ship had developed a heavy list. Two hours later, the ferry was at the bottom of the Baltic. Of the 989 people onboard, 852 died in the freezing water. Inspection of the wreck by divers and two remotely operated submersibles confirmed suspicions that the car deck had flooded when waves tore off the bow door. The investigators blamed poor maintenance and excessive speed for the tragedy.

CASE STUDY



FLIGHT 1141 TO SALT LAKE CITY ▶
This flight from Dallas crashed on takeoff in 1988 because the crew set wing flaps incorrectly. On retrieving the klaxon (horn) that should have warned of the error, investigators found it did not work.