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**AIRCRAFT  
ACCIDENT  
REPORT**  
**Trans World Airlines Flight 800**  
**Part I**  
**Consideration of Reasonable Probable Causes**



**Report on the accident to  
Trans World Airlines Flight 800  
Boeing 747-131, N93119  
Near East Moriches, New York  
July 17, 1996  
by John Barry Smith,  
Independent Aircraft Accident Investigator**

## **Part I: Consideration of Reasonable Probable Causes**

Abstract and excerpts from Aircraft Accident Report NTSB/AAR-00/03. Abstract: This report explains the accident involving Trans World Airlines, Inc. flight 800, which experienced an in-flight breakup and then crashed into the Atlantic Ocean near East Moriches, New York, on July 17, 1996. The National Transportation Safety Board determines that the probable cause of the TWA flight 800 accident was an explosion of the center wing fuel tank (CWT), resulting from ignition of the flammable fuel/air mixture in the tank. The source of ignition energy for the explosion could not be determined with certainty, but, of the sources evaluated by the investigation, the most likely was a short circuit outside of the CWT that allowed excessive voltage to enter it through electrical wiring associated with the fuel quantity indication system.

Many witnesses in the area of the accident at the time that it occurred reported that they saw and/or heard an explosion, accompanied by a fireball over the ocean, and observed debris falling to the water. These witness reports and the widespread distribution of the wreckage indicated that TWA flight 800 had experienced a catastrophic in-flight structural breakup. In addition, a noise recorded on the CVR in the last few tenths of a second before the CVR recording stopped was similar to the last noises heard on CVR recordings from other airplanes that had experienced structural breakups (including fuel tank explosions). On the basis of this initial information, investigators considered several possible causes for TWA flight 800 in-flight structural breakup: a structural failure and decompression; detonation of a high-energy explosive device, such as a bomb exploding inside the airplane or a missile warhead exploding upon impact with the airplane; and a fuel/air explosion in the center wing fuel tank (CWT).

This Smith Trans World Airlines Flight 800 AAR states there are three reasonable alternatives to the CWT explosion explanation based on the previous similar accidents of United Airlines Flight 811, Air India Flight 182, and Pan Am Flight 103. Of the three reasonable alternatives, two can be ruled out with confidence: Missile strike and bomb explosion; and one ruled in: The shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup explanation which closely matches the probable cause of the United Airlines Flight 811 accident. Since the discovered hazards of faulty wiring or switch and the hazard of nonplug cargo doors currently exist in the five hundred early model Boeing 747s in service, further official investigation is warranted and urgently needed.

### **Table of Contents**

#### **Part I: Consideration of Reasonable Probable Causes**

1. Factual Information
  - 1.1 History of the Flight
2. Premise Explanations for Trans World Airlines Flight 800
  - 2.1 Explosion in flight in the forward cargo compartment leading to inflight breakup.
    - 2.1.2 Discussion
    - 2.1.3 Conclusion:
  - 2.2.1 Premise: Surface to air or air to air missile strike inflight:
    - 2.2.2. Discussion:
    - 2.2.3 Conclusion:
  - 2.3.1 Premise: Center Fuel Tank explosion with undetermined ignition source:
    - 2.3.2 Discussion:
    - 2.3.3 Conclusion:

- 2.4.1 Premise: Explosion in the forward cargo compartment on the starboard side caused by explosive decompression caused by structural failure of a ruptured open forward cargo door at one or both of the midspan latches caused by faulty electrical wiring or switch shorting on the door unlatch motor.
- 2.4.2 Discussion:
- 2.4.3 Conclusion:
- 2.5.1. Premise: Explosion of a improvised explosive device in the forward cargo compartment.
- 2.5.2 Discussion:
- 2.5.3 Conclusion:
- 2.6. Summary:
3. Sequence of disintegration.
4. Hindsight Pattern.
5. Specific Conclusions for Trans World Airlines Flight 800:
6. Concluding Comment:

## **Part II: Comparison to Similar Accidents**

1. Introduction:
2. Purpose of Part II:
3. Premise Explanation: Explosion in the forward cargo compartment of explosive decompression caused by structural failure of ruptured open forward cargo door at one or both of the midspan latches caused by faulty electrical wiring:
4. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had probable causes which were initially thought to be bomb explosions:
5. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had the original cause of bomb explosion modified.
6. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had breakups in their airframes in a similar amidships location.
7. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had at least nine never recovered bodies.
8. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had passengers that showed explosive decompression type injuries and no evidence of bomb explosion injuries.
9. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had experienced a sudden, loud, audible sound on the cockpit voice recorder at event start time:
10. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had the source of the sudden, loud, audible sound as a bomb explosion disputed and the source of the sudden, loud, audible sound as an explosive decompression supported.
11. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had an abrupt power cut to the data recorders immediately after a sudden, loud, audible sound at event start time.
12. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had an explosion in or adjacent to the forward cargo compartment.
13. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had similar shattered fuselage skin in and around the forward cargo door.
14. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had relatively mild damage on the port side of the nose forward of the wing directly opposite the shattered zone around the forward cargo door at the same initial event time.
15. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had similar damage to their airframe structures from inflight ejected debris.

16. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had foreign object damage to engine number three.
17. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had incomplete reports of the status of the forward cargo door.
18. Air India Flight 182, Pan Am Flight 103, and Trans World Airlines Flight 800, and United Airlines Flight 811 to a much lesser extent, had similar debris patterns on the surface of the ground or sea bottom.
19. Summary of matching evidence for all aircraft:
20. Summary of matching evidence between Trans World Airlines Flight 800 and United Airlines Flight 811 specifically:
21. Cargo Door Operation for Boeing 747:
22. Inadvertent Cargo Door Opening Causes:
23. Wiring:
24. Comment:
25. General Conclusions for Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800:
26. Specific Conclusions for Trans World Airlines Flight 800:
27. Contributing causes:
28. Recommendations:

### **Part III: Door Story**

Forward Cargo Door Areas Compared for United Airlines Flight 811, Pan Am Flight 103, Air India Flight 182, and Trans World Airlines Flight 800.

1. Introduction.
2. Normal Operation.
3. United Airlines Flight 811.
4. Air India Flight 182.
5. Pan Am Flight 103.
6. Trans World Airlines Flight 800
7. Forward cargo door areas examined in detail.
8. Pressure relief doors examined in detail.
9. Port and Starboard side of Trans World Airlines Flight 800 examined in detail.
10. Conclusions.

### **Part IV: Anomalies within the NTSB investigation, the public docket, and NTSB AAR 00/03 for Trans World Airlines Flight 800**

1. CVR sound matches United Airlines Flight 811.
2. First parts to leave aircraft were forward of the wing.
3. Engine number 3 was uncontained.
4. Unilateral damage to aircraft and not bilateral.
5. Unusual red paint smears on airframe.
6. Trans World Airlines Flight 800 not matched to United Airlines Flight 811.
7. Ruptured open forward cargo door ruled out without proper consideration.
8. Only aft cargo door still recovered.
9. Wreckage debris tags in database changed.
10. Wiring faulty in cargo door area but not considered as initial event.
11. Mysteries solved: Streak source, ignition source, red paint smears, no burns on passengers, and sudden loud sound on CVR.
12. Never interviewed by authorities although requested many times.
13. Typical response from NTSB to an inquiry and author's reply.

## **Glossary**

Acronyms  
References and Source Materials  
Definitions

## **Appendices:**

Appendix A: Boeing 747 Accidents  
Appendix B: Avianca Accident  
Appendix C: Comet Accidents  
Appendix D: DC-10 Accidents  
Appendix E: Boeing History  
Appendix F: Cargo Door Incidents  
Appendix G: Wiring  
Appendix H: Miscellaneous Accidents  
Appendix I: Questions  
Appendix J; Bruntingthorpe  
Appendix K: Weapon Firings  
Appendix L: AAIB 2/90  
Appendix M: NTSB 92/02  
Appendix N: NTSB TAGS database

## **Glossary:**

Acronyms and Abbreviations:

CASB, Canadian Aviation Safety Board, now TSB, Transportation Safety Board, of Canada  
UK AAIB, United Kingdom Air Accidents Investigation Branch, Farnborough, U.K  
NTSB USA, National Transportation Safety Board, United States of America  
CVR, cockpit voice recorder  
DFDR, digital flight data recorder  
ATC, air traffic control  
AAR, aircraft accident report  
MEC, main equipment compartment  
PSI, pounds per square inch  
FOD, foreign object damage  
IED, improvised explosive device  
KTS, knots  
TAS, true air speed  
IAS, indicated air speed  
AI, Air India  
PA, Pan Am World Airways  
UAL, United Airlines,  
TWA, Trans World Airlines  
JAL, Japan Air Lines  
NAVAVNSAFECEN, Naval Aviation Safety Center  
a.c. alternating current  
AC advisory circular  
AD airworthiness directive  
ALPA Air Line Pilots Association  
amp ampere  
AOA angle-of-attack

APU auxiliary power unit  
ARTCC air route traffic control center  
ASR airport surveillance radar  
ATC air traffic control  
ATP airline transport pilot  
CAM cockpit area microphone  
CFR Code of Federal Regulations  
c.g. center of gravity  
CVR cockpit voice recorder  
CWT center wing fuel tank  
d.c. direct current  
DNA deoxyribonucleic acid  
E/E electrical/electronics  
EME electromagnetic environment  
EMI electromagnetic interference  
EPR engine pressure ratio  
F Fahrenheit  
FAA Federal Aviation Administration  
FARs Federal Aviation Regulations  
FBI Federal Bureau of Investigation  
FDR flight data recorder  
FQIS fuel quantity indication system  
GPS global positioning system  
HF high frequency  
Hg mercury  
HIRF high-intensity radiated fields  
Hz hertz (cycles per second)  
JFK John F. Kennedy International Airport (New York, New York)  
MHz megahertz  
msl mean sea level  
NASA National Aeronautics and Space Administration  
NOAA National Oceanic and Atmospheric Administration  
NPRM notice of proposed rulemaking  
PETN pentaerythritol tetranitrate  
P/N part number  
psi (pressure expressed in) pounds per square inch  
P&W Pratt & Whitney  
RDX cyclotrimethylenetrinitramine  
SB service bulletin  
SDR service difficulty report  
SL service letter  
S/N serial number  
STA body station  
STC supplemental type certificate  
TWA Trans World Airlines, Inc.  
USAF U.S. Air Force  
USCG U.S. Coast Guard

Glossary from NTSB AAR 00/03 for Trans World Airlines Flight 800:

Air conditioning pack: An assembly of air conditioning system components that reduces the temperature and pressure of hot bleed air that is then routed to

pressurized areas of the cockpit, cabin, and cargo compartments to provide environmental control (pressurization, ventilation, and temperature). The bleed air source can be any one or a combination of the following: engines, auxiliary power unit (APU), or ground air connections.

**Air cycle machine (ACM):** An assembly in the air conditioning system that includes components such as a fan and compressor. When partially cooled air from the heat exchangers requires additional cooling, the air is routed through the ACM expansion turbine for maximum cooling.

**Alternating current (a.c.):** An electric current that periodically changes in direction and constantly changes in magnitude. **Ampere (amp):** The basic unit of measurement of electric current flow. **Arcing:** Arcing is defined by Underwriters Laboratories, Inc., as a luminous discharge of electricity across an insulating medium. The electrical discharge of an arc can involve temperatures of several thousand degrees Celsius. **Auto ignition:** Spontaneous ignition of a fuel/air vapor when it is sufficiently elevated in temperature for ignition to occur without direct contact with an ignition source, such as a spark, arc, or hot surface or filament. Auto ignition is highly dependent upon many factors, including the size of the heated volume and container and other environmental conditions that affect fuel vapor. Existing research indicates that the auto ignition temperature for Jet A fuel/air vapor at sea level is about 460 Fahrenheit (F). Auto ignition temperature increases as the altitude increases. **Ballistic coefficient:** The weight of an object divided by the product of its drag coefficient multiplied by its area, used to determine the motion of an object in an atmospheric environment.

**Bleed air:** The hot pressurized air ducted from an airplane's engines, APU, or a ground source for use by other airplane systems (such as pressurization and air conditioning).

**Body station (STA):** A longitudinal point along an airplane's fuselage, identified numerically by its distance in inches from a reference point. In a classic 747, this point is 90 inches forward of the airplane's nose. **Bomb:** (as used in this report) An explosive device designed to release destructive material at high velocity upon detonation, as distinguished from a small explosive charge. **Glossary of Terms 418 Aircraft Accident Report Bonding:** Connecting components to maintain them at a common electric potential.

**Boost pump:** (as used in this report) A pump mounted in the wing fuel tanks designed to move fuel from certain wing tanks to the engines. **Capacitance:** The property of conductors separated by a dielectric material (for example, air or fuel) that permits the storage of electricity when potential differences exist between conductors.

**Center wing fuel tank (CWT):** A fuel tank that, in the 747-100 series, is located in the wing center section (WCS), between the rear spar and spanwise beam (SWB) 3 and that has a Jet A fuel capacity of 86,363 pounds (12,890 gallons). (See wing center section.)

**Conductivity:** A measure of the extent to which a material is capable of conducting an electric current. (See ohm.) **Connector:** (as used in this report) A device that makes an in-line connection(s) between one or more wires for a continuous electrical path(s) at a location where the wires are subject to being disconnected and reconnected without mismatching circuits. Typical military-specification multicontact electrical connectors are assembled from two subassemblies, the plug and receptacle, which mate to connect wires with pin and socket contacts.

**Contact:** (as used in this report) A device within an electrical connector used to

provide the electrical path joining two individual wires. Coupling: Transferring energy between elements or circuits of an electrical system.

Current: The movement of electricity (the flow of electrons) through a conductor. Measured in amps.

Dielectric: A nonconductor of electricity. Direct current: An electric current that flows continuously in one direction. Dry bay: A compartment in the WCS that is not intended to contain fuel. In the 747-100, a dry bay is located between SWB3 and the forward spar. Electromagnetic environment (EME): The total of all electromagnetic fields and the associated frequencies, power levels, and polarizations in a given or defined region. The EME consists of natural and manufactured sources of electromagnetic energy. Electromagnetic interference: (as used in this report) Electromagnetic energy from a source either internal or external to an aircraft that imposes greater-than-intended voltage on an electrical system.

Glossary of Terms 419 Aircraft Accident Report Energy: The capacity for doing work. It may exist in potential, kinetic, thermal, electrical, chemical, nuclear, or other forms and be transformed from one form to another. Electromagnetic energy is expressed in units of work, such as joules (J) or kilowatt-hours. Explosion: (as used in this report) The sudden and rapid escape of gases from a confined space, accompanied by high temperatures, violent shock, and loud noise. Extremely improbable failure condition: As defined in Federal Aviation Administration Advisory Circular (AC) 25.1309-1A, a condition so unlikely that it is not anticipated to occur during the entire operational life of all airplanes of one type and that has a probability of occurrence on the order of  $1 \times 10^{-9}$  or less each flight hour, based on a flight of mean duration for the airplane type. Failure modes and effects analysis: A structured and systematic analytical method for identifying potential failure modes of a component or system and for evaluating the potential risk(s) that might be posed by various failure modes. Fault tree analysis: An analysis designed to examine an end event through consideration of assumed precipitating events. Each of these precipitating events is in turn broken down until a level is attained in which no additional precipitating events will occur. The total of all of the events and the way in which they are tied together creates the fault tree analysis.

Fireball: (as defined by the TWA flight 800 investigations' Witness Group) One or more downward-moving ball(s) of fire in the sky. According to the Witness Groups definition, it could be characterized (by witnesses) as either stationary or descending; however, to meet the groups definition of a fireball, it must not have been reported to have appeared in the sky after the termination of a streak of light (if such a streak were reported). It could not have been an ascending object or an object that met the groups definition of a streak of light.

Flash point: The minimum temperature at sea level at which a liquid fuel vaporizes sufficiently to form an ignitable mixture with air (when exposed to an open flame), as determined by a standardized test procedure. Flashing: (as used in this report) A category of electrical activity observed during short-circuit tests conducted by Lectromechanical Design Company (Lectromec) as a part of the TWA flight 800 accident investigation, characterized by an arcing discharge seen as a single flash of light with an accompanying popping sound. Fuel mass loading: A measure of the amount of fuel relative to the entire volume of its container.

Fuel quantity indication system (FQIS): In the 747-100, a system that measures changes in the capacitance of tubular probes located in each fuel tank for the display of fuel quantity on cockpit gauges and on repeater gauges located at the fueling station in the left wing. The system is also connected to systems that require fuel quantity information, Glossary of Terms 420 Aircraft Accident Report including the



gross weight/total fuel weight indicator, airborne integrated data acquisition, and the volumetric shutoff ([VSO] ground refueling) systems. Fuel quantity compensator: A component used in the FQIS or VSO system to compensate for variations in the dielectric constant of fuel, which varies from one type of fuel to another (and even within the same type of fuel, depending on the batch and age of the fuel) to ensure consistent fuel quantity indications. There is at least one compensator in each fuel tank.

Fuel quantity probe: A component of the FQIS, a set of which is positioned in each of an airplane's fuel tanks, used to measure the quantity of fuel in each tank through a range of levels within the tank. The 747-100 may have 65 or more fuel quantity probes positioned within the 7 fuel tanks.

Fuel washing: Motion of fuel over a part, which can lead to electrostatic charge accumulation or removal of contaminants (such as sulfides). Green zone: One of three debris fields, labeled during the TWA flight 800 accident investigation, from which the accident airplane's wreckage was recovered. This zone was located farthest east (farthest from John F. Kennedy International Airport [JFK]) in the wreckage distribution. This zone contained pieces of wreckage from both wings and most of the aft portions of the fuselage, including the following: both wings; all four engines; pieces of SWB1, SWB2, mid spar, and rear spar; the aft portion of the keel beam; the main landing gear; and the tail section. Grounding: Connecting electrical circuits to a large common conductor considered to be at zero electrical potential such as the earth or, in the case of an airplane, the skin of the airplane, which is at a fixed electrical potential. Heat exchangers: (as used in this report) Devices in the 747-100 used to initially cool the heated bleed air coming from the engines located within the air conditioning pack bay under the CWT.

High-intensity radiated fields: High-power electromagnetic fields that exist in a defined environment, particularly in the vicinity of high-power radar sites, broadcast antennas, and other high-power radio frequency sources. Hot surface ignition: A phenomenon in which a very high temperature surface comes into contact with fuel or fuel vapor that results in ignition. Hot surface ignition is highly dependent upon many factors, including the geometric aspects of the hot surface and other environmental conditions that affect fuel and fuel vapor. Existing research indicates that hot surface ignition temperatures at sea level for fuels similar to Jet A range from 900 to 1,300 F. The hot surface ignition temperature increases as the altitude increases.

Glossary of Terms 421 Aircraft Accident Report Ignition energy: The quantity of heat or electrical energy that must be absorbed by a fuel/air vapor mixture in a finite volume to generate a propagating flame. Commonly measured as the energy provided by a small (millimeter size) spark. Impeller: A blade on a rotating part in an air compressor or fuel pump. Improbable failure condition: As defined in AC 25.1309-1A, a condition not anticipated to occur during the entire operational life of a single random airplane; however, it may occur occasionally during the entire operational life of all airplanes of one type. It has the probability of occurrence on the order of  $1 \times 10^{-5}$  or less, but greater than on the order of  $1 \times 10^{-9}$  each flight hour, based on a flight of mean duration for the airplane type.

Jet A fuel: A kerosene fuel used in civilian turbine engine airplanes. Jet A fuel is composed of a mixture of more than 100 distinct types of hydrocarbon molecules; the precise composition often varies between refinery and by season. Jet A fuel is specified to have a minimum flash point of 100 F. Jet A-1 is a similar fuel, but has a slightly lower freezing point. Although Jet A fuel is available in some other countries, it is used primarily in the United States.

**Jettison/override pump:** In the 747, a fuel pump that has two uses, one of which is to jettison fuel overboard when this function is selected at the flight engineering station. The pump is also designed to provide fuel to the engine manifolds at a higher pressure than the boost pumps, which are located in the wing fuel tanks. Two CWT jettison/override pumps are mounted on the rear spar of the CWT, and pressure from these pumps closes the main tank check valves, resulting in the use of fuel from the CWT before that of fuel from the wing tanks.

**Joule (J):** A unit of measurement of electrical work or energy; 1 J is the amount of work done by 1 watt of power in 1 second. **Keel beam:** A box-shaped, load-bearing structure located along the airplane's centerline that extends from the aft wall of the forward cargo compartment below the WCS and through the main and body landing gear compartments to the forward wall of the aft cargo compartment. The CWT is located above the keel beam. **Kilojoule (kJ):** A unit of measurement equaling 1,000 J. **Lower flammability limit:** The lowest temperature that will provide a sufficient concentration of fuel vapor to propagate a flame. **Millijoule (mJ):** A unit of measurement equaling one-thousandth of a J. **Minimum ignition energy (MIE):** The minimum quantity of heat or electrical energy that must be absorbed by an optimal fuel/air vapor mixture in a finite volume to generate a propagating flame. The MIE for Jet A fuel is generally accepted to be about 0.25 mJ.

**Glossary of Terms 422 Aircraft Accident Report Ohm:** The unit of resistance of an electrical conductor, at which the fall of potential is 1 volt when the current is 1 amp. (See resistance.) **Overpressure event:** (as used in this report) An event in which the pressure in the CWT is increased in a relatively short time to a level at which the structural integrity of the CWT is compromised.

**Power:** The time rate of energy transfer; the practical unit of measurement is 1 watt. (See watt.)

**Primary radar target:** A radar target produced when a radar signal reflects off of an objects surface and returns to a ground-based radar antenna/site for processing and display.

**Quenching:** The extinguishment of a combustion flamefront; often as a result of decreased temperature or propagation through a passageway, such as an orifice or a vent. **Raceway:** A term used to refer to areas within the 747 where wire bundles are grouped into a common route.

**Red zone:** One of three debris fields, labeled during the TWA flight 800 accident investigation, from which the accident airplane's wreckage was recovered. This zone was located farthest west (closest to JFK) in the wreckage distribution. A relatively small amount of widely dispersed debris was recovered from the red zone, including the following: pieces from the WCS front spar and SWB3, the manufacturing access door from SWB2, pieces of the fuselage from STA 840 and STA 1000, main cabin floor beams and flooring material from above and in front of the WCS area, and the two forward air conditioning packs. (See figure 3a.)

**Resistance:** The property of a conductor that tends to restrict the flow of an electric current. (See ohm.)

**Ring chord:** An angle member that attaches the bottom of the forward fuselage section to the front side of the lower pressure bulkhead and the front spar.

**Scavenge pump:** (as used in this report) A small fuel pump designed to remove the last amounts of accessible fuel from the lowest point of a 747 CWT and discharge the fuel into the left inboard fuel tank. Although the scavenge pump removes fuel not accessible by the jettison/override pumps, a small amount of residual fuel will remain in the fuel tank that the scavenge pump is not able to remove. **Scintillation:**

(as used in this report) A category of electrical activity observed during short-circuit tests conducted by Lectromec as a part of the TWA flight 800 accident investigation, characterized by a high frequency micro-discharge that usually results in the formation of char or soot on a wire (and adjacent wires) over time. Glossary of Terms 423 Aircraft Accident Report Secondary radar target: A radar target produced when a radar signal is detected by an airplane's transponder, which transmits a coded message in response to interrogation by a ground-based transmitter.

Shielding: (as used in this report) Metal covers placed around electric wires and electronic devices to prevent the intrusion of external electrostatic and electromagnetic fields.

Short circuit: An unintended current path between conductors. Short circuits can occur either directly, if the protective insulation covering between internal conductors in each wire is compromised and there is direct contact between the conductors, or through a bridge created by contaminants, such as metal shavings or fluid. Sleeve (wire): A woven or flexible jacket that protects electrical wiring. Small explosive charge: A minimal amount of a highly explosive material (such as a plastic explosive) detonated by a fusing device. Spanwise beam 1: One of the lateral beams in the CWT that divides it into compartments and supports the structure of the WCS. SWB1 is located between the mid and rear spars.

Spanwise beam 2: One of the lateral beams in the CWT that divides it into compartments and supports the structure of the WCS. SWB2 is located between the mid spar and SWB3.

Spanwise beam 3: One of the lateral beams in the CWT that divides it into compartments and supports the structure of the WCS. SWB3 is located between SWB2 and the front spar.

Spar: A beam that extends laterally through the WCS into the outboard wing structure. The 747-100 has front, mid, and rear spars. Splice (wire): (as used in this report) A fixed connection of two electrical wires. Splices can be made by various methods, such as soldering wires together or with crimped metal barrels, and are typically covered by insulating material. Streak of light: (as defined by the TWA flight 800 investigations' Witness Group) An object moving in the sky that could be variously described in witness documents as a point of light, fireworks, a flare, a shooting star, or something similar, which was usually described as ascending, but could also be described as arcing over and/or descending. Streak-of-light witness: (as defined by the TWA flight 800 investigations' Witness Group)

Any witness who reported seeing an airplane in the general vicinity of a streak of light at the same time that the streak of light was visible (around the time and vicinity of the TWA flight 800 accident). (See witness.) Glossary of Terms 424 Aircraft Accident Report Stringer: A stiffening member found in the 747-100s fuselage and wings that helps to support and reinforce the structure. Strong arcing: (as used in this report) A category of electrical activity observed during short-circuit tests conducted by Lectromec as a part of the TWA flight 800 accident investigation, characterized by an arcing discharge that could continue for hundreds of cycles, typically involving 5 kJ of electrical energy. Surge tank protection system: A system to detect and extinguish fire that consists of a series of optical photocells that trigger the discharge of Halon (a fire extinguishing agent) into the surge tank when a flame or bright light source is sensed in the surge tank. Discharge of the extinguishing agent is designed to occur about 1 millisecond after the photocell senses a flame. Transient suppression device: An electrical device that limits the amount of energy or current that can pass through it to a

predetermined amount. Transient voltage: A temporary voltage surge or excursion; for example, that which occurs when first turning an electrical system on. Transponder: The airborne receiver/transmitter portion of a radar system that responds to interrogation signals received from ground-based equipment. Ullage: The space in a fuel containing tank not occupied by liquid fuel. Upper flammability limit: The maximum temperature at which a concentration of fuel vapor will propagate a flame.

Volt: The basic unit of measurement of electromotive force (the force that causes electrons to flow through a conductor). One volt is the electromotive force required to cause current to flow at the rate of 1 amp through a resistance of 1 ohm. One volt equals 1 amp times 1 ohm.

Watt: The basic unit of measurement of power. In electrical application, 1 watt equals 1 volt times 1 amp. (See power.)

Weathering: The change in a liquid fuel chemical composition as a result of exposure to environmental conditions. An example involves heating and pressure changes to a vented aircraft fuel tank, where preferential evaporation of the lower molecular weight components of the jet fuel occurs, resulting in a redistribution of the chemical composition of the remaining liquid fuel. Wing center section: A large structural box located aft of the forward cargo compartment and forward of the main landing gear bay in the lower fuselage between the wings, which comprises the CWT and a dry bay directly forward of the CWT. (See center wing fuel tank.)

Glossary of Terms 425 Aircraft Accident Report Witness: (as defined by the TWA flight 800 investigations' Witness Group) Anyone who reported hearing a sound and/or seeing an event or object or objects (including smoke or fire) in the sky around the time and vicinity of the TWA flight 800 accident. According to the Witness Groups definition, it must have been likely that the sound or object observed was related to the crash, and the report must not have been a secondhand account.

Yellow zone: One of three debris fields, labeled during the TWA flight 800 accident investigation, from which the accident airplane's wreckage was recovered. This zone was the smallest of the three zones and was contained within the red zone on its northeastern side and located in a small concentrated area. This zone contained wreckage from the forward portion of the fuselage, from STA 90 (the nose of the airplane) to STA 840, including the cockpit, section 41, and the forward portions of section 42. (See figure 3a.) This wreckage was found relatively intact.

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NTSB AAR 90/01 UAL Flight 811, 23 February 1989, Boeing 747  
NTSB AAR 92/02 UAL Flight 811, 23 February 1989, Boeing 747  
NTSB AAR 00/03 TWA Flight 800, 17 July 1996, Boeing 747  
NTSB AAR 93/06, JAL Flight 46E, 31 March, 1993, Boeing 747

## **Definitions: Definitions as used in this report:**

**Bomb:** 'Bomb' may mean an explosive device designed to release destructive material at high velocity upon detonation; an explosive device placed in an aircraft with an intent to detonate.

**Cargo Door:** In the Boeing 747 both the forward and aft lower cargo doors are similar in appearance and operation. They are located on the lower starboard side of the fuselage and are outward opening and nonplug. The door opening is approximately 110 inches wide by 99 inches high, as measured along the fuselage.

**Cargo Compartments:** The forward and aft freight holds are used for the storage of cargo and baggage in standard air-transportable containers. The forward freight compartment has a length of approximately 40 feet and a depth of approximately 6 feet. The containers are loaded into the forward hold through a large cargo door on the starboard side of the aircraft.

**Conclusion of fact:** An inference drawn from the subordinate or evidentiary facts.

**Conclusive evidence:** That which is incontrovertible, either because the law does not permit it to be contradicted, or because it is so strong and convincing as to overbear all proof to the contrary and establish the proposition in question beyond reasonable doubt.

**Ear Barotrauma:** Injury to the tympanic membrane (eardrum) when a sudden pressure differential exists between the middle ear cavity and the external ear.

**Evidence:** A species of proof, or probative matter, legally presented at the trial of an issue, by the act of the parties and through the medium of witnesses, records, documents, exhibits, concrete objects, etc., for the purpose of inducing belief in the minds of the court or jury as to their contention.

**Circumstantial Evidence:** The proof of various facts or circumstances which usually attend the main fact in dispute, and therefore tend to prove its existence, or to sustain, by their consistency, the hypothesis claimed. Testimony not based on actual personal knowledge or observation of the facts in controversy, but of other facts from which deductions are drawn, showing indirectly the facts sought to be proved. Evidence of facts or circumstances from which the existence or nonexistence of fact in issue may be inferred. Inferences drawn from facts proved.

**Direct Evidence:** Evidence in the form of testimony from a witness who actually saw, heard, or touched the subject of questioning.

**Tangible Evidence:** Evidence which consists of something that can be seen or touched. In contrast to testimonial evidence, tangible evidence is real evidence.

**Expert:** One who is knowledgeable in a specialized field, that knowledge being obtained from either education or personal experience. One who by reason of education or special experience has knowledge respecting a subject matter about which persons having no particular training are incapable of forming an accurate opinion or making a correct deduction.

**Expert Testimony:** Opinion evidence of some person who possesses special skill or knowledge in some science, profession, or business which is not common to the average man and which is possessed by the expert by reason of his special study or experience.

**Expert Witness:** One who by reason of education or specialized experience possesses superior knowledge respecting a subject about which persons have no particular training are incapable of forming an accurate opinion, or deducing correct conclusions. One possessing, with reference to particular subject, knowledge not acquired by ordinary persons.

**Explosion:** To burst or cause to burst violently and noisily. The sudden and rapid escape of gases from a confined space, accompanied by high temperatures, violent shock, and loud noise.

**Explosive Decompression:** Explosive decompression is an aviation term used to mean a sudden and rapid loss of cabin pressurization of higher internal air pressure venting outside to the lower pressure air.

**Finding:** The result of the deliberations of a jury or a court. A decision upon a question of fact reached as the result of a judicial examination or investigation by a court, jury, referee, coroner, etc. A recital of the facts found.

**Outward Opening Nonplug:** A type of cargo door which undergoes stress to open in flight under a high pressure differential because it opens outward and the door does not 'plug up' or 'block' the opening.

**Premise:** A statement of fact or a supposition made or implied as a basis of argument.

**Reasonable doubt:** The standard used to determine the guilt of innocence of a person criminally charged. Reasonable doubt which will justify acquittal is doubt based on reason and arising from evidence or lack of evidence, and it is doubt which a reasonable man or woman might entertain, and it is not fanciful doubt, is not imagined doubt, and is not doubt that juror might conjure up to avoid performing an unpleasant task or duty. Reasonable doubt is such a doubt as would cause prudent men to hesitate before acting in matters of importance to themselves. Doubt based on reasons which arise from evidence or lack of evidence.

**Starboard Side:** The right side of the fuselage looking from aft to forward. The port side is the left side looking aft to forward. The starboard side of the aircraft faces the viewer when the nose is to the right. Both cargo doors are on the starboard side of the Boeing 747.

**Shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup explanation:** Mechanical explanation for the inflight breakup of Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 as caused by an explosion in the forward cargo compartment of explosive decompression when the forward cargo door ruptures open in flight, probably at one or both of the midspan latches and probably caused by faulty wiring inadvertently turning on the door unlatch motor.

## **Introduction:**

This Smith AAR has been created by an independent aircraft accident investigator who has no affiliation with the manufacturer, law enforcement agencies, attorney, airlines, or victim's families. Much of the text is quoted verbatim from official government documents. The primary documents are NTSB Aircraft Accident Report AAR 00/03 and the NTSB Public Docket SA-516.

This Smith AAR has the benefit of hindsight with the ability to review and analyze dozens of subsequent Boeing 747 accidents as well as evaluating previous accidents of other types. There also exists an early model Boeing 747, United Airlines Flight 811, that suffered an explosion of explosive decompression in a cargo compartment which left much evidence. This AAR shall compare the evidence of Trans World Airlines Flight 800 to that of the other other three explosive events to identify which of the three is most closely matched, the bomb explosion, the center fuel tank explosion, or the ruptured open cargo door explosive decompression explosion.

## **1. Factual Information**

1.1 History of the Flight On July 17, 1996, about 2019, TWA flight 800 took off from John F. Kennedy International Airport (JFK), New York, New York, destined for Charles DeGaulle International Airport, Paris, France. The airplane climbed over the Atlantic Ocean without incident and leveled off at its assigned altitude of 13,000 feet about 2027. At 2030:18, in response to an air traffic control (ATC) instruction to climb to 15,000 feet, the flight crew increased the airplane is engine thrust. The airplane was ascending through 13,760 feet at 2031:12 when both the cockpit voice recorder (CVR) and the flight data recorder ceased recording without warning.

## **2. Premise Explanations for Trans World Airlines Flight 800**

The NTSB report conclusion is interpreted to mean the center wing fuel tank spontaneously

exploded and blew Trans World Airlines Flight 800 out of the sky. That interpretation may not be correct as there are alternatives based on previous similar accidents such as United Airlines Flight 811. An alternative probable cause to Trans World Airlines Flight 800 must be considered if the alternative were:

1. Plausible.
2. Reasonable.
3. Well documented by official investigative reports.
4. Has close precedent.
5. Reveals current hazard.

There is one solid conclusion and four reasonable explanations for the probable cause for Trans World Airlines Flight 800 based upon subsequent similar fatal inflight accidents to early model Boeing 747s:

- 2.1. Explosion in flight in or near the forward cargo compartment leading to inflight breakup as an initial event and is a solid conclusion. The cause of that explosion is to be determined.
- 2.2. Missile strike. (Brought up by Trans World Airlines Flight 800.)
- 2.3. Center wing fuel tank explosion with undetermined ignition source. (Brought up by Trans World Airlines Flight 800.)
- 2.4. Shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup. (Brought up by United Airlines Flight 811.)
- 2.5. Explosion in flight from a bomb in the forward cargo compartment. (Brought up by Air India Flight 182, Pan Am Flight 103, Trans World Airlines Flight 800, and United Airlines Flight 811.)

**2.1 Premise:** Explosion in flight in or near the forward cargo compartment leading to inflight breakup.

2.1.2 Discussion: The unanimous conclusion by authorities of a sudden inflight breakup implies an explosion of explosive decompression since the hull of Trans World Airlines Flight 800 was pressurized at approximately 3.5 pounds per square inch differential between inside and outside air at 13,700 feet above mean sea level. Explosive decompression is a symptom of a sudden hull breakup, not the cause. If the hull is not compromised by a break, hole, or tear in it, decompression does not occur. Any break of substantial size in that highly pressurized hull, for reasons such as a bomb explosion, a midair collision, or an inadvertently opened cargo door, would be sufficient to cause an explosive decompression and subsequent partial or full inflight breakup. Inflight breakups can be caused by an explosive decompression which can be caused by a 'bomb' explosion, or structural failure, or an inadvertent door opening. All bomb explosions, all structural failures, and all inadvertent door openings do not cause inflight breakups; in fact, many aircraft have suffered those events and landed safely. On the other hand, any one of those events has the potential to cause an inflight breakup and have done so in the past, depending on the sizes of the bomb, the skin tear, or the open door.

When a catastrophic event occurs, such as an explosion of a bomb or a large door opening in flight, much evidence is left behind for investigators to recover, examine, and evaluate specific to that cause. All explosions of any kind leave certain similar evidence regardless of the cause of the explosion. Evidence of an explosion does not imply a 'bomb' nor an explosive decompression

from any source. Even when there is a single piece of tangible evidence that indicates a specific type of explosion such as a bomb, structural failure, or an inadvertent door opening, other corroborative evidence is required to sustain the conclusion of the type of explosion since all types of explosions can cause similar evidence and explosive decompressions from any source can mimic a bomb explosion and vice versa.

The evidence which shows there was an explosion in or near the forward cargo compartment can be summed up by the following evidence.

- A. Inflight breakup just forward of the wing causing damage to right wing leading edge and engines.
- B. Debris pattern showing nose came off the aircraft in flight.
- C. Suddenness of event.
- D. Sudden loud sound on the CVR.
- E. Abrupt power cut to the FDR.
- F. First pieces to leave aircraft were from area just forward of the wing.
- G. Trajectory pattern shows explosion in or near forward cargo compartment.
- H. Outwardly peeled skin in forward cargo compartment area.

There is now revealed a new structural weakness in the forward cargo compartment for Boeing 747s and by implication all pressurized jets with large outward opening nonplug cargo doors.

For the Boeing 747: The four eight foot vertical slices in the fuselage skin for the sides of the forward and aft cargo doors are held in place by only one latch in each side. Each eight foot vertical slice has one midspan latch to hold four feet closed on each side of it. The midspan latch has no locking sector on the latching cam to prevent inadvertent back driving in flight. All of the eight bottom latches on each door, for a total of sixteen latches, have locking sectors. The four midspan latches for the two cargo doors have none. The weakness is at the midspan latches and the absence of locking sectors. One latch with no locking sector for eight feet of fuselage slice is not enough. The aft or forward or both midspan latches ruptures open in flight and causes the tell tale peeled back and down skin from the latch such as in Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 and apparently Air India Flight 182.

There are many ways for an explosion to occur in or near the forward cargo compartment at the forward cargo door: (Current official opinion in parentheses)

- A. Bomb explosion. (Partially accepted for two flights, ruled out for two flights.)
- B. Crew or passenger error. (Ruled out for all flights.)
- C. Electrical fault in switch or wiring. (Accepted for two flights, ruled out for two flights.)
- D. Pneumatic overpressure. (Ruled out for all flights.)
- E. Cargo shift. (Ruled out for all flights.)
- F. Compressed air tank explosion. (Ruled out for all flights.)
- G. Fire in compartment. (Ruled out for all flights.)
- H. Missile strike. (Ruled out for all flights.)
- I. Midair collision. (Ruled out for all flights.)
- J. Fuel tank explosion. (Accepted for one flight, ruled out for three flights.)
- K. Stowaway. (Ruled out for all flights.)
- L. Electromagnetic interference. (Ruled out for all flights.)
- M. Comet or meteor. (Ruled out for all flights.)
- N. Space debris. (Ruled out for all flights.)
- O. Turbulence. (Ruled out for all flights.)
- P. Out of rig door. (Ruled out for all flights.)



- Q. Lightning. (Ruled out for all flights.)
- R. Metal fatigue. (Ruled out for all flights.)
- S. Improperly latched. (Initially accepted for one flight, then ruled out for all flights.)
- T. Design error. (Accepted for one flight, ruled out for three flights.)
- U. Repair error. (Ruled out for all flights.)
- V. Maintenance error. (Accepted for one flight, ruled out for three flights.)
- W. Collision with terrain. (Ruled out for all flights.)

Of the twenty three ways to cause an explosive decompression in or near the forward cargo compartment in flight, only five are reasonable for Trans World Airlines Flight 800 based on precedent and other evidence.

1. Missile strike. (Brought up by Trans World Airlines Flight 800.)
2. Center fuel tank explosion with undetermined ignition source. (Brought up by Trans World Airlines Flight 800.)
3. Shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup. (Brought up by United Airlines Flight 811.)
4. Bomb. (Brought up by Air India Flight 182 and Pan Am Flight 103 and Trans World Airlines Flight 800 and United Airlines Flight 811.)
5. Rather large shotgun. (Brought up by Pan Am Flight 103.)

2.1.3 Conclusion: There was an explosion in or near the forward cargo compartment which caused an explosive decompression that led the the inflight breakup of Trans World Airlines Flight 800.

**2.2.1 Premise:** Surface-to-air or air-to-air missile strike inflight:

2.2.2. Discussion: A missile could have struck the aircraft in flight. Only a hit in the forward cargo compartment would have caused the abrupt power cut to the recorders and the sudden loud sound in addition to all the other evidence of inflight damage to the airframe forward of the wing. There is no corroborative evidence that a missile struck Trans World Airlines Flight 800. There were no military planes nearby nor reports of missing missiles, there were no reports of missile sightings at event time, there is no wreckage evidence of residue, missile casing, pitting, or cratering which follows a high explosive detonation, and there was no missile explosion sound on the CVR.

Page 257 to page 259 of NTSB AAR 00/03 for Trans World Airlines Flight 800: '2.2.1.2 Consideration of a High-Energy Explosive Device Detonation (Bomb or Missile Warhead) Several factors led to speculation that the accident might have been caused by a bomb or missile strike. These factors included heightened safety and security concerns because of the 1996 Olympics then being held in the United States, the fact that TWA flight 800 was an international flight, and the sudden and catastrophic nature of the in-flight breakup. In addition, numerous witnesses to the accident reported seeing a streak of light and then a fireball, which some people believed represented a missile destroying the airplane. Further, some anomalous primary radar targets were recorded by the Islip, New York, radar site in the general vicinity of TWA flight 800 at the time of the accident that apparently could not be explained. Accordingly, the Safety Board considered the possibility that a bomb exploded inside the airplane or that a missile warhead from a shoulder-launched missile exploded upon impact with the airplane. Testing performed by the Federal Bureau of Investigation (FBI) found trace amounts of explosives on three

separate pieces of airplane wreckage (described by the FBI as a piece of canvaslike material and two pieces of floor panel). However, none of the damage characteristics typically associated with a high-energy explosion of a bomb or missile warhead (such as severe pitting, cratering, petalling, or hot gas washing) were found on any portion of the recovered airplane structure, including the pieces on which the trace amounts of explosives were found. Only about 5 percent of the airplane's fuselage was not recovered, and none of the areas of missing fuselage were large enough to have encompassed all of the damage that would have been caused by the detonation of a bomb or missile. Although several large holes are visible in the reconstructed portion of the airplane fuselage, almost all of the structure that originally filled in these holes is attached to the remaining structure but is folded either inward or outward. No area of structure in the reconstructed portion of the airplane contained any unexplained holes large enough to represent the entry point of a missile. Further, the victims remains showed no evidence of injuries that could have been caused by high-energy explosives, nor was there any damage to the airplane seats and other interior components consistent with a high-energy explosion. Investigators considered several scenarios to determine how the trace amounts of explosive residue might have gotten on the wreckage from the accident airplane. Trace amounts of explosive residue could have been transferred to the contaminated pieces from the military personnel (and their associated clothing, boots, and equipment) that were on board the accident airplane when it was used to transport troops during the Gulf War in 1991. In addition, explosives were placed and then removed from several locations in the accident airplane during a dog-training explosive detection exercise about 1 month before the accident. Despite being unable to determine the exact source of the trace amounts of explosive residue found on the wreckage, the lack of any corroborating evidence associated with a high-energy explosion indicates that these trace amounts did not result from the detonation of a high-energy explosive device on TWA flight 800. Accordingly, the Safety Board concludes that the in-flight breakup of TWA flight 800 was not initiated by a bomb or a missile strike.”

2.2.3 Conclusion: Based upon lack of corroborative evidence, a missile strike as a probable cause for Trans World Airlines Flight 800 may be ruled out.

**2.3.1 Premise:** CWT fire/explosion with undetermined ignition source as the initial event:

2.3.2 Discussion: The evidence shows that there was a fire and/or an explosion in the center wing fuel tank of Trans World Airlines Flight 800. However, the explosion of the CWT was not the initial event. The fire/explosion was a secondary symptom, not a probable cause of the eventual destruction.

NTSB documentation of CWT fire/explosion below:

Public Docket SA-516, Exhibit 20A  
Fire and Explosion Group Factual Report

Details of the Investigation: Extensive fire damage is limited to a few specific areas of the airplane. Fire damage was found on components in the center wing tank; floor beams and some of the seats above and just aft of the center wing tank; part of the fuselage over the right wing; parts of the right wing including the wing front spar; and parts of the left wing just outboard of the number 1 engine. Sooting of the

fuselage aft of the front spar was generally limited to the external skin of the aircraft. However, there was heavy sooting on the aft (broken near the midspar) section of the keel beam. The forward section of the keel beam shows little sooting.

The wreckage showed evidence of an over-pressurization (explosion) in the center wing tank. Evidence of a center wing tank explosion occurring early in the accident sequence is supported by the combination of fire/sooting/structural deformation patterns along with location of parts found in the first debris field. These parts included center wing tank pieces, parts mounted underneath the center wing tank, and fuselage parts just forward of the front spar, all found along the first part of the debris path. Reconstruction of the recovered pieces of the center wing tank was initiated to provide a better picture of how the damage to the various pieces was interrelated. As additional pieces were recovered during the investigation, they were fitted into the reconstruction.

Various potential ignition sources have been considered for the center wing tank explosion. These include mechanical/electrical, a pre-existing fire below the CWT, a bomb, and a missile. Inspection of the lower surface of the CWT, the keel beam, and the air cycle machines has shown no evidence of a pre-existing fire below the CWT. No evidence of a bomb or a missile has been found on the hardware of the center wing tank or surrounding area. No ignition source has been confirmed by the Fire/Explosion Group. Ignition sources that are being explored include the electrical fuel gauging system, electrical power to the fuel pumps, static electric charge/discharge, and other systems.

Pieces of the tank that were found in the first debris field below the flight path of TWA 800 show little if any fire or soot damage. These include the majority of the parts from the front spar and spanwise beam #3, and the manufacturing access panel from spanwise beam #2. No other pieces of spanwise beam #2 were found in the first debris field. The majority of parts from the front spar and spanwise beam #3 are free of fire/sooting damage. Most pieces of spanwise beam #2 were extensively fire damaged, 1 BL 0 is Buttock line 0 which represents the centerline of the airplane running fore and aft with small areas of melted aluminum at various locations. However, the manufacturing access panel (CW703, Tag 490) in spanwise beam #2 was found in the first debris field and is almost free of any fire damage or sooting.

Large pieces of the fuselage immediately forward of the front spar are also free of fire/sooting and were found in the first debris field. Main cabin floor beams and flooring material (composite fiberglass) were also found in the first debris field and are free of fire/soot damage. The two air cycle machines (ACM) located under the forward part of the center wing tank to the right and left of the keel beam were recovered from the first debris field. These ACMs did not show any heat damage, and the turbine sections were intact.

The two most forward large pieces of upper skin of the center wing tank are free of fire damage (see diagram 1 and 2). The upper surface of these two pieces is clean of sooting. The lower surface is moderately sooted forward of spanwise beam #3 and outboard of RBL 75. These pieces are fractured at approximately spanwise beam #2. The large upper right skin piece is extensively bowed upward to the right of center. The left piece is also deformed. The upper skin pieces on the right side,

immediately aft of the forward piece, are heavily sooted including the fracture surfaces. The sooting patterns on the upper and lower skin pieces of the center wing tank are shown in diagrams 1 through 4. A large piece of the right fuselage with attached upper tank skin and upper surface of the right wing is heavily sooted. The fuselage section of this piece exhibits evidence of melting aluminum and broomstrawing.

A large center piece of the rear spar is heat damaged and sooted heavily. The sooting is on the outside and inside surfaces of this center piece. The pieces of the rear spar on both sides of this center piece are only lightly sooted.

The keel beam was broken between the midspar and spanwise beam number 1. The forward piece is relatively clean with some sooting just forward of the trim air tube that passes through the keel beam at approximately station 1125. The fracture surfaces on this section of the keel beam are free of soot. The aft section of the keel beam is heavily sooted including the fracture surfaces.

No seats forward of the center wing tank (forward of front spar) showed fire damage. Some fire damage was noted on seats aft of the rear spar. No passengers showed inhalation fire damage or serious external burns.

Based on the fire damage and soot deposits, a fire occurred after the explosion in this tank. An ignition source for this explosion, has not as yet been identified. No evidence of electrical arcing or other mechanical failure signature has been noted on the hardware.”

Public Docket SA-516, Exhibit 8A, Powerplants, Page 11, paragraph 3, discussing results of engine 3 disassembly, "Of the 46 fan blades in the fan rotor, 21 blades with complete or partial airfoils and 6 root sections were recovered. All of the fan blades had sooting on the convex airfoil surfaces. Most of the full length airfoils were bent rearward and the tips outboard of the outer midspan shroud were bent forward slightly. About half of the fan blades had impact damage to the leading and trailing edges. Almost all of the impact damage to the airfoils could be matched to contact with the midspan shroud on an adjacent blade. One full length blade had four soft body impacts along the leading edge and a partial airfoil had a soft body impact, which had some streaking extending rearward."

Public Docket Number SA-516, Exhibit No. 22A, Trajectory Study, page 3: The wreckage distribution shows that parts were initially shed from the area just forward of the wing. This was followed by the separation of the forward fuselage. This study concentrated on items in the red field, the first ground search area along the flight path. This corresponded to items shed between the initial event and the separation of the forward fuselage.

As will be seen, the trajectory study shows that the red zone pieces departed the aircraft in the first few seconds after the initial event.

Using the last FDR speed and pitch angle, it is possible to roughly calculate the time from the initial event to the nose separation. However, because of the large uncertainty, this time ranges from 3.9 seconds to 7.5 seconds.

From Public Docket SA-516, Exhibit 7A Structures

Fuselage The fuselage of the airplane was severely fragmented and recovered predominantly from the three debris fields. (Some parts were recovered outside these established debris fields during the trawling operation.) The Red debris field contained fuselage pieces from an area just forward of the center wing tank. Generally, these pieces were from the circumference of the fuselage between fuselage station (STA) 840 and 1000; all of the pieces in this area of the fuselage have not been accounted for. The Yellow debris field contained fuselage sections generally forward of STA 840. The Green debris field contained fuselage sections generally aft of STA 1000.

Below pictures are from NTSB Exhibit 17 D of Public Docket SA 516 and show the left front and the right front of the plane.



**The left front of the reconstruction at LF4**

Nose to left.



Right front of the plane

Nose to right.



Right front and middle of Trans World Airlines Flight 800 revealing sharp sooted and non sooted cut in fuselage, nose to right.

Analysis of the above NTSB documentation:

A CWT fire/explosion needs three things to occur, fuel, air, and ignition source. Without any one



of those three, there can be no conclusion as to when or where the event occurred. As a secondary event after the forward cargo door ruptured open an ignition source for the fire was present. As an initial event of CWT fire/explosion the ignition source for the fire was absent and undetermined even after an extensive search.

A CWT fire/explosion would give sooting on the entire tank, seats above it, burns on passengers, and soot on the pieces of wreckage which left the aircraft first. That was not so. A CWT fire/explosion after the forward section of the aircraft had broken away would give no sooting on the departed section and leave soot on the remaining sections. That was so.

A CWT fire/explosion as the initial event would not give the clean cut of sooted outside fuselage skin and the sooted section as can be seen by the photographs of the wreckage reconstruction.

A CWT fire/explosion would be spherical, not directed, and would produce equal damage on both sides of the fuselage of TWA 800. However, the wreckage reconstruction shows smooth skin with little damage forward of the wing on the port/left side yet severe, shattered, torn, and frayed damage on the starboard/right side of the fuselage in the cargo door area. A CWT fire/explosion would not cause unilateral damage on starboard side only, as can be seen.

A CWT fire/explosion would give equal damage to engines number two and three; however, only engine number three revealed any unusual inflight damage of missing turbine blades, sooting, and soft body impacts.

A CWT fire/explosion as the initial event would cause the first pieces to depart the aircraft to come from aft of the leading edge of the wing; however, the first pieces to depart were forward of the wing.

The sudden loud sound on Cockpit Voice Recorder is described as the initial event and start of aircraft breakup but is not the sound of a fuel tank explosion which, if it were the initial event, would be heard on the recorder. The sudden sound on the CVR does not match another staged Boeing 747 center fuel tank explosion. An explosion in the center tank powerful enough to start the aircraft breakup by blowing off the nose of a Boeing 747 would be heard first on the CVR and was not. The sound of the subsequent secondary explosion in the CWT was not heard because the power had previously been cut to the recorders after the sudden loud sound on the CVR.

A CWT fire/explosion would be far enough away from power cables on top of the fuselage and recorders in the aft end to allow the Flight Data Recorder to record slightly longer than the abrupt power cut it suffered. A CWT fire/explosion which was not loud enough to be heard on the CVR and some distance away would not be powerful enough to abruptly cease power to the FDR and CVR which is what occurred.

The timing of the CWT fireball as seen by other nearby aircraft is at least twelve seconds after the initial event of the sudden loud sound where the nose separated approximately four seconds after the sudden loud sound.

The corroborative evidence required to be present for the CWT fire/explosion to be the initial event would be equal sooting around the explosion area, fireball seen at the initial event time, the sudden loud sound to be matched to the staged fuel tank explosion, burns on passengers above the tank, bilateral damage on the sides of the fuselage, bilateral damage to engines two and three, an ignition source determined, and first pieces to depart the aircraft to be from the center fuel tank. That evidence was not present and thus the CWT fire/explosion as the initial event may be ruled out.

The CWT fire/explosion as a secondary event:

A CWT fire/explosion needs three things to occur, fuel, air, and ignition source. Without any one of those three, there can be no conclusion as to when or where the event occurred. As a secondary event an ignition source was present as an on fire engine number three. As an initial event the ignition source was absent.

The evidence of a secondary event would be sooted turbine blades in engine number three, a clean cut separating the forward section of the fuselage from the middle, no soot on the forward broken part of the CWT and other parts forward of the clean cut, and soot on the remaining sections. That corroborative evidence was present.

After the forward part of the fuselage separated approximately several seconds after the initial event of the sudden loud sound, the rest of the aircraft would start to disintegrate from the wind forces on the now compromised structural integrity of the fuselage. As the fuselage and wings with broken fuel tanks fell, fuel vapor would be in a cloud around the debris. Engine number three would be spewing fire from its exhaust because of the foreign objects ingested into it which would ignite the fuel vapor cloud thousands of feet and seconds later than the initial event.

The corroborative evidence required to be present for the CWT fire/explosion to be the secondary event would be a clean cut of a sooted and a not sooted area at the separation point of the forward section of the fuselage, non burned passengers, the sudden loud sound at initial event time to be some other source than a fuel/air explosion, an ignition source determined, unilateral damage to engine number three, unilateral damage to the starboard side of the fuselage, and the first pieces to depart the aircraft were from just forward of the wing. That evidence was present.

### 2.3.3 Conclusions:

A. The corroborative evidence required for the CWT fire/explosion with undetermined ignition source to be the initial event is lacking and therefore may be ruled out.

B. The corroborative evidence required for the CWT fire/explosion to be the secondary event is present and therefore may be ruled in.

**2.4.1 Premise:** Explosion in the forward cargo compartment on the starboard side caused by explosive decompression caused by structural failure of a ruptured open forward cargo door at one or both of the midspan latches caused by faulty electrical wiring or switch shorting on the door unlatch motor.

### 2.4.2. Discussion:

A. The wiring/cargo door explanation is plausible as a sequence of events from wiring short to airframe breakup as it all could happen according to physical laws of nature.

B. Its reasonable because of the explosive effects of an unintentional hull rupture in a pressurized jet as learned from the Comet and DC-10 experiences.

C. Its well documented by the Kirpal Report, the Canadian Aviation Safety Board AAR, Three NTSB AARs (90/01 and 92/02, and 00/03), AAIB Aircraft Accident Report No 2/90 (EW/C1094), and aviation safety public docket information.

D. It has close precedent because of United Airlines Flight 811 (NTSB AAR 92/02).

E. It reveals a current hazard of aging defective wiring in early Boeing 747s of which about 500 are still in service and it reveals a poorly designed outward opening nonplug cargo door.



The corroborative evidence is literally in volumes: NTSB AAR 90/01 and NTSB AAR 92/02 for United Airlines Flight 811 and AAIB 2/90 for Pan Am Flight 103.

Below are specific matches between Trans World Airlines Flight 800 and UAL 811 gleaned from those government AARs. Both were:

aged  
high flight time  
poly x wired  
early model Boeing 747  
and shortly after takeoff  
experienced hull rupture forward of the wing  
foreign object damage to starboard engine number 3  
fire in number three engine  
more severe inflight damage on starboard side,  
at least nine never recovered bodies,  
torn off skin in forward cargo door area on starboard side,  
post side smooth forward of the wing.  
rupture at forward cargo door at aft midspan latch,  
outward peeled skin on upper forward fuselage,  
downward bent floor beams in cargo door area,  
bare wire found in cargo door area.  
vertical fuselage tear lines forward of the wing  
parts initially shed from just forward of the wing  
first pieces of structure to leave aircraft in flight from forward cargo bay  
forward cargo door frayed  
hoop stress found in cargo door area  
door skin shattered outward.  
sudden sound on CVR  
loud sound on the CVR  
short duration sound on the CVR  
abrupt data loss to FDR  
inadvertent opening of forward cargo door in flight considered initially thought to be a bomb  
but later ruled out.

Below Sole NTSB documentation for consideration of the shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup explanation for Trans World Airlines Flight 800:

**NATIONAL TRANSPORTATION SAFETY BOARD**

Office of Research and Engineering  
 Materials Laboratory Division  
 Washington, D.C. 20594



April 22, 1997

**METALLURGIST'S FACTUAL REPORT**

Report No. 97-82

**A. ACCIDENT**

Place : East Moriches, New York  
 Date : July 17, 1996  
 Vehicle : Boeing 747-100  
 NTSB No. : DCA96-M-A070  
 Investigator : Al Dickinson, AS-10

**B. COMPONENTS EXAMINED**

Section 41 / Section 42 joint, Lower Lobe Forward Cargo Door

**C. DETAILS OF THE EXAMINATION**

The joint between manufactured sections 41 and 42 is located at station (STA) 520. The fuselage skin at this location is butted together with a strap on the inside of the skin. Stringers (S) aft of STA 520 (section 42) have a "hat" cross section, while stringers forward of STA 50 (section 41) have a "Z" shape. The stringers across STA 520 are connected with splices. The frame at STA 520 is added in sections and is larger than the typical nearby frames. The forward edge of the lower lobe forward cargo door is located several feet aft of STA 520 on the lower right side of the fuselage. The STA 520 joint and cargo door were examined on the reconstructed airplane.

The joint at STA 520 was not separated across the top of the airplane (between S-2AL and S5R), along portions of the right side (between S-19R and S-28R and between S-40R and S-45R), and along portions of the left side (between S-18L and S-39L and between S44L and S-47L). The portions of the STA 520 joint that were separated were examined for evidence of preexisting fatigue or other preexisting damage. All fractures were typical of overstress separations, and no evidence of fatigue, fretting, or significant corrosion was noted.

Examination of the lower lobe forward cargo door showed that all eight of the door latching cams remain attached (along with pieces of the door itself) to the pins along the lower door sill.

Overall examination of the forward portion of the airplane showed that sections 41 and 42 contained uniform crushing damage that extended from S-39L across the bottom of the fuselage and up above the right side main cabin window belt to S-14R. This crushing damage is consistent with the intact forward portion of the airplane (including sections 41 and 42) impacting the water with a right wing low attitude. The lower lobe forward cargo door was in the crush area.

James F. Wildey II  
National Resource Specialist - Metallurgy

From NTSB AAR 00/03:

2.2.1.1 Consideration of a Structural Failure and Decompression Close examination of the wreckage revealed no evidence of preexisting airplane structural faults (such as fatigue, corrosion, or mechanical damage) that could have contributed to the in-flight breakup. The examination revealed that the structure did have minimal preexisting corrosion damage, none of which could have led to or affected the breakup of the airplane. Small fatigue cracks were found in some parts of the airplane, including in the lower chord of the front spar and in the shear ties for the floor beams and stiffeners at the front spar; however, none of these cracks had coalesced into a propagating crack that could have led to the in-flight breakup. Further, although the joint between fuselage sections 41 and 42 on some 747s purportedly had been subject to manufacturing assembly problems, there was no evidence that it had separated in any locations before impact.

It was also suggested that the breakup could have been initiated by the in-flight separation of the forward cargo door. However, all eight of the latching cams along the bottom of the door (and some pieces of the cargo door itself) remained attached to the pins along the lower door sill, and there were no indications of preimpact failure of the hinge at the top of the door. This evidence indicates that the door was closed and locked at impact. Further, deformation and fracture patterns on the door matched damage to the adjacent fuselage structure, confirming that the door was in the closed position at the time of impact. Therefore, the Safety Board concludes that the in-flight breakup of TWA flight 800 was not initiated by a preexisting condition resulting in a structural failure and decompression.

1. Docket No. SA-516, Exhibit No. 18A, Sequencing Study, page 20, "Downward separation directions were noted at STA 900, 880, 840, 820, 800, and 780..." and ""The initial opening of the fuselage lower lobe (e.g. LF6A) would have the expected result of rapid depressurization accompanied by collapse of the main deck floor for some distance forward of STA 1000. The red area recovery of interior components as far forward as STA 600 would not be inconsistent with this floor collapse and associated structural breakup."

2. Docket No. SA-516, Exhibit No. 7A, Structures Group Chairman's Factual Report of Investigation, page 11 which discusses direct circumferential tension or hoop stress tension found on lower right side skin in the red zone only.

3. Docket Number SA-516, Exhibit No. 15C, Report Number 97-82, Section

41/42 Joint, Forward Cargo Door, "Examination of the lower lobe forward cargo door showed that all eight of the door latching cams remain attached (along with pieces of the door itself) to the pins along the lower door sill."

From NTSB AAR 00/03:

1.16.4.4 Metallurgical Examination of the Forward Cargo Door The Safety Board also considered the possibility that the forward cargo door (the forward edge of which is located several feet aft of STA 520 on the lower right side of the fuselage) separated from the accident airplane in flight and that this separation initiated the breakup sequence. The Board examined the pieces of the forward cargo door, which were recovered from the yellow zone. All eight of the latching cams at the bottom of the door were recovered attached to pieces of the lower end of the door and were in the latched position. Additionally, the latching cams and pieces of the cargo door remained attached to the pins along the lower door sill. The hinge at the top of the door was broken into several pieces, but the hinge pin still held the various pieces of the hinge together. There was no evidence to suggest that this hinge separated. The forward cargo door exhibited severe crushing deformation and fragmentation, very similar to damage observed on the adjacent fuselage structure. "

Analysis of above NTSB documentation:

(The photographs and analysis which matches up the forward cargo door areas of Pan Am Flight 103, United Airlines Flight 811, Trans World Airlines Flight 800, and a drawing of Air India Flight 182 are shown in Part III: Door Story, of this Smith AAR for Trans World Airlines Flight 800.)

A detailed examination of a possibly defective forward cargo door was done in the second AAR for United Airlines Flight 811 (NTSB 92/02). It includes close examination of the latch pins for bluing from overpressure, the hinges for overtravel, the torque tubes for bending, the bellcranks for slack, the overpressure relief doors for operation, the manual locking handle for status, the locking sectors for damage, and other evaluations. There is little discussion of the forward cargo door in NTSB 00/03. The forward cargo door area does need the depth of examination that was conducted for United Airlines Flight 811 and described in Part II of this Smith AAR.

The cargo doors on Boeing 747s have been the subject of many Airworthiness Directives over the years to correct problems such as bent sills, exposed wiring, too soft metal, and poorly placed safety placards. There are many Service Difficulty Reports of leaking seals requiring emergency landings. Cargo doors on Boeing 747s are extremely complex devices, proven capable of explosive action, poorly designed, and prone to failure. They have failed in flight before in addition to the fatal event of United Airlines Flight 811.

From NTSB 92/02: Previous Cargo Door Incident On March 10, 1987, a Pan American Airways B-747-122, N740PA, operating as flight 125 from London to New York, experienced an incident involving the forward cargo door. According to Pan Am and Boeing officials who investigated this incident, the flightcrew experienced pressurization problems as the airplane was climbing through about 20,000 feet. The crew began a descent and the pressurization problem ceased about 15,000 feet. The crew began to climb again, but about 20,000 feet, the cabin altitude began to rise rapidly again. The flight returned to London. When the

airplane was examined on the ground, the forward cargo door was found open about 1 1/2 inches along the bottom with the latch cams unlatched and the master latch lock handle closed. The cockpit cargo door warning light was off. (Note that Pan Am Flight 125 was the same airline as Pan Am Flight 103 and the aircraft, N740PA, is the sister ship of N739PA- PA 103. Author)

TWA 800 wreckage reconstruction shows red paints smears only above the forward cargo door area and nowhere else on both side of the Boeing 747 fuselage. After the rupture at the aft midspan latch, the door fractured and upper piece of the red painted door was pushed outward, rotated on its hinge, slammed upward and smashed into the white painted fuselage skin above, transferring red paint to the white painted area between the passengers windows, as shown by the TWA 800 reconstruction.

The explosive decompression in the cargo compartment would severely disrupt the cargo hold floor and the adjacent main equipment compartment in which the power cables are located. The severe disruption would abruptly cease power to the FDR and CVR.

The rupture of the forward cargo door area when the aft midspan latch ruptured and subsequent explosive decompression would give the shattered, torn and frayed damage to the starboard cargo door area while leaving the port/left/opposite side smooth and light damage. The forward cargo door rupture would give the unilateral damage on starboard side as shown by TWA 800 wreckage and also give the sole foreign object damage to the adjacent engine number three.

The sudden loud sound is the sound of explosive decompression which gives a sudden loud sound when forward cargo door ruptures/opens in flight. The TWA 800 sudden loud sound was linked to PA 103 sudden loud sound on CVR which was linked to AI 182 sudden loud sound on CVR which was linked to confirmed DC-10 cargo door explosive decompression on CVR. UAL 811 had a cargo door rupture/open in flight and recorded a sudden loud sound on the CVR. The sound is the sudden rushing of air molecules which were compressed now moving fast outward to equalize with the lower pressure outside air.

The cargo door theory explains the streak because the initial event happened when the plane was in the correct sun angle and time of day for the fuselage to reflect sun to observers on the ground. At any other 23 hours and 30 minutes of the day, the streak would not have been seen. But, at 8:31 PM on July 17th near NYC the sun angle was correct for the departing metal door to reflect evening orange sunlight to ground observers to the west as the shiny metal pieces spun away.

The cargo door theory may explain the mysterious radar blip near the initial event time because the spinning metal cargo door with fuselage skin attached would reflect primary radar at that distance, just like it did with the DC-10 cargo door and the UAL 811 cargo door departures.

2.4.3 Conclusions: Based upon an abundance of corroborative evidence, (Detailed in Part II: Comparison) an electrical problem of wiring or switch causing a hull rupture in flight at the midspan latches of the forward cargo door as a probable cause for Trans World Airlines Flight 800 may be ruled in.

**2.5.1. Premise:** Explosion of a improvised explosive device in the forward cargo compartment.

2.5.2 Discussion: The evaluation which refutes an explosion of a bomb in the forward cargo compartment can be summed up by the following evidence.

If a powerful bomb were to explode in the forward cargo hold of Trans World Airlines Flight 800, certain corroborating evidence would be present such as hot-gas pitting on pieces of metal, punctures, shrapnel, explosive residue, pitting, cratering, explosive type injuries to passengers sitting in the cabin, timer, fuze, and a bomb explosion sound on the cockpit voice recorder.

For Trans World Airlines Flight 800:

- A. Pitting: Absent
- B. Cratering: Absent
- C. Hot gas washing: Absent
- D. Holes: Absent
- E. Punctures: Absent
- F. Shrapnel: Absent
- G. Explosive residue: Found.
- H. Burn injuries to passengers sitting in the cabin: Absent
- I. Sooted metal: Present
- J. Timer or bomb casing: Absent
- K. Fuze: Absent
- L. Bomb explosion sound on the cockpit voice recorder: Absent

Bombs have been considered for Air India Flight 182 and Trans World Airlines Flight 800 as well as Pan Am Flight 103 and thus extensively investigated. The same reasons for ruling out a bomb for Trans World Airlines Flight 800 are the same reasons to rule it out for Air India Flight 182 and Pan Am Flight 103.

The NTSB states in AAR 00/03 regarding Trans World Airlines Flight 800: Page 180, footnote 368: 'Evidence of a bomb explosion included deformation of materials away from a location at the height of the passenger seat pan, hot-gas pitting damage on multiple pieces of wreckage that formed a pattern radiating from the same location (including into the CWT), punctures radiating from the same location, and shrapnel. Further, according to the FBI's laboratory report, No. 91204034 S YQ YB/91207052 S YQ YB, dated January 30, 1990, chemical analysis of a piece of wreckage from the right side of the CWT identified the presence of RDX and PETN high explosive. These two explosives comprise about 86 percent of the composition of SEMTEX, which is a rubberlike material manufactured by Synthesia Corporation of Semtin, Czechoslovakia, primarily for use in mining and other civil engineering activities. According to the FBI, SEMTEX has been used by criminal and terrorist elements in Europe since 1966. (SEMTEX was identified as the material used in the bomb placed on Pan Am flight 103. For additional information, see section 1.11.1.2.)'

Page 257 to page 259 of NTSB AAR 00/03 for Trans World Airlines Flight 800 '2.2.1.2 Consideration of a High-Energy Explosive Device Detonation (Bomb or Missile Warhead) Several factors led to speculation that the accident might have been caused by a bomb or missile strike. These factors included heightened safety and security concerns because of the 1996 Olympics then being held in the United States, the fact that TWA flight 800 was an international flight, and the sudden and catastrophic nature of the in-flight breakup. In addition, numerous witnesses to the accident reported seeing a streak of light and then a fireball, which some people believed represented a missile destroying the airplane. Further, some anomalous primary radar targets were recorded by the Islip, New York, radar site in the

general vicinity of TWA flight 800 at the time of the accident that apparently could not be explained. Accordingly, the Safety Board considered the possibility that a bomb exploded inside the airplane or that a missile warhead from a shoulder-launched missile exploded upon impact with the airplane. Testing performed by the Federal Bureau of Investigation (FBI) found trace amounts of explosives on three separate pieces of airplane wreckage (described by the FBI as a piece of canvaslike material and two pieces of floor panel). However, none of the damage characteristics typically associated with a high-energy explosion of a bomb or missile warhead (such as severe pitting, cratering, petalling, or hot gas washing) were found on any portion of the recovered airplane structure, including the pieces on which the trace amounts of explosives were found. Only about 5 percent of the airplane's fuselage was not recovered, and none of the areas of missing fuselage were large enough to have encompassed all of the damage that would have been caused by the detonation of a bomb or missile. Although several large holes are visible in the reconstructed portion of the airplane fuselage, almost all of the structure that originally filled in these holes is attached to the remaining structure but is folded either inward or outward. No area of structure in the reconstructed portion of the airplane contained any unexplained holes large enough to represent the entry point of a missile. Further, the victims remains showed no evidence of injuries that could have been caused by high-energy explosives, nor was there any damage to the airplane seats and other interior components consistent with a high-energy explosion. Investigators considered several scenarios to determine how the trace amounts of explosive residue might have gotten on the wreckage from the accident airplane. Trace amounts of explosive residue could have been transferred to the contaminated pieces from the military personnel (and their associated clothing, boots, and equipment) that were on board the accident airplane when it was used to transport troops during the Gulf War in 1991. In addition, explosives were placed and then removed from several locations in the accident airplane during a dog-training explosive detection exercise about 1 month before the accident. Despite being unable to determine the exact source of the trace amounts of explosive residue found on the wreckage, the lack of any corroborating evidence associated with a high-energy explosion indicates that these trace amounts did not result from the detonation of a high-energy explosive device on TWA flight 800. Accordingly, the Safety Board concludes that the in-flight breakup of TWA flight 800 was not initiated by a bomb or a missile strike.”

The initial event time was officially determined to be the sudden loud sound on the CVR. The initial event of the sudden loud sound is likely the explosive decompression sound when the rupture/structural failure occurred and the air molecules rushed out making the sudden loud sound on the CVR. Pan Am Flight 103 has been matched to Air India Flight 182 in the AAIB report. This initial event sudden sound on the CVR for Air India Flight 182 has been matched to a DC-10 explosive decompression sound when its cargo door opened in flight. All four Boeing 747 sudden sound events have been matched by NTSB in Chart 12 of the public docket for Trans World Airlines Flight 800 (Chart 12 on cover sheet of Part II). The accidents are all linked together by the sudden loud sound on the CVR which is the primary, not the secondary event, of the structural failure when the door ruptured open and explosive decompression ensued. (Detailed in Part II: Comparisons.)

2.5.3 Conclusion: Based upon a very small amount or a benign finding of corroborative evidence, an explosion of a powerful explosion from a bomb as a probable cause for Trans World Airlines Flight 800 may be ruled out.

**2.6. Summary:** To summarize conclusions about Trans World Airlines Flight 800:

- A. No bomb explosion.
- B. No missile strike.
- C. Center wing tank explosion was not the initial event but a secondary event.
- D. Initial event was faulty wiring shorting on the forward cargo door unlatch motor causing ruptures at the midspan latches and subsequent explosive decompression.

**3. Sequence of disintegration for TWA Flight 800**

Hot humid air in forward cargo compartment was subjected to cold conditioned air after takeoff from hot summer evening near New York on July 17, 1996. Condensation was precipitated out and formed on cold metal fuselage skin. Poly-X wire bundle which held cargo door motor on power was chafed by the friction of continuous vibration against clamp or many door openings and closings on it. Sheath around bundle was worn through to insulation and then worn through to bare wire. Condensed water met the bare wire and shorted against fuselage metal charring wires and powering on door motor which attempted to turn all ten cam sectors to unlocked position. At 13700 feet MSL and 300 KCAS, the eight lower cam sectors were prevented from unlocking because of strengthened locking sectors. However, the two midspan latches have no locking sectors at all. The slack in bellcranks, torque tubes, and high time worn cam latches allowed the aft midspan latch to rotate just past center allowing the 3.5 PSI internal pressure to rupture outward the forward cargo door at the aft midspan latch.

The nine foot by nine foot squarish door burst open at midspan latch sending the latch and door material spinning away in the setting sun which reflected upon the shiny metal as it spun away erratically and appeared as red-orange streak to ground observers moving all which ways. The aft door frame was clean of attachment to door and bulged outward. Fuselage skin was torn vertically. The door fractured and shattered. The bottom eight latches held tight to the bottom eight latch pins on bottom sill while bottom external skin of door blew away. The top piece of red topped cargo door opened out and up smashing into the white fuselage skin above it leaving the red paint of the door on the white paint between passenger windows above. The red paint of the trim was rubbed away showing the white paint underneath. The top piece of the door took the hinge with it and fuselage skin as it is tore away. The loose red painted trim piece and top of door flew directly aft and impacted the right horizontal stabilizer leaving a red paint transfer mark on it. The hinge still appears to be working normally likely having overtravel impression marks on the opposite hinge when door overextended to slam on fuselage above. The top piece of the door shows inward damage when it hit fuselage above.

The explosive decompression of the thirty eight thousand pounds of internal force on the door blew out a large hole about twenty feet wide and forty feet high on the right side of the nose forward of the wing. Parts of the cargo hold structure were the first parts to leave the aircraft. The now uncompressed air molecules rushed out of the huge hole equalizing high pressure inside to low pressure outside while making a very loud noise. Fuselage skin was peeled outward at various places on the right side of the nose. The sudden rushing air was recorded on the Cockpit Voice Recorder as a sudden loud sound. The explosive decompression of the forward cargo hold severely disrupted the nearby main equipment compartment which housed power cables and abruptly shut off power to the Flight Data Recorder.

At least nine passenger's bodies were never found, only bone fragments. The number three engine also ingested metal in baggage and started on fire from inefficient burning of fuel. The number three engine with pylon started to vibrate and a stator blade from the engine was spit out and



impacted directly behind it in the right horizontal stabilizer.

The floor beams above the cargo hold were bent downward, fractured and broken from the sudden decompression. The main structural members of door and frame were gone and compromised. The flight attitude of the aircraft was askew to the left from reaction of explosive decompression to the right. Air rushed into the hole and weakened other skin and frame peeling skin outward. The 300 knots of air pressed upon the weakened nose and crumpled it into the large hole. The nose tore off and landed in a dense debris heap apart from the rest of the plane.

The port side forward of the wing was smooth and unshattered while the starboard side forward of the wing was shattered, torn, and frayed at ruptured cargo door area and severely disturbed over twenty feet by forty foot explosive decompression zone. Outward petal shaped fuselage skin appeared at aft midspan latch from rupture. Aft midspan latch was blown away. Outward peeled skin appeared from blowout. Fuselage skin remained smooth next to blown out skin.

The rest of the plane without the nose suddenly decelerated from 300 knots and caused whiplash injuries to passengers. Passengers inside fuselage had baro-trauma to eardrums which ruptured trying to equalize middle ear pressure. The plane maneuvered with huge gaping wound in front increasing drag. The wind force disintegrated the fuselage and wings. Fuel poured out of ruptured tanks as wreckage fell. The broken fuselage, the ruptured wings, the fuel cloud, the center tank, and the spinning, on fire engine number three met at 7500 feet and exploded into a bright loud fireball putting singe marks on the fuselage skin while leaving earlier departed nose burn and singe mark free. The center tank exploded as well as other nearby fuel tanks. Forward passengers were not burned because they were in the earlier separated nose. The debris fell and spread out from 7500 feet to sea level in windblown southeast directly, leaving a wide debris field.

Ground observers heard the fireball explosion of the center tank and other fuel and looked up. They saw fire and smoke and falling debris.

Explosive decompression at the forward cargo hold led to suspicion of bomb in cargo compartment but bomb later ruled out. Debris ejected to the right from explosive decompression led to suspicion of missile exploding on left side of nose. Streak of shiny metal object spinning away reflecting evening sun to ground observers led to suspicion of missile exhaust but later ruled out.

Fire/explosion of center tank into fireball led to suspicion of center tank explosion as initial event. There were difficulties in determining ignition source, fuel volatility, unheard fuel explosion sound on CVR, unilateral fuselage damage, singe marks, and other evidence needed to corroborate center tank explosion as initial explosion.

Fuselage rupture at aft midspan latch of forward cargo door inflight is initially rejected because bottom eight latches are found latched around locking pins while two midspan latches are unexamined and status unreported.

#### **4. Hindsight Pattern.** A pattern has been revealed which includes Pan Am Flight 103. Significant Direct and Tangible Evidence Obtained for Four B747 Breakups in Flight

	AI 182	PA103	UAL 811	TWA 800
Boeing 747	Yes	Yes	Yes	Yes
Early model -100 or -200	Yes	Yes	Yes	Yes
Pressure Relief doors open or jammed	Maybe	Yes	Yes	Yes
Sudden airframe breakup in flight (partial or total)	Yes	Yes	Yes	Yes
Breakup occurs amidships	Yes	Yes	Yes	Yes
High flight time (over 55,000 flight hours)	No	Yes	Yes	Yes

Aged airframe (over 18 years of service)	No	Yes	Yes	Yes
Previous maintenance problems with forward cargo door	Yes	Maybe	Yes	Maybe
Initial event within an hour after takeoff	No	Yes	Yes	Yes
Initial event at about 300 knots while proceeding normally in all parameters	Yes	Yes	Yes	Yes
Initial event has unusual radar contacts	Maybe	Yes	Yes	Yes
Initial event involves hull rupture in or near forward cargo door area	Yes	Yes	Yes	Yes
Initial event starts with sudden sound	Yes	Yes	Yes	Yes
Initial event sound is loud	Yes	Yes	Yes	Yes
Initial event sound is audible to humans	Yes	Yes	Yes	Yes
Initial event followed immediately by abrupt power cut to data recorders	Yes	Yes	Yes	Yes
Initial event sound matched to explosion of bomb sound	No	No	No	No
Initial event sound matched to explosive decompression sound in wide body airliner	Yes	Yes	Yes	Yes
Torn off skin on fuselage above forward cargo door area	Yes	Yes	Yes	Yes
Unusual paint smears on and above forward cargo door	Maybe	Maybe	Yes	Yes
Evidence of explosion in forward cargo compartment	Yes	Yes	Yes	Yes
Foreign object damage to engine or cowling of engine number three	Yes	Yes	Yes	Yes
Fire/soot in engine number three	Maybe	Yes	Yes	Yes
Foreign object damage to engine or cowling of engine number four	Yes	Yes	Yes	Yes
Right wing leading edge damaged in flight	Yes	Maybe	Yes	Maybe
Vertical stabilizer damaged in flight	Yes	Yes	Yes	Maybe
Right horizontal stabilizer damaged in flight	Yes	Yes	Yes	Yes
More severe inflight damage on starboard side than port side	Yes	Yes	Yes	Yes
Port side relatively undamaged by inflight debris	Yes	Yes	Yes	Yes
Vertical fuselage tear lines just aft or forward of the forward cargo door	Yes	Yes	Yes	Yes
Fracture/tear/rupture at a midspan latch of forward cargo door	Maybe	Yes	Yes	Yes
Midspan latching status of forward cargo door reported as latched	No	No	No	No
Airworthiness Directive 88-12-04 implemented (stronger lock sectors)	No	No	No	Yes
Outwardly peeled skin on upper forward fuselage	Yes	Yes	Yes	Yes
Rectangular shape of shattered area around forward cargo door	Yes	Yes	Yes	Yes
Forward cargo door fractured in two longitudinally	Yes	Yes	Yes	Maybe
Status of aft cargo door as intact and latched	Yes	Yes	Yes	Maybe
Passengers suffered decompression type injuries	Yes	Yes	Yes	Yes
At least nine missing and never recovered passenger bodies	Yes	Yes	Yes	Yes
Wreckage debris field in two main areas, forward and aft sections of aircraft	Yes	Yes	No	Yes
Initial official opinion of probable cause as bomb explosion.	Yes	Yes	Yes	Yes
Initial official opinion modified from bomb explosion	Yes	Yes	Yes	Yes
Structural failure considered for probable cause	Yes	Yes	Yes	Yes
Inadvertently opened forward cargo door considered for probable cause	Yes	No	Yes	Yes
Official probable cause as bomb explosion	Yes	Yes	No	No
Official probable cause as 'improvised explosive device'	No	Yes	No	No
Official probable cause as explosion by unstated cause	Yes	No	No	No
Official probable cause as explosion in center fuel tank with unknown ignition source	No	No	No	Yes
Official probable cause as improper latching of forward cargo door	No	No	Yes	No
Official probable cause as switch /wiring inadvertently opening forward cargo door	No	No	Yes	No
Significant Direct and Tangible Evidence Obtained for Four B747 Breakups in Flight				
	AI 182	PA103	UAL 811	TWA 800

The pattern above is based on similar evidence in four early model Boeing 747 inflight fatal events. The pattern is clear yet complex and detailed. When a forward cargo door ruptures open in flight, certain things have to happen and they happened for Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800.

The significance of the pattern is that it is possible only one cause is for all and that cause, faulty electrical wiring or switch, still exists, is a current hazard. There is urgency.

An additional significance of the pattern is that enough current hard evidence exists to justify a supplemental safety investigation into Trans World Airlines Flight 800, Air India Flight 182, and Pan Am Flight 103, based upon subsequent similar accidents such as United Airlines Flight 811.

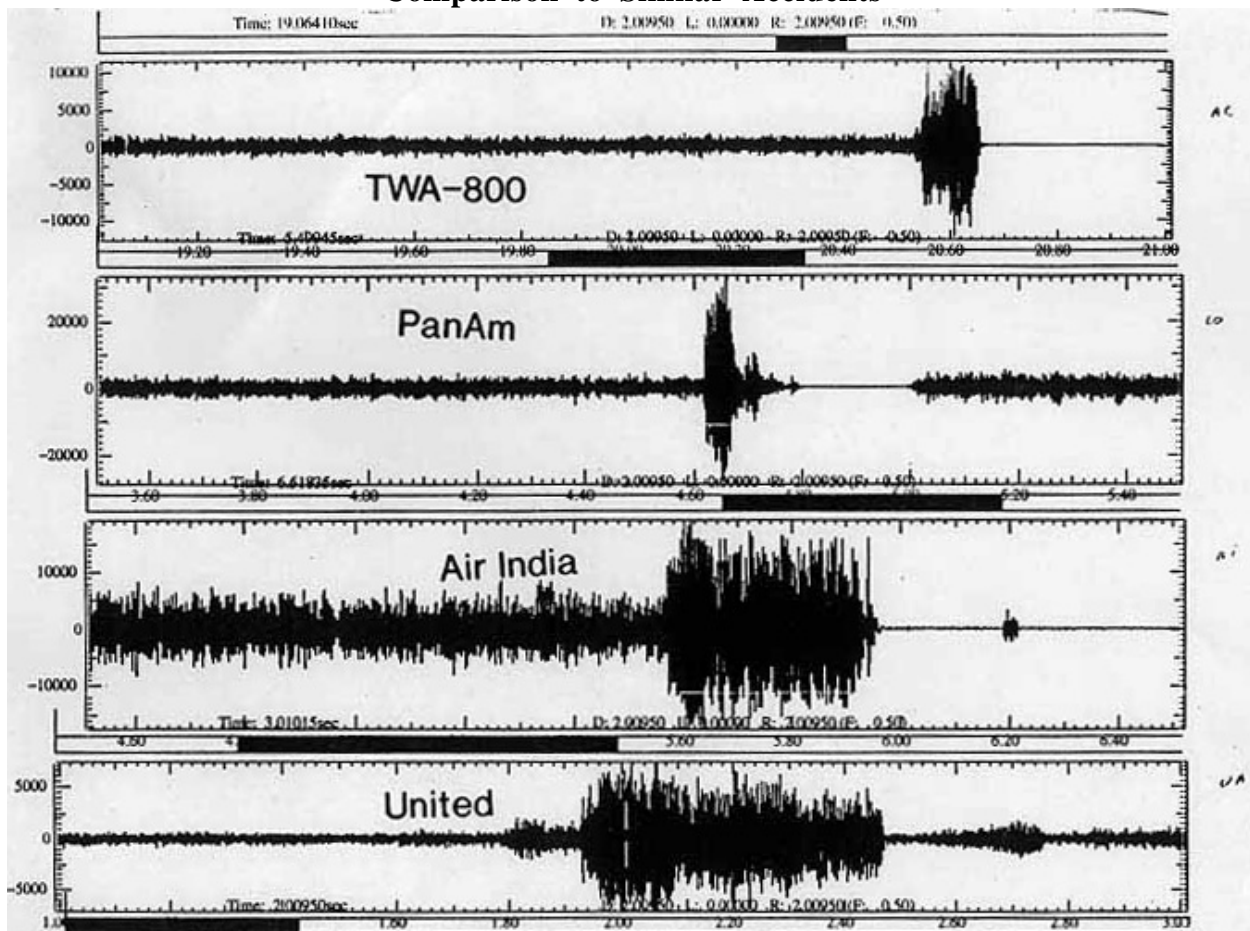
**5. Specific Conclusions for Trans World Airlines Flight 800:**

- A. While proceeding normally, an inflight breakup of Trans World Airlines Flight 800 occurred suddenly and catastrophically at 13700 feet at 300 knots TAS. There were no survivors.
- B. The breakup was caused by an explosion in the forward cargo compartment.
- C. The explosion was a severe and sudden explosive decompression.
- D. The explosive decompression was caused by the suddenly ruptured open forward cargo door probably at one or both of the midspan latches.
- E. The ruptured open forward cargo door was probably caused by faulty wiring which turned on the door unlatch motor which unlatched the latching cams from around the latching pins in flight.
- F. The wiring fault was probably the Poly X wiring with inferior insulation which easily cracks or chafes to bare wire especially in the presence of moisture.
- G. There was no bomb explosion in any cargo compartment, crew cabin, passenger cabin, or anywhere else on the aircraft.
- H. There was no explosion in the aft cargo compartment.
- I. The sudden loud sound on the cockpit voice recorder was the sound of the air rushing out during the explosive decompression in the forward cargo compartment.
- J. The abrupt power cut to the recorders was caused by the explosive effects of the decompression affecting the power cables in the adjacent main equipment compartment to the forward cargo compartment.
- K. The explosion in the Center Wing Tank was not the initial event but happened after the nose had separated from the rest of the aircraft.
- L. The ignition source for the explosion of the CWT was probably the on fire engine number three igniting the fuel vapors from the disintegrating fuel tank as both fell to the ocean.
- M. The streak was probably evening orange sunlight reflecting off the pieces of the forward fuselage as they tore away from the aircraft and were reflected to the observers on the ground to the west.

**6. Concluding Comment on Part I:** The hazard of faulty wiring or switch still exists in the five hundred early model Boeing 747s in service and the design flaw of inadequate midspan latches with no locking sectors in a non plug cargo door exists in many thousands of Boeing airliners in service today. These hazards present dangers which are preventable.

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**AIRCRAFT  
ACCIDENT  
REPORT**  
**Trans World Airlines Flight 800**  
**Part II**  
**Comparison to Similar Accidents**



**Report on the accident to  
Trans World Airlines Flight 800  
Boeing 747-131, N93119  
Near East Moriches, New York  
July 17, 1996  
by John Barry Smith,  
Independent Aircraft Accident Investigator**

## Part II: Comparison to Similar Accidents

### Table of Contents:

1. Introduction:
2. Purpose of Part II:
3. Premise Explanation: Explosion in the forward cargo compartment of explosive decompression caused by structural failure of ruptured open forward cargo door at one or both of the midspan latches caused by faulty electrical wiring:
4. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had probable causes which were initially thought to be bomb explosions:
5. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had the original cause of bomb explosion modified.
6. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had breakups in their airframes in a similar amidships location.
7. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had at least nine never recovered bodies.
8. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had passengers that showed explosive decompression type injuries and no evidence of bomb explosion injuries.
9. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had experienced a sudden, loud, audible sound on the cockpit voice recorder at event start time:
10. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had the source of the sudden, loud, audible sound as a bomb explosion disputed and the source of the sudden, loud, audible sound as an explosive decompression supported.
11. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had an abrupt power cut to the data recorders immediately after a sudden, loud, audible sound at event start time.
12. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had an explosion in or adjacent to the forward cargo compartment.
13. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had similar shattered fuselage skin in and around the forward cargo door.
14. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had relatively mild damage on the port side of the nose forward of the wing directly opposite the shattered zone around the forward cargo door at the same initial event time.
15. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had similar damage to their airframe structures from inflight ejected debris.
16. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had foreign object damage to engine number three.
17. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had incomplete reports of the status of the forward cargo door.
18. Air India Flight 182, Pan Am Flight 103, and Trans World Airlines Flight 800, and United Airlines Flight 811 to a much lesser extent, had similar debris patterns on the surface of the ground or sea bottom.
19. Summary of matching evidence for all aircraft:
20. Summary of matching evidence between Pan Am Flight 103 and United Airlines Flight 811 specifically:
21. Cargo Door Operation for Boeing 747:
22. Inadvertent Cargo Door Opening Causes:

23. Wiring:
24. Comment:
25. General Conclusions for Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800:
26. Specific Conclusions for Trans World Airlines Flight 800:
27. Contributing causes:
28. Recommendations:

**1. Introduction:** There is a history of aviation accidents not being fully explained in the first AAR.

Icarus was the first aviation related fatality and his mythic accident was said to have been caused when the wax by which he affixed the wings to his body melted when he flew too close to the sun; the wings came off, and down he went.

The AAR might have been worded thus:

When King Minos of Crete found out that his son, the Minotaur, had been killed and Theseus had escaped with his daughter, he was angry with Daedalus for not building a complex enough labyrinth. In revenge, he imprisoned the inventor in there with his young son Icarus. Determined to escape from this unfair punishment, Daedalus fashioned two pairs of wings, each on a wooden frame, lined with many feathers which were fixed with beeswax.

When the inventor had finished, he and his son climbed up to the highest part of the labyrinth, catching the wind and looking down into the sea which surrounded the walls. They fixed their wings on each other and planned their escape. Daedalus told Icarus that he was to keep his arms wide apart so as to catch even the slightest breath of wind and to keep close behind his father, keeping a straight course between the sun and the sea. "For if you fly too close to the sea, your feathers will dampen and you will drown under the weight of the frame. If you fly too close to the sun however, the beeswax will melt and the feathers will loosen. Remember these words and you will be safe."

The two of them then leapt from the walls, Daedalus going first and Icarus following closely behind. However, Icarus soon became bolder as he flew effortlessly in the skies and left his father's straight course of flight to twirl and loop in the air. As his loops became bolder, he flew higher and forgot his father's warning. All too late, he noticed the feathers falling off the frame for he had flown too close to the sun. He called out to his father as he fell from the sky and into the sea where he drowned.

Daedalus had heard his cries but it was too late for Icarus had already fallen. He recovered the body which had swept up onto a nearby island and buried it there, naming it 'Icaria'. He then flew on and found refuge in Etna's land.

This explanation was not meant to be examined closely, of course, as the explanation makes no sense. For instance, how does one affix large wings to a human body with beeswax; how does one fly high enough to get too close to the sun, how did Icarus find enough energy to get off the ground in the first place, and lastly, who was to blame? Was it the designer Daedalus who used the defective wax? Was it the King who gave them reason to fly away? Was it pilot error of flying his craft outside accepted operating limits? What could be done to prevent such a

reoccurrence? Better flight training, better adhesives? Aviation accident investigations are very complex affairs with many parties interested in the outcome. (Note that laypersons who have heard about Icarus are usually unaware of the wise admonition to not fly too low and are only aware of the warning hazard of flying too high. Only the fatal accident causes are remembered.)

The probable cause for Icarus' accident made sense at the time of telling, but now, years later, we understand it did make a good story and fulfilled the wishful thinking of those listening to it but was clearly impossible based on the tangible, circumstantial, and direct evidence.

With the introduction of the jet age in commercial airliners in the late 1950's, such as the Comet from the United Kingdom, large hulls were pressurized and subjected to many cycles of pressurizing and depressurizing. Cracks appeared in the fuselage which led to structural failure and powerful explosive decompressions which appeared as an explosion which led to the inflight breakup of the early airliner.

There is a history of inadvertent explosive decompressions in commercial airliners being initially suspected as bomb explosions. Those events are usually controversial. (Appendix B, Avianca Accident) It is an understandable error of deduction because an explosion of explosive decompression closely mimics a bomb in producing explosive effects such as ejecting material at high velocity, making a loud noise, being unexpected, and not supposed to happen inside an airliner as well as cratering, pitting curling, folding, and tearing metal. An explosive decompression is referred to in accident investigations as an 'explosion' and described by a crewmember who suffered through one as a 'tremendous explosion.'

All explosions give some similar evidence; it is the corroborating evidence for a specific type of explosion that is required before a determination may be made as to type of explosion, such as bomb, fuel tank, or explosive decompression. Explosive decompression is the most difficult to determine because it leaves no residue or soot and therefore, its determination lies largely in the absence of corroborating evidence for an alternative explanation of residue, timer, fuze, ignition source, burns, or soot. An explosive decompression does need a highly pressurized vessel and a rupture location identified whereas the others do not. Bombs and fuel tanks can explode on the ground; fatal explosive decompressions from any source have all occurred inflight.



The solution to the early mystery of the Comet crashes was achieved by matching two similar events in the similar aircraft which left similar evidence.

Excerpts of corroborative statements to support the Comet explosive decompression explanation: (Appendix C, Comet Accidents)  
<http://www.tech.plym.ac.uk/sme/FailureCases/FAILURE.htm>

Professor M Neil James Webpage:  
<http://www.plym.tech.ac.uk/sme/uoa30/structur.htm>

Comet Airliner: Jet transportation age began in on May 5 1952 when the De Havilland Comet 1 began scheduled flights from London to Johannesburg. In April 1953, a Tokyo to London service was inaugurated – flying time for the 10 200 mile distance dropped from 85 hours to 36 hours. The Comet had a cruising speed of 490 mph at 35 000 feet and a range of 1 750 miles with a payload of 44 passengers.

The cabin was pressurized to maintain a pressure equivalent to 8 000 feet at an aircraft altitude of 40 000 feet, which was required for efficient operation of the engines. This gave a pressure differential of 8.25 psi (56 kPa) across the fuselage – twice the value previously used. De Havilland conducted ‘many tests’ to ensure structural integrity of the cabin. However, a series of 3 accidents occurred where Comet aircraft disintegrated in flight:

(a) Investigation by R.A.E. (Excerpts) The loss of Yoke Peter and Yoke Yoke presented a problem of unprecedented difficulty, the solution of which was clearly of the greatest importance to the future, not only of the Comet, but also of Civil Air Transport in this country and, indeed, throughout the world. They thought it necessary to satisfy themselves about the structural integrity of the aircraft, in particular of the cabin and the tail and to consider in more detail possible sources of explosion and loss of control. But at the time when their attention became directed to fatigue of the pressure cabin they were influenced chiefly by the apparent similarity of the circumstances of the two accidents, and by the fact that the modifications carried out after Elba seemed to rule out many of the other possible causes.

(2) There were serious lessons resulting from explosive decompression and deceleration.

G-ALYV after leaving Calcutta – May 1953. Violent storms were thought to be involved and some wreckage was recovered. No firm conclusions drawn as to cause.

G-ALYP over Elba – January 1954 after 1 286 cabin pressurisation cycles. Little wreckage was recovered and no major problems found in fleet inspection. Fire was assumed the most likely cause and modifications made to improve fire prevention and control. Aircraft returned to service.

G-ALYY flying as SA 201 after leaving Rome – April 1954. and all Comet 1 aircraft were subsequently withdrawn from service.

A more intensive effort was made to recover the wreckage of G-ALYP using underwater television cameras for the first time. About 70% of the aircraft was recovered and reconstructed at Farnborough. The Royal Navy was charged with getting the relevant fuselage piece of G-ALYP from the sea (using simulation trials, based on the way the aircraft was now thought to break up in flight, to establish the likely position of this part of the aircraft on the seabed. This was recovered within a few hours of searching and showed, in the language of the coroner, the ‘unmistakable fingerprint of fatigue’. The fatigue crack was associated with the



stress concentrations of the rather square rear ADF window cutout (stress of 315 MPa at edge of window), and with a bolt hole around the window (although the stress at the bolt position was only 70 MPa).

In the 1960s a new type of airliner came into production called a 'widebody', the DC-10 (Appendix D, DC-10 Accidents) and the Boeing 747 (Appendix E, Boeing 747 History). These aircraft had a much larger cabin to accommodate several hundred passengers. This larger size of the hull required greater pressurization loads on the internal fuselage which were underestimated by designers. Subsequently two flights of the DC-10 suffered explosive decompressions in flight from inadvertent cargo door openings which left evidence of a sudden loud sound on the cockpit voice recorder which was used to match to later explosive decompression events in another wide body airliner, the Boeing 747 in Air India Flight 182. The design of the outward opening nonplug cargo door was criticized as inadequate for both types of aircraft in subsequent accident reports.



June 12, 1972

McDonnell Douglas DC-10-10 N103AA, American Airlines

Over Windsor, Ontario

Mechanical Failure due to Design Flaw/Human Error

Occupants: 67

Fatalities: 0

Following takeoff from Detroit, the rear cargo door blew off due to a door latch system that had been damaged by ground crew members. The loss of pressurization caused the cabin floor to buckle and damaged the hydraulic control lines of the aircraft. The captain, having trained himself in simulator sessions to fly the aircraft using its throttles (a method called "differential thrust steering"), made an emergency landing in Detroit.

March 3, 1974

McDonnell Douglas DC-10-10 TC-JAV Turk Hava Yollari - THY

Outside Paris, France

Mechanical Failure due to Design Flaw/Human Error

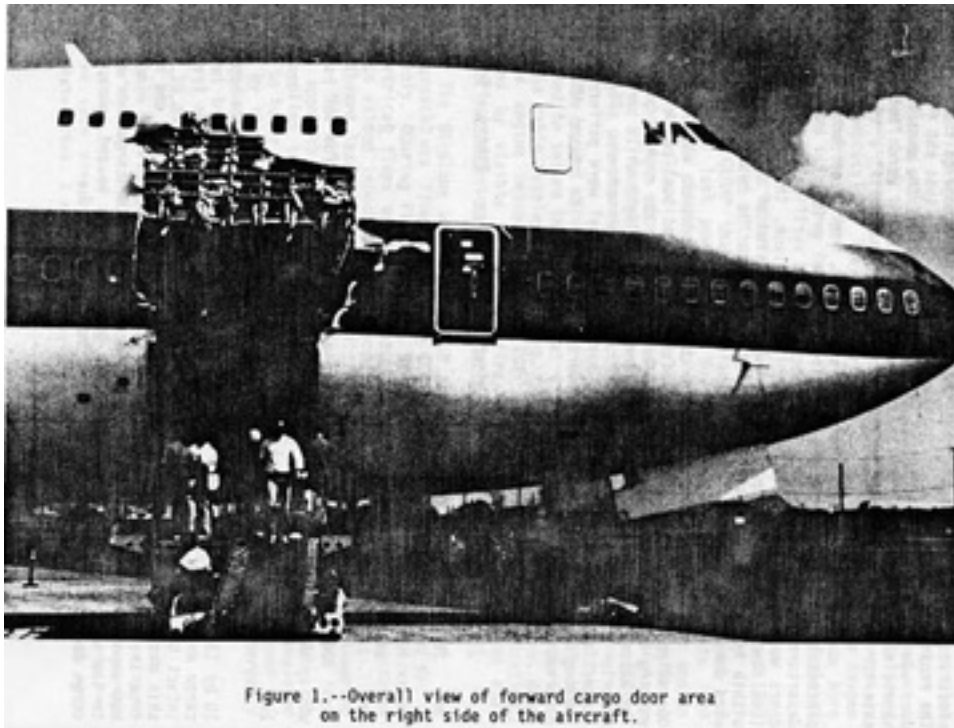
Occupants: 346

Fatalities: 346

The latch mechanism of the aft cargo door, the design of which was susceptible to damage, had been damaged before the accident. Before takeoff the door had not been secured properly. Shortly after takeoff from Paris, the door failed. The resulting depressurization led to the disruption of the floor structure, causing six

passengers and parts of the aircraft to be ejected, rendering No.2 engine inoperative, and impairing the flight controls so that it was impossible for the crew to regain control of the aircraft.

On February 24, 1989, United Airlines Flight 811, a Boeing 747-122, experienced an explosive decompression as it was climbing between 22,000 and 23,000 feet after taking off from Honolulu, Hawaii, en route to Sydney, Australia with 3 flightcrew, 15 flight attendants, and 337 passengers aboard.



After an investigation, the NTSB issued AAR 90/01 which concluded:

'The National Transportation Safety Board determines that the probable cause of this accident was the sudden opening of the improperly latched forward lower lobe cargo door in flight and the subsequent explosive decompression.' NTSB also stated: 'The next opportunity for the FAA and Boeing to have reexamined the original assumptions and conclusions about the B-747 cargo door design and certification was after the findings of the Turkish Airline DC-10 accident in 1974 near Paris, France. The concerns for the DC-10 cargo door latch/lock mechanisms and the human and mechanical failures, singularly and in combination, that led to that accident, should have prompted a review of the B-747 cargo door's continuing airworthiness. In the Turkish Airlines case, a single failure by a ramp service agent, who closed the door, in combination with a poorly designed latch/lock system, led to a catastrophic accident. The revisions to the DC-10 cargo door mechanisms mandated after that accident apparently were not examined and carried over to the design of the B-747 cargo doors. Specifically, the mechanical retrofit of more positive locking mechanisms on the DC-10 cargo door to preclude an erroneous locked indication to the flightcrew, and the incorporation of redundant sensors to show the position of the latches/locks, were not required to be retrofitted at that time

for the B-747.'

After extensive efforts from the family of one of the victims, the forward cargo door pieces of United Airlines Flight 811 were retrieved from the bottom of the ocean and it was discovered that, in fact, the cargo door had been properly latched, thus exonerating the accused ground baggage handler of the deaths of nine innocent passengers. The NTSB issued another aircraft accident report, AAR 92/02, with the corrected probable cause, apparently the only known time that two aircraft accident reports have been written about the same accident.

NTSB AAR 92/02 states: "Thus, as a result of the recovery and examination of the cargo door, the Safety Board's original analysis and probable cause have been modified. This report incorporates these changes and supersedes NTSB/AAR-90/01. The National Transportation Safety Board determines that the probable cause of this accident was the sudden opening of the forward lower lobe cargo door in flight and the subsequent explosive decompression. The door opening was attributed to a faulty switch or wiring in the door control system which permitted electrical actuation of the door latches toward the unlatched position after initial door closure and before takeoff."

Over a period of eleven years, from 1985 to 1996, there have been four early model Boeing 747 aircraft which have suffered fatal explosive decompressions in flight which were all initially attributed to 'bombs', one of which was United Airlines Flight 811 as reported by the surviving crew. Two of the accidents have since had a bomb explosion ruled out as the probable cause while one cause is in dispute as a bomb or not and one cause is stated to be 'an improvised explosive device' which may or may not be a bomb. All four flights were and are controversial. It is these four flights that in similar circumstances with similar aircraft that left similar evidence that has led this investigator to conclude that one similar probable cause is the same for four, , Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800, and that similar cause is the only confirmed and irrefutable probable cause: the sudden opening of the forward lower lobe cargo door in flight and the subsequent explosive decompression refined to the locations as the midspan latches and the cause as faulty wiring or switch.

The implication of this conclusion is that there were never any bombs, or missiles, or center fuel tanks initially exploding in flight on the four flights but an event in each occurred which mimics those other explosions, that is, an explosive decompression after an inadvertently ruptured open forward cargo door in flight. An additional important implication is that the hazards still exist to this day and are a potential danger to the passengers flying in the five hundred early model Boeing 747s still in service.

## **2. Purpose of Part II Comparison to Similar Accidents:**

This part shall evaluate the four fatal in-flight breakups of Boeing 747s using the cumulative evidence of seventeen years to sustain the matching pattern for all four of an explosion in the forward cargo compartment by a sudden ruptured opening of the forward cargo door in flight at one or both of the midspan latches probably caused by faulty wiring.

Specific data about the four early model Boeing 747s:

Air India Flight 182: Sequence in construction:#330, Construction Number 21473  
Date completed: 19 June 78, Type Aircraft: B747-237B Type of wiring: Poly-X  
(Raychem Corp), accident date: June 23 1985

Pan Am Flight 103: Sequence in construction: #15, Construction Number 19646,

Date completed: 25 Jan 70, Type Aircraft: B747-121 Type of wiring: Poly-X (Raychem Corp), accident date: 21 December 88

United Airlines Flight 811: Sequence in construction:#89, Construction Number 19875, Date completed: 20 Oct 70, Type Aircraft: B747-122 Type of wiring: Poly-X (Raychem Corp), accident date: 23 February 89

Trans World Airlines Flight 800: Sequence in construction:#153, Construction Number 20083, Date completed: 18 August 71, Type Aircraft: B747-131 Type of wiring: Poly-X (Raychem Corp), accident date: 17 July 96

Excerpts of official corroborative statements for background: Air India Flight 182

From: Report Of The Court Investigating Accident To Air India Boeing 747 Aircraft VT-EFO, "Kanishka" On 23rd June 1985

From Canadian Aviation Bureau Safety Board

Aviation Occurrence Air India Boeing 747-237b VT-EFO Cork, Ireland 110 Miles West 23 June 1985

Boeing 747-237B 'Kanishka' aircraft VT-EFO was manufactured by Messrs Boeing Company under Sl.No. 21473. The aircraft was acquired by Air India on 19th June, 1978. Initially, it came with the expert Certificate of Airworthiness No. E-161805. Subsequently, the Certificate of Airworthiness No. 1708 was issued by the Director General of Civil Aviation, India on 5th July, 1978. The C of A was renewed periodically and was valid up to 29th June, 1985. From the beginning of June, 1985, C of A renewal work of the aircraft was in progress. The aircraft had the Certificate of Registration No. 2179 issued by the DGCA on 5th May, 1978. The commercial flight of 'Kanishka' aircraft started on 7th July, 1978.

2.4.1.2 The aircraft was maintained by Air India following the approved maintenance schedules. It had logged 23634:49 hours and had completed 7525 cycles till the time of accident.

A. On the morning of 23rd June, 1985 Air India's Boeing 747 aircraft VT-EFO (Kanishka) was on a scheduled passenger flight (AI-182) from Montreal and was proceeding to London enroute to Delhi and Bombay. It was being monitored at Shannon on the Radar Scope. At about 0714 GMT it suddenly disappeared from the Radar Scope and the aircraft, which has been flying at an altitude of approximately 31,000 feet, plunged into the Atlantic Ocean off the south-west coast of Ireland at position latitude 51 degrees 3.6 minutes N and Longitude 12 degrees 49 minutes W. This was one of the worst air disasters wherein all the 307 passengers plus 22 crew members perished.

The Canadian Aviation Safety Board respectfully submits as follows:

#### 4.1 Cause-Related Findings

1. At 0714 GMT, 23 June 1985, and without warning, Air India Flight 182 was subjected to a sudden event at an altitude of 31,000 feet resulting in its crash into the sea and the death of all on board.
2. The forward and aft cargo compartments ruptured before water impact.
3. The section aft of the wings of the aircraft separated from the forward portion before water impact.
4. There is no evidence to indicate that structural failure of the aircraft was the lead event in this occurrence.
5. There is considerable circumstantial and other evidence to indicate that the initial event was an explosion occurring in the forward cargo compartment. This evidence

is not conclusive. However, the evidence does not support any other conclusion.' The Indian Kirpal Report: "3.4.6.60 The only conclusion which can, however, be arrived at is that the aircraft had broken in midair and that there has been a rapid decompression in the aircraft.' and 4.10 'After going through the entire record we find that there is circumstantial as well as direct evidence which directly points to the cause of the accident as being that of an explosion of a bomb in the forward cargo hold of the aircraft.'

Excerpts of official corroborative statements for background: Pan Am Flight 103

From: Air Accidents Investigation Branch Aircraft Accident Report No 2/90  
1.6.1 Leading particulars Aircraft type: Boeing 747-121 Constructor's serial number: 19646

N739PA first flew in 1970 and spent its whole service life in the hands of Pan American World Airways Incorporated. Its Certificate of Airworthiness was issued on 12 February 1970 and remained in force until the time of the accident, at which time the aircraft had completed a total of 72,464 hours flying and 16,497 flight cycles.

The accident was notified to the Air Accidents Investigation Branch at 19.40 hrs on the 21 December 1988 and the investigation commenced that day. The aircraft, Flight PA103 from London Heathrow to New York, had been in level cruising flight at flight level 310 (31,000 feet) for approximately seven minutes when the last secondary radar return was received just before 19.03 hrs. The radar then showed multiple primary returns fanning out downwind. Major portions of the wreckage of the aircraft fell on the town of Lockerbie with other large parts landing in the countryside to the east of the town. Lighter debris from the aircraft was strewn along two trails, the longest of which extended some 130 kilometres to the east coast of England. The report concludes that the detonation of an improvised explosive device led directly to the destruction of the aircraft with the loss of all 259 persons on board and 11 of the residents of the town of Lockerbie.

Excerpts of official corroborative statements for background: United Airlines Flight 811:

From: National Transportation Safety Board  
Washington, D.C. 20594

Aircraft Accident Report Explosive Decompression-- Loss Of Cargo Door In Flight  
United Airlines Flight 811 Boeing 747-122, N4713U  
Honolulu, Hawaii February 24, 1989

The accident airplane, serial No. 19875, registered in the United States as N4713U, was manufactured as a Boeing 747-122 transport category airplane by the Boeing Commercial Airplane Company (Boeing), Seattle, Washington, a Division of the Boeing Company. N4713U, the 89th B-747 built by Boeing, was manufactured in accordance with Federal Aviation Administration (FAA) type certificate No. A20WE, as approved on December 30, 1969. The airplane was certificated in accordance with the provisions of 14 CFR Part 25, effective February 1, 1965.

On February 24, 1989, United Airlines flight 811, a Boeing 747-122, experienced an explosive decompression as it was climbing between 22,000 and 23,000 feet after taking off from Honolulu, Hawaii, en route to Sydney, Australia with 3

flightcrew, 15 flight attendants, and 337 passengers aboard. The airplane made a successful emergency landing at Honolulu and the occupants evacuated the airplane. Examination of the airplane revealed that the forward lower lobe cargo door had separated in flight and had caused extensive damage to the fuselage and cabin structure adjacent to the door. Nine of the passengers had been ejected from the airplane and lost at sea.

The National Transportation Safety Board determines that the probable cause of this accident was the sudden opening of the forward lower lobe cargo door in flight and the subsequent explosive decompression. The door opening was attributed to a faulty switch or wiring in the door control system which permitted electrical actuation of the door latches toward the unlatched position after initial door closure and before takeoff.

Excerpts of official corroborative statements for background: Trans World Airlines Flight 800:

From: National Transportation Safety Board  
Washington, D.C. 20594  
Aircraft Accident Report  
In-flight Breakup Over the Atlantic Ocean  
Trans World Airlines Flight 800  
Boeing 747-131, N93119  
Near East Moriches, New York  
July 17, 1996

The accident airplane, N93119, a 747-100 series airplane (model 747-131), serial number (S/N) 20083, was manufactured by Boeing in July 1971 and purchased new by TWA. The airplane was added to TWA's operating certificate on October 27, 1971, and, except for a 1-year period, was operated by TWA in commercial transport service until the accident occurred. According to TWA records, the accident airplane had 93,303 total hours of operation (16,869 flight cycles) at the time of the accident. The 747-100 is a low-wing, transport-category airplane that is about 225 feet long and 63 feet high (from the ground to the top of the vertical stabilizer), with a wingspan of about 195 feet.

On July 17, 1996, about 2031 eastern daylight time, Trans World Airlines, Inc. (TWA) flight 800, a Boeing 747-131, N93119, crashed in the Atlantic Ocean near East Moriches, New York. TWA flight 800 was operating under the provisions of Code of Federal Regulations Part 121 as a scheduled international passenger flight from John F. Kennedy International Airport (JFK), New York, New York, to Charles DeGaulle International Airport, Paris, France. The flight departed JFK about 2019, with 2 pilots, 2 flight engineers, 14 flight attendants, and 212 passengers on board. All 230 people on board were killed, and the airplane was destroyed. Visual meteorological conditions prevailed for the flight, which operated on an instrument flight rules flight plan.

The National Transportation Safety Board determines that the probable cause of the TWA flight 800 accident was an explosion of the center wing fuel tank (CWT), resulting from ignition of the flammable fuel/air mixture in the tank. The source of ignition energy for the explosion could not be determined with certainty, but, of the sources evaluated by the investigation, the most likely was a short circuit outside of the CWT that allowed excessive voltage to enter it through electrical wiring

associated with the fuel quantity indication system.

Excerpts of corroborative statements for background:  
For Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800:

**3. Premise Explanation:** Explosion in the forward cargo compartment of explosive decompression caused by structural failure of ruptured open forward cargo door at one or both of the midspan latches caused by faulty electrical wiring:

**Proponent:** John Barry Smith

**Analysis:** To determine the pattern in early model Boeing 747 accidents that suffered breakups in flight, it was necessary to evaluate carefully all the official accident reports concerning them. A pattern was detected of similar significant evidence among only four of the many hull losses. It was very probable that one initial event by one cause was the reason for all four. The evidence is detailed below. There are many significant individual matches of evidence among each flight to each other. For instance, three flights had strange radar returns at event time but Air India Flight 182 was out of radar range and therefore there is no match for all, therefore the match is not included below. Only the matches for all four flights are listed below.

**Matching Significant Circumstantial Evidence:** The matching significant circumstantial evidence that follows is for all the four aircraft, Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800:

- A. All four aircraft had probable causes initially thought to be bomb explosions.
- B. All four aircraft had the probable cause of bomb explosion modified.
- C. All four aircraft had breakups in their airframes in a similar amidships location.
- D. All four aircraft had at least nine missing never recovered bodies.
- E. All four aircraft had passengers which showed explosive decompression type injuries and no injuries consistent with a detonation of a powerful bomb.
- F. All four aircraft experienced a sudden, loud, audible sound on the cockpit voice recorder at event start time.
- G. All four aircraft had the source of the sudden, loud, audible sound as a bomb explosion disputed and the source as an explosive decompression supported.
- H. All four aircraft had an abrupt power cut to the recorders immediately after the sudden, loud, audible sound.
- I. All four aircraft had an explosion in or adjacent to the forward cargo compartment.
- J. All four aircraft had similar shattered fuselage skin in and around the forward cargo door.
- K. All four aircraft had relatively mild damage on the port side of the nose forward of

the wing directly opposite the shattered zone around the forward cargo door at the same initial event time.

L. All four aircraft had similar damage to their airframe structures from inflight ejected debris.

M. All four aircraft had foreign object damage to engine number three.

N. All four aircraft had incomplete reports of the status of the forward cargo door, in particular, the status of the two midspan latches was omitted.

O. All four aircraft had similar debris patterns on the surface of the ground or sea bottom. (United Airlines Flight 811 had much lesser debris that still fell in the same pattern as the rest which was first items to leave the aircraft landed the closest to the initial event location.)

**4. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had probable causes which were initially thought to be bomb explosions:**

Air India Flight 182. Initial action was to speculate on explosive sabotage for the cause and immediately requisition the services of a specialist in the detection of explosives sabotage in aircraft wreckage.

Pan Am Flight 103: Within a few days items of wreckage were retrieved upon which forensic scientists found conclusive evidence of a detonating high explosive.

United Airlines Flight 811: The flight crew heard the explosion, checked the damage and reported to the tower a bomb had gone off in their aircraft.

Trans World Airlines Flight 800: Initial information led to consideration of the detonation of a high energy explosive device.

Excerpts of official corroborative statements to support the match that all four flights were thought initially to be 'bombs'.

**Air India Flight 182**

From the Indian Kirpal Report: Initial Action Taken by the Government of India 1.2.8 It was also being speculated that the accident may have occurred due to an explosion on board the aircraft. In order to see whether there was any evidence of an explosion which could be gathered from the floating wreckage which was being salvaged, the Government of India requisitioned the services of Mr. Eric Newton, a Specialist in the detection of explosives sabotage in aircraft wreckage.

**Pan Am Flight 103**

From Air Accidents Investigation Branch Aircraft Accident Report No 2/90 Synopsis: Within a few days items of wreckage were retrieved upon which forensic scientists found conclusive evidence of a detonating high explosive.

**United Airlines Flight 811**

From NTSB AAR 92/02 1.15 Survival Aspects: At 0210, the FAA notified the U.S. Coast Guard that a United Airlines, Inc., B-747, with a possible bomb on



board, had experienced an explosion and was returning to HNL.

#### Trans World Airlines Flight 800

From NTSB AAR 00/03 2.2.1 The In-Flight Breakup: On the basis of this initial information, investigators considered several possible causes for TWA flight 800s in-flight structural breakup: a structural failure and decompression; detonation of a high-energy explosive device, such as a bomb exploding inside the airplane or a missile warhead exploding upon impact with the airplane; and a fuel/air explosion in the center wing fuel tank (CWT). Several factors led to speculation that the accident might have been caused by a bomb or missile strike. These factors included heightened safety and security concerns because of the 1996 Olympics then being held in the United States, the fact that TWA flight 800 was an international flight, and the sudden and catastrophic nature of the in-flight breakup.

### **5. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had the original cause of bomb explosion modified.**

Two flights, United Airlines Flight 811 and Trans World Airlines Flight 800, had the accident cause changed from 'bomb explosion' to other; one flight, Air India Flight 182, remained a bomb for the Indians and maybe a bomb by the Canadians, and one flight, Pan Am 103, became an "improvised explosive device" which may or may not be a bomb.

Air India Flight 182 is now stated to be an explosion from an unstated source by the Canadian aviation accident investigators and an explosion by bomb by the judicial inquiry of Judge Kirpal.

Pan Am Flight 103 is now stated to be an explosion by an 'an improvised explosive device', which may or may not be a 'bomb'. The British accident investigators could certainly have called the cause a 'bomb' if they had chosen to but declined as the evidence supported a conclusion of an improvised explosive device but did not support the conclusion of a 'bomb.' A cargo door has become an improvised explosive device in the United Airlines Flight 811 and the Paris Turkish Airlines DC-10 events in which tremendous explosions occurred by the inadvertently improvised complex door device. Firecrackers and fireworks illegally carried aboard in a cabin or cargo compartment can become inadvertent improvised explosive devices.

United Airlines Flight 811 is now stated to be an explosion by explosive decompression caused by an inadvertently opened forward cargo door in flight from defective electrical wiring or switch. After landing safely the crew and ground personnel discovered that the forward cargo door had opened in flight and there was no evidence of a bomb on board as they previously reported.

Trans World Airlines Flight 800 is now stated to be an explosion of the center fuel tank by an unknown ignition source but probably faulty wiring. NTSB concluded that the in-flight breakup of TWA flight 800 was not initiated by a bomb or a missile strike because of the lack of any corroboration evidence associated with a high energy explosion. A bomb explosion or missile strike was the official working explanation for seventeen months. Evidence of a detonating high explosive was discovered but determined to be benign such as a 'dog sniffing' test.

Excerpts of official corroborative statements that two of the aircraft changed their initial cause from 'bomb', one aircraft had explosion as a bomb or an explosion of unstated cause, and one aircraft had an explosion by an improvised explosive device.

#### Air India Flight 182

From the Canadian Aviation Occurrence Report: Canadian Aviation Safety Board respectfully submits as follows:

4.1 Cause-Related Findings 5. There is considerable circumstantial and other evidence to indicate that the initial event was an explosion occurring in the forward cargo compartment. This evidence is not conclusive. However, the evidence does not support any other conclusion.'

From the Kirpal Report: 4.10 After going through the entire record we find that there is circumstantial as well as direct evidence which directly points

to the cause of the accident as being that of an explosion of a bomb in the forward cargo hold of the aircraft. At the same time there is complete lack of evidence to indicate that there was any structural failure.

#### Pan Am Flight 103

From AAIB Aircraft Accident Report No 2/90: Synopsis. The report concludes that the detonation of an improvised explosive device led directly to the destruction of the aircraft with the loss of all 259 persons on board and 11 of the residents of the town of Lockerbie

#### United Airlines Flight 811:

From NTSB AAR 92/02: Executive Summary: The airplane made a successful emergency landing at Honolulu and the occupants evacuated the airplane. Examination of the airplane revealed that the forward lower lobe cargo door had separated in flight and had caused extensive damage to the fuselage and cabin structure adjacent to the door.

#### Trans World Air Airlines Flight 800

From NTSB AAR 00/03: 2.2.1.2 Consideration of a High-Energy Explosive Device Detonation (Bomb or Missile Warhead) Despite being unable to determine the exact source of the trace amounts of explosive residue found on the wreckage, the lack of any corroborating evidence associated with a high-energy explosion indicates that these trace amounts did not result from the detonation of a high-energy explosive device on TWA flight 800. Accordingly, the Safety Board concludes that the in-flight breakup of TWA flight 800 was not initiated by a bomb or a missile strike. The National Transportation Safety Board determines that the probable cause of the TWA flight 800 accident was an explosion of the center wing fuel tank (CWT), resulting from ignition of the flammable fuel/air mixture in the tank. The source of ignition energy for the explosion could not be determined with certainty,

### **6. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had breakups in their airframes in a similar amidships location.**

For three of the aircraft the sudden huge hole appearing on the starboard side just forward of the wing was too large and the forward part of the aircraft pulled away from the aft part for a total breakup. United Airlines Flight 811 had a partial breakup with 'only' a ten foot by fifteen foot hole appearing and was able, with difficulty, to safely land soon after the explosive decompression when the forward cargo door opened in flight.

Air India Flight 182 had an inflight breakup when the aft part separated from the forward part.

Pan Am Flight 103 had an inflight breakup when the forward part pulled away from the rear part.

United Airlines Flight 811 had an inflight partial breakup of the forward part when a huge hole appeared in the nose of the aircraft.

Trans World Airlines Flight 800 had an inflight breakup when the nose portion pulled away from the rest of the aircraft.

Excerpts of official corroborative statements to support the match that all four flights had breakups in their airframes at a similar amidships location:

Air India Flight 182:

From the Canadian Aviation Occurrence Report: 3.3 Aircraft Break-up Sequence Hence, it is likely that the aft portion of the aircraft separated from the forward portion before striking the water. Canadian Aviation Safety Board Air India 23 June 1985, page 48

Pan Am Flight 103:

From AAIB Aircraft Accident Report No 2/90: 2.14 Summary The combined effect of the direct and indirect explosive forces was to destroy the structural integrity of the forward fuselage. UK AAIB Report 2/90 Page 56 The forward fuselage and flight deck area separated from the remaining structure within a period of 2 to 3 seconds." UK AAIB Report 2/90 Page 57 Although the pattern of distribution of bodies on the ground was not clear cut there was some correlation with seat allocation which suggested that the forward part of the aircraft had broken away from the rear early in the disintegration process. UK AAIB Report 2/90 Page 30

United Airlines Flight 811:

From NTSB AAR 92/02: 1.3 Damage to the Airplane The primary damage to the airplane consisted of a hole on the right side in the area of the forward lower lobe cargo door, approximately 10 by 15 feet large. An area of fuselage skin measuring about 13 feet lengthwise by 15 feet vertically, and extending from the upper sill of the forward cargo door, to the upper deck window belt, had separated from the airplane at a location above the cargo door extending to the upper deck windows. The floor beams adjacent to and inboard of the cargo door area had been fractured and buckled downward. NTSB/AAR 92/02 Page 4

Trans World Airlines Flight 800:

From NTSB AAR 00/03: 2.2.1.3 Consideration of a Fuel/Air Explosion in the Center Wing Fuel Tank It was clear from the wreckage recovery locations that the first pieces to depart the airplane were from the area in and around the airplane's wing center section (WCS), which includes the CWT, and, therefore, that the breakup must have initiated in this area.

**7. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had at least nine never recovered bodies.**

Extensive and long searches were made at the four accident sites soon after the events. The never recovered passengers were mostly those seated in the cabin near and above the forward

cargo door. One published report gives the macabre explanation for the missing bodies for United Airline Flight 811 as they were ingested into the adjacent number three engine.

Air India Flight 182 had 131 bodies recovered of the 329 which left 198 bodies never recovered with passengers assigned seats near and above the forward cargo compartment included in the missing.

Pan Am Flight 103 had ten passengers never recovered although evidence was presented of recovering very small items such as fragments of pieces of metal which indicates the extensive and thorough search that was conducted on land.

United Airlines Flight 811 had nine never recovered passengers, all expelled from the huge hole created when the forward cargo door opened in flight which took fuselage skin with it leaving the passengers above exposed. US Navy ships were on the scene very quickly but recovered no bodies.

Trans World Airlines Flight 800 has at least nineteen bodies never recovered although DNA testing of the fragments of bones identified all the passengers.

Excerpts of official corroborative statements to support the match that all four flights had at least nine missing, never recovered bodies.

#### Air India Flight 182

From the Canadian Aviation Occurrence Report: 3.1.6 In his testimony in Court, Wing Commander Dr. I.R. Hill further stated that the significance of flail injuries being suffered by some of the passengers was that it indicated that the aircraft had broken in mid-air at an altitude and that the victims had come out of the aeroplane at an altitude. He further explained that if an explosion had occurred in the cargo hold, it was possible that the bodies may not show any sign of explosion. It may here be mentioned that the forensic examination of the bodies do not disclose any evidence of an explosion. Furthermore, the seating pattern also shows that none of the bodies from Zone A or B was recovered, in fact as per the seating plan Zone B was supposed to have been unoccupied. This Zone is directly above the forward cargo compartment. Medical examination was conducted on the 131 bodies recovered after the accident. This comprises about 40 percent of the 329 persons on board. Canadian Aviation Safety Board Air India 23 June 1985, page 19

#### Pan Am Flight 103:

From AAIB Aircraft Accident Report No 2/90 1.13 Medical and pathological information The bodies of 10 passengers were not recovered and of these, 8 had been allocated seats in rows 23 to 28 positioned over the wing at the front of the economy section. UK AAIB Report 2/90 Page 31

#### United Airlines Flight 811

From NTSB AAR 92/02: Executive Summary: Nine of the passengers had been ejected from the airplane and lost at sea. 1.2 Injuries to Persons Injuries Flightcrew Cabincrew Passengers Others Serious Lost in flight. An extensive air and sea search for the passengers was unsuccessful. 1.15 Survival Aspects The fatal injuries were the result of the explosive nature of the decompression, which swept nine of the passengers from the airplane. The explosive decompression of the cabin when the cargo door separated caused the nine fatalities. The floor structure and

seats where the nine fatally injured passengers had been seated were subjected to the destructive forces of the decompression and the passengers were lost through the hole in the fuselage. Their remains were not recovered. Passengers-Nine Passengers who were seated in seats 8H, 9FGH, 10GH, 11GH and 12H, were ejected from the fuselage and were not found; and thus, are assumed to have been fatally injured in the accident.

Trans World Airlines Flight 800:

From NTSB AAR 00/03: 1.13 Medical and Pathological Information: Most identifications of occupants were accomplished through the use of fingerprints or dental records. However, in 29 cases, neither of these methods was successful; these cases required the use of deoxyribonucleic acid (DNA) protocols or forensic radiography as the primary means of identification. (Nineteen occupants were identified solely by DNA, and 10 were identified by forensic radiography, either by the medical examiner or the Armed Forces Institute of Pathology.)

**8. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had passengers that showed explosive decompression type injuries and no evidence of bomb explosion injuries.**

Air India Flight 182 has at least twenty five passengers who showed signs of decompression injuries and no evidence of bomb explosion injuries.

Pan Am Flight 103 had a majority of passengers who had been injured by the inflight disintegration of the aircraft and showed no evidence of bomb explosion injuries.

United Airlines Flight 811 had surviving passengers who suffered decompression type injuries such as baro trauma to the ear and no evidence of bomb explosion injuries.

Trans World Airlines Flight 800 had passengers who suffered from the effects of an inflight breakup of the aircraft and no evidence of bomb explosion injuries.

Excerpts of official corroborative statements to support the match that all four flights had passengers who suffered from decompression type injuries and no evidence of bomb explosion injuries.

Air India Flight 182

From the Canadian Aviation Occurrence Report: 2.9 Medical Evidence Flail pattern injuries were exhibited by eight bodies. Five of these were in Zone E, one in Zone D, two in Zone C and one crew member. The significance of flail injuries is that it indicates that the victims came out of the aircraft at altitude before it hit the water. There were 26 bodies that showed signs of hypoxia (lack of oxygen), including 12 children, 9 in Zones C, 6 in Zone D and 11 in Zone E. There were 25 bodies showing signs of decompression, including 7 children. Pathological examination failed to reveal any injuries indicative of a fire or explosion.

Pan Am Flight 103

From AAIB Aircraft Accident Report No 2/90 1.13 Medical and pathological information The results of the post mortem examination of the victims indicated that the majority had experienced severe multiple injuries at different stages, consistent with the in-flight disintegration of the aircraft and ground impact. There was no

pathological indication of an in-flight fire and no evidence that any of the victims had been injured by shrapnel from the explosion. There was also no evidence which unequivocally indicated that passengers or cabin crew had been killed or injured by the effects of a blast. Of the casualties from the aircraft, the majority were found in areas which indicated that they had been thrown from the fuselage during the disintegration. Although the pattern of distribution of bodies on the ground was not clear cut there was some correlation with seat allocation which suggested that the forward part of the aircraft had broken away from the rear early in the disintegration process. The bodies of 10 passengers were not recovered and of these, 8 had been allocated seats in rows 23 to 28 positioned over the wing at the front of the economy section.

#### United Airlines Flight 811

From NTSB AAR 92/02: Injury Information Passengers.--Nine Passengers who were seated in seats 8H, 9FGH, 10GH, 11GH, and 12H, were ejected from the fuselage and were not found; and thus, are assumed to have been fatally injured in the accident. Passengers seated in the indicated seats sustained the following injuries: Seat 7C Barotrauma to both ears 9E Superficial abrasions and contusions to the left hand, mild barotrauma to both ears 13D Barotrauma to both ears 13E Bleeding in both ears 14A Laceration in the parietal occipital area, barotrauma to both ears 16J Barotrauma to both ears 26A Barotrauma to both ears 26B Barotrauma to both ears 26H Barotitis to both ears, low back pain, irritation to the right eye due to foreign bodies 27A Barotrauma to the right ear 28J Superficial abrasions and a contusion to the left hand, mild barotrauma to both ears

#### Trans World Airlines Flight 800

From NTSB AAR 00/03: 1.13 Medical and Pathological Information A Medical Forensic Investigation Analysis Report, dated January 28, 1999, and prepared for the Department of Justice/FBI by a medical/forensic expert, 166 concluded the following: Exhaustive analysis of all available medical data on the victims of TWA Flight 800 by an experienced team of forensic pathologists, biomechanicists and criminal investigators failed to find any evidence that any victim was directly exposed to a bomb blast or missile warhead detonation. This finding makes it highly unlikely that a localized explosion occurred within the passenger cabin of TWA Flight 800. All injuries found in the victims were consistent with severe in-flight break up and subsequent water impact.

### **9. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had experienced a sudden, loud, audible sound on the cockpit voice recorder at event start time:**

It is very unusual to have a sudden, loud, audible sound appear to the flightcrew in flight. It never happens under usual circumstances and only four times in accidents. The rarity and difficulty in creating such an event leads to the assumption that one identical initial event caused the sound which appeared on all four cockpit voice recorders, such as a bomb explosion, a center tank explosion, or an explosive decompression from a sudden hull rupture.

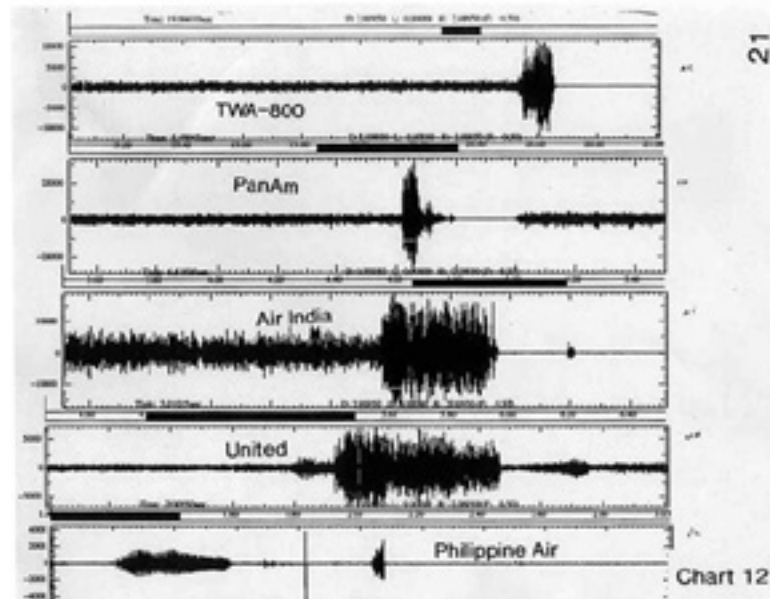
Air India Flight 182 was flying normally when a sudden, loud, audible sound occurred.

Pan Am Flight 103 was flying normally when a sudden, loud, audible sound occurred.

United Airlines Flight 811 was flying normally when a sudden, loud, audible sound occurred and described by a survivor as a 'tremendous explosion'.

Trans World Airlines Flight 800 was flying normally when a sudden, loud, audible sound occurred.

Excerpts of official corroborative statements to support the match that all four flights experienced a sudden, loud audible sound on the cockpit voice recorder at event start time.



Above Chart 12 from TWA 800 Public Docket for TWA 800 and shows CVR data for TWA 800, Pan Am Flight 103, Air India Flight 182, United Airlines Flight 811, and a Philippines Airlines 737.

**Air India Flight 182:**

From the Canadian Aviation Occurrence Report: 2.10.1 Analysis by National Research Council, Canada From the CVR and DFDR, AI 182 was proceeding normally en route from Montreal to London at an altitude of 31,000 feet and an indicated airspeed of 296 knots when the cockpit area microphone detected a sudden loud sound. The sound continued for about 0.6 seconds, and then almost immediately, the line from the cockpit area microphone to the cockpit voice recorder at the rear of the pressure cabin was most probably broken. This was followed by a loss of electrical power to the recorder. Canadian Aviation Safety Board Air India 23 June 1985, page 21

**Pan Am Flight 103:**

From AAIB Aircraft Accident Report No 2/90 1.11.2 Cockpit voice recorder The CVR tape was listened to for its full duration and there was no indication of anything abnormal with the aircraft, or unusual crew behaviour. The tape record ended, at 19:02:50 hrs +/- second, with a sudden loud sound on the CAM channel followed almost immediately by the cessation of recording whilst the crew were copying their transatlantic clearance from Shanwick ATC." UK AAIB Report 2/90

Page 15 It is not clear if the sound at the end of the recording is the result of the explosion or is from the break-up of the aircraft structure. The short period between the beginning of the event and the loss of electrical power suggests that the latter is more likely to be the case. UK AAIB Report 2/90 Page 38

**United Airlines Flight 811:**

From NTSB AAR 92/02: 1.11 Flight Recorders The CVR revealed normal communication before the decompression. At 0209:09:2 HST, a loud bang could be heard on the CVR. The loud bang was about 1.5 seconds after a "thump" was heard on the CVR for which one of the flightcrew made a comment. They heard a sound, described as a "thump," which shook the airplane. They said that this sound was followed immediately by a "tremendous explosion." The airplane had experienced an explosive decompression. The electrical power to the CVR was lost for approximately 21.4 seconds following the loud bang. The CVR returned to normal operation at 0209:29 HST, and cockpit conversation continued to be recorded in a normal manner. NTSB Accident Report 92-02 Page 25.

**Trans World Airlines Flight 800:**

From NTSB AAR 00/03: 1. Factual Information 1.1 History of Flight The CVR then recorded a very loud sound for a fraction of a second (0.117 second) on all channels immediately before the recording ended. 1.11.1.2 Cockpit Voice Recorder-Related Airplane Tests As previously discussed in section 1.1, the CVR recorded an event (a very loud sound) that was about 40 percent louder than the previous signals during the last few tenths of a second of the CVR recording, which continued until the CVR recording abruptly stopped. The CVRs recovered from these airplanes all recorded very loud sound events just before they stopped recording. The sound signatures from these events were compared with the sound signatures recorded at the end of the TWA flight 800 CVR recording. Generally, the sound signatures could be characterized based on how quickly the loud noise event rose from the background noise (rise time), the duration of the loud noise event, and how quickly the loud noise event decreased (fall time). 121 The TWA flight 800 CVR recorded noise characteristics that were most similar to those recorded by the CVRs on board the United flight 811 and Philippine Airlines airplanes. At 2031:12, the CVR recording ended. A sound spectrum study of the information recorded by the CVR revealed that twice within the last second of the CVR recording (about 0.73 and 0.68 seconds before the recording stopped), the captain's channel recorded harmonic tones at the 400 Hertz 10 (Hz) frequency, but it did not record other electrical system background noise that it had recorded previously throughout the recording. These other electrical system background noises were recorded on the other CVR channels without interruption. 11 The CVR then recorded a every loud sound for a fraction of a second (0.117 second) on all channels immediately before the recording ended. The accident airplane's last recorded radar 12 transponder return occurred at 2031:12, and a review of the FDR data indicated that the FDR lost power at 2031:12.

**10. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had the source of the sudden, loud, audible sound as a bomb explosion disputed and the source of the sudden, loud, audible sound as an explosive decompression supported.**



#### Air India Flight 182:

The sudden loud, audible sound lacked certain low frequencies and had a slower rise time for it to be the sound of a bomb explosion. The sudden loud sound matched that of an explosive decompression of a wide body DC-10 decompression accident sound.

#### Pan Am Flight 103:

The sudden loud, audible sound did not match any bomb explosion sounds. The sound did match the sound of its structure breaking up.

#### United Airlines Flight 811

The sudden loud, audible sound did not match any bomb explosion sounds because a bomb explosion was conclusively ruled out. The sudden loud sound did match the sound of the explosive decompression when its forward cargo door opened in flight which allowed the inside compressed air to rush out suddenly into the low pressure outside air.

#### Trans World Airlines Flight 800

The sudden loud, audible sound did not match any bomb explosion sounds because a bomb explosion was conclusively ruled out. The sudden loud sound was matched to the sound of a Boeing 747 explosive decompression accident sound, specifically, United Airlines Flight 811.

Excerpts of official corroborative statements to support the match that all had the source of the sudden, loud, audible sound as a bomb explosion disputed and the source as an explosive decompression supported.

#### Air India Flight 182

From the Canadian Aviation Occurrence Report: 2.10.2 Analysis by Accidents Investigation Branch (AIB), United Kingdom An analysis of the CVR audio found no significant very low frequency content which would be expected from the sound created by the detonation of a high explosive device. Considering the different acoustic characteristics between a DC-10 and a B747, the AIB analysis indicates that there were distinct similarities between the sound of the explosive decompression on the DC-10 and the sound recorded on the AI 182 CVR. 3.4.6.52 It would be pertinent to note that even according to the report of Mr. Davis the rise time in the case of Kanishka, which has been given for the peak is about 40 milliseconds. 3.4.6.55 A reference may also be made, at this stage, the frequency spectrum of the sound of the hand gun which was fired on a Boeing 737 flight deck. He has stated that the rise time for reaching the peak is almost instantaneous. Same is the case with regard to the frequency spectrum prepared by him of a bomb in a B-737 aircraft where the bomb had been placed in the freight hold which is shown in Fig. 6. A perusal of that spectrum also shows that the peak was reached in approximately 5 ms. 3.4.6.57 The fact that a bang was heard is evident to the ear when the CVR as well as the ATC tapes are played. The bang could have been caused by a rapid decompression but it could also have been caused by an explosive device. One fact which has, however, to be noticed is that the sound from the explosion must necessarily emanate a few milliseconds or seconds earlier than the sound of rapid decompression because the explosion must necessarily occur before a hole is made, which results in decompression. In the event of there being an

explosive detonation then the sound from there must reach the area mike first before the sound of decompression is received by it. The sound may travel either through the air or through the structure of the aircraft, but if there is no explosion of a device, but there is nevertheless an explosive decompression for some other reason, then it is that sound which will reach the area mike. To my mind it will be difficult to say, merely by looking at the spectra of the sound, that the bang recorded on the CVR tape was from an explosive device.

#### Pan Am Flight 103

From AAIB Aircraft Accident Report No 2/90 2.3.2 Cockpit voice recorders The analysis of the cockpit voice recording, which is detailed in Appendix C, concluded that there were valid signals available to the CVR when it stopped at 19:02:50 hrs  $\pm 1$  second because the power supply to the recorder was interrupted. It is not clear if the sound at the end of the recording is the result of the explosion or is from the break-up of the aircraft structure. The short period between the beginning of the event and the loss of electrical power suggests that the latter is more likely to be the case.

#### United Airlines Flight 811

From NTSB AAR 92/02: 1.11 Flight Recorders Examination of the data plotted from the DFDR indicated that the flight was normal from liftoff to the accident. The recorder operated normally during the period. However, the decompression event caused a data loss of approximately 2 1/2 seconds. When the data resumed being recorded, all values appeared valid with the exception of the pitch and roll parameters. Lateral acceleration showed a sharp increase immediately following the decompression. Vertical acceleration showed a sharp, rapid change just after the decompression and a slight increase as the airplane began its descent. The CVR revealed normal communication before the decompression. At 0209:09:2 HST, a loud bang could be heard on the CVR. The loud bang was about 1.5 seconds after a "thump" was heard on the CVR for which one of the flightcrew made a comment. The electrical power to the CVR was lost for approximately 21.4 seconds following the loud bang. The CVR returned to normal operation at 0209:29 HST, and cockpit conversation continued to be recorded in a normal manner

#### Trans World Airlines Flight 800

From NTSB AAR 00/03: 1.11.1.2 Cockpit Voice Recorder-Related Airplane Tests Sound spectrum analysis plots from these airplane tests were compared with those from the TWA flight 800 CVR recording. For further comparisons, the Safety Board plotted the CVR recordings from other known in-flight explosions/breakups (such as Pan Am flight 103, a 747-100 airplane that crashed at Lockerbie, Scotland, after a bomb on board exploded; 117 an Air India 747-100 that crashed in the Atlantic Ocean southwest of Ireland after a bomb on board exploded; and United flight 811, a 747-100 that lost its forward cargo door in flight. The CVRs recovered from these airplanes all recorded very loud sound events just before they stopped recording. The sound signatures from these events were compared with the sound signatures recorded at the end of the TWA flight 800 CVR recording. Generally, the sound signatures could be characterized based on how quickly the loud noise event rose from the background noise (rise time), the duration of the loud noise event, and how quickly the loud noise event decreased (fall time). The TWA flight 800 CVR recorded noise characteristics that were most similar to those recorded by the CVRs on board the United flight 811 and Philippine Airlines airplanes.

**11. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had an abrupt power cut to the data recorders immediately after a sudden, loud, audible sound at event start time.**

It is very unusual to have an abrupt power cut to the data recorders in flight. It never happens under usual circumstances and only four times in accidents which were preceded by another rare occurrence, a sudden, loud, audible sound on the flightdeck. The rarity and difficulty in creating such an event leads to the assumption that one identical initial event caused the abrupt power cut which disrupted all four data recorders, such as a bomb explosion, a center tank explosion, or an explosive decompression from a sudden hull rupture

The actual duration or the fall time of the sudden loud sound can not be determined because the power to the recording device was severed before the sound ended. The sound may have lasted for quite a long time but it is not recorded. The duration of the sound and the fall time of it on the recorders is independent of the actual duration and fall time of the sudden loud sound.

Air India Flight 182 was proceeding normally until a sudden, loud, audible sound was immediately followed by an abrupt power cut to the data recorders.

Pan Am Flight 103 was proceeding normally until a sudden, loud, audible sound was immediately followed by an abrupt power cut to the data recorders.

United Airlines Flight 811 was proceeding normally until a sudden, loud, audible sound was immediately followed by an abrupt power cut to the data recorders.

Trans World Airlines Flight 800 was proceeding normally until a sudden, loud, audible sound was immediately followed by an abrupt power cut to the data recorders.

Excerpts of official corroborative statements to support the match that all four flights were proceeding normally until a sudden, loud, audible sound was immediately followed by an abrupt power cut to the data recorders.

**Air India Flight 182**

From the Canadian Aviation Occurrence Report: ' 2.10.1 Analysis by National Research Council, Canada From the CVR and DFDR, AI 182 was proceeding normally en route from Montreal to London at an altitude of 31,000 feet and an indicated airspeed of 296 knots when the cockpit area microphone detected a sudden loud sound. The sound continued for about 0.6 seconds, and then almost immediately, the line from the cockpit area microphone to the cockpit voice recorder at the rear of the pressure cabin was most probably broken. This was followed by a loss of electrical power to the recorder. Canadian Aviation Safety Board Air India 23 June 1985, page 21 When synchronized with other recordings it was determined, within the accuracy that the procedure permitted, that the DFDR stopped recording simultaneously with the CVR. Canadian Aviation Safety Board Air India 23 June 1985, page 22

**Pan Am Flight 103**

From AAIB Aircraft Accident Report No 2/90 2.3.1 Digital flight data recordings The analysis of the recording from the DFDR fitted to N739PA, which is detailed in Appendix C, showed that the recorded data simply stopped. Following careful

examination and correlation of the various sources of recorded information, it was concluded that this occurred because the electrical power supply to the recorder had been interrupted at 19:02:50 +/- second. UK AAIB Report 2/90 Page 37 The analysis of the cockpit voice recording, which is detailed in Appendix C, concluded that there were valid signals available to the DVR when it stopped at 19:02.50 +/- second because the power supply to the recorder was interrupted. It is not clear if the sound at the end of the recording is the result of the explosion or is from the break-up of the aircraft structure. The short period between the beginning of the event and the loss of electrical power suggests that the latter is more likely to be the case. UK AAIB Report 2/90 Page 38

#### United Airlines Flight 811

From NTSB AAR 92/02: 1.11 Flight Recorders However, the decompression event caused a data loss of approximately 2 1/2 seconds. The CVR revealed normal communication before the decompression. At 0209:09:2 HST, a loud bang could be heard on the CVR. The loud bang was about 1.5 seconds after a "thump" was heard on the CVR for which one of the flightcrew made a comment. The electrical power to the CVR was lost for approximately 21.4 seconds following the loud bang. NTSB AAR 92/02. page 25

#### Trans World Airlines Flight 800:

From NTSB AAR 00/03: 1.11.2 Flight Data Recorder During the first 12 1/2 minutes of the accident flight (from the start of the takeoff roll until 2031:12, when the recording stopped abruptly), the FDR operated continuously and recorded data consistent with a normal departure and climb. The data indicated that the airplane was in a wings-level climb, and the vertical and longitudinal acceleration forces were consistent with normal airplane loads when the recording stopped. Examination of the FDR data revealed that the interruption of the recording at 2031:12 was consistent with the loss of electrical power to the recorder. 1.1 History of Flight At 2031:12, the CVR recording ended. The CVR then recorded a every loud sound for a fraction of a second (0.117 second) on all channels immediately before the recording ended. The accident airplane's last recorded radar 12 transponder return occurred at 2031:12, and a review of the FDR data indicated that the FDR lost power at 2031:12.

### **12. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had an explosion in or adjacent to the forward cargo compartment.**

Air India Flight 182 had an explosion in the forward cargo compartment.

Pan Am Flight 103 had an explosion in the forward cargo compartment.

United Airlines Flight 811 had an explosion in the forward cargo compartment.

Trans World Airlines Flight 800 had an explosion in the center fuel tank immediately adjacent to the forward cargo compartment with much tangible evidence of an explosion in the forward cargo compartment as the initial event and the center tank explosion later as a consequence.

Excerpts of official corroborative statements to support the match that all four flights had an explosion in or adjacent to the forward cargo compartment.

**Air India Flight 182:**

From the Canadian Aviation Occurrence Report: 4.1 Cause-Related Findings "There is considerable circumstantial and other evidence to indicate that the initial event was an explosion occurring in the forward cargo compartment." Canadian Aviation Safety Board Air India 23 June 1985, page 58

**Pan Am Flight 103:**

From AAIB Aircraft Accident Report No 2/90 1.12.2.4 Baggage containers It was evident, from the main wreckage layout, that the explosion had occurred in the forward cargo hold and, although all baggage container wreckage was examined, only items from this area which showed the relevant characteristics were considered for the reconstruction. The initial explosion triggered a sequence of events which effectively destroyed the structural integrity of the forward fuselage. UK AAIB Report 2/90 Page 43 The direct explosive forces produced a large hole in the fuselage structure and disrupted the main cabin floor. UK AAIB Report 2/90 Page 56

**United Airlines Flight 811:**

From NTSB AAR 92/02: 1.6.2 Cargo Door Description and Operation Both the forward and aft lower cargo doors are similar in appearance and operation. They are located on the lower right side of the fuselage and are outward-opening. The door opening is approximately 110 inches wide by 99 inches high, as measured along the fuselage. 1.3 Damage to the Airplane The primary damage to the airplane consisted of a hole on the right side in the area of the forward lower lobe cargo door, approximately 10 by 15 feet large. The cargo door fuselage cutout lower sill and side frames were intact but the door was missing (see figures 1 and 2). An area of fuselage skin measuring about 13 feet lengthwise by 15 feet vertically, and extending from the upper sill of the forward cargo door to the upper deck window belt, had separated from the airplane at a location above the cargo door extending to the upper deck windows. The floor beams adjacent to and inboard of the cargo door area had been fractured and buckled downward. Executive Summary The National Transportation Safety Board determines that the probable cause of this accident was the sudden opening of the forward lower lobe cargo door in flight and the subsequent explosive decompression.

**Trans World Airlines Flight 800:**

NTSB AAR 00/03 Executive Summary: The National Transportation Safety Board determines that the probable cause of the TWA flight 800 accident was an explosion of the center wing fuel tank (CWT), resulting from ignition of the flammable fuel/air mixture in the tank. The source of ignition energy for the explosion could not be determined with certainty, but, of the sources evaluated by the investigation, the most likely was a short circuit outside of the CWT that allowed excessive voltage to enter it through electrical wiring associated with the fuel quantity indication system. From NTSB TWA 800 Photographs and text from Public Docket No. SA-516, Exhibit No. 18A, Sequencing Study, page 20, "Downward separation directions were noted at STA 900, 880, 840, 820, 800, and 780...The initial opening of the fuselage lower lobe (e.g. LF6A) would have the expected

result of rapid depressurization accompanied by collapse of the main deck floor for some distance forward of STA 1000. The red area recovery of interior components as far forward as STA 600 would not be inconsistent with this floor collapse and associated structural breakup."

**13. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had similar shattered fuselage skin in and around the forward cargo door.**

The forward cargo doors of Pan Am Flight 103 and Air India Flight 182, are shown in drawings as equally split longitudinally which matches the retrieved United Airlines Flight 811 forward cargo door longitudinal split of its retrieved forward cargo door. The Trans World Airlines Flight 800 forward cargo door is shown in photographs as very shattered with two ruptures of outward peeled skin at each midspan latch.

The text description of the damage of the Air India Flight 182 forward cargo door and the surrounding area fits very closely with the photographs of the forward cargo door and the surrounding area of Trans World Airlines Flight 800, a Boeing 747 that also suffered an inflight breakup in flight thought to be caused by a bomb explosion in the forward cargo compartment. Photographs of the forward cargo door area of Trans World Airlines Flight 800 with the closeup of the forward cargo door area demonstrate the shattered destruction of the door area. The text from the Indian Kirpal report concerning pieces of wreckage debris around the forward cargo door of Air India Flight 182 describes very accurately the details in the photographs of the same area of Trans World Airlines Flight 800. The matches of both cargo door areas to each other with similar holes, flaps, fractures, inward concavity, tears, deformities, outward bent petals, curls, missing pieces, cracks, separations, curved fragments, spikes, and folds are apparent by matching the photographs of Trans World Airlines Flight 800 to the text of Air India Flight 182. There are no photographs yet available of the forward cargo door area of Air India Flight 182 in the accident reports to compare to the other three aircraft.



Above/previous page is a NTSB photograph of the wreckage reconstruction of Trans World Airlines Flight 800 starboard side over and forward of the wing. Fuselage station 600 is to the right extending to fuselage station 960 to the left in the photograph. A little over half of the forward cargo door is the shattered area in the lower right hand section. An outward opening petal shaped rupture can be seen at the aft midspan latch of the forward cargo door. The mildly damaged right hand, number two passenger door is in the middle left of the photograph.



Above is a closeup photograph of about a half of the Trans World Airlines Flight 800 forward cargo door extending from fuselage station 520 on the right to fuselage station 620 to the left in the photograph. The cargo door hinge is in red near the top of the photograph. The outward opening petal shaped oval rupture is located at the forward midspan latch of the forward cargo door.



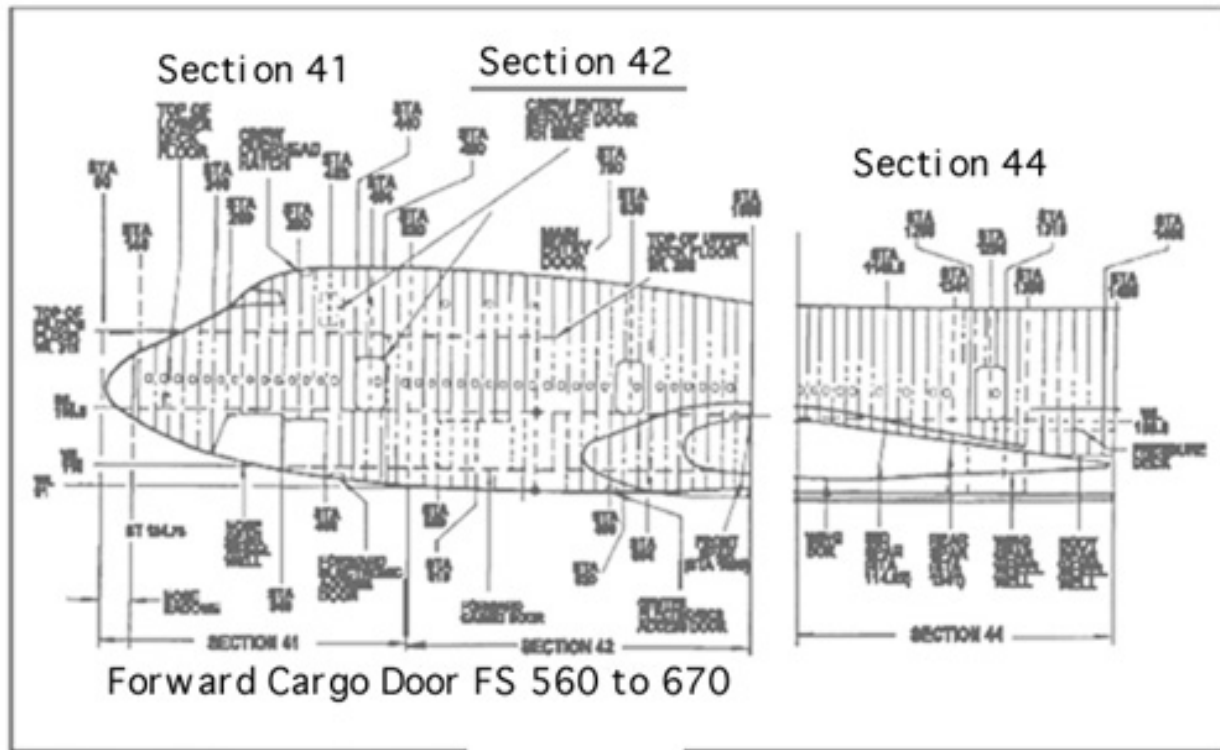


Figure 3a. Locator of fuselage sections 41, 42, and 44.

Above is a drawing from NTSB AAR 00/03 showing fuselage station numbers and sections.

Below is text from the Canadian Aviation Occurrence Report and the Indian Kirpal Report referring to Air India Flight 182 area forward of the wing on the starboard side:

E. Damage in air : The cargo door of the front cargo compartment was also found ruptured from above.

2.11.4.6 Section 42 Portions of section 42, consisting of the forward cargo hold, main deck passenger area, and the upper deck passenger area, were located near section 41. This area was severely damaged and some of section 42 was attached to section 44. Some of the structure identified from section 42 was the crown skin, the upper passenger compartment deck, the belly skin, and some of the cargo floor including roller tracks. The right-hand, number two passenger door including some of the upper and aft frame and outer skin was located beside section 44. Scattered on the sea bed near this area were a large number of suitcases and baggage as well as several badly damaged containers. All cargo doors were found intact and attached to the fuselage structure except for the forward cargo door which had some fuselage and cargo floor attached. This door, located on the forward right side of the aircraft, was broken horizontally about one-quarter of the distance above the lower frame. The damage to the door and the fuselage skin near the door appeared to have been caused by an outward force. The fractured surface of the cargo door appeared to have been badly frayed.

3.2.11.23 Target 399 - Fuselage around 2R Door This target is shown in Fig. 399-1. A detailed description is given below : TARGET 399 Fuselage Station 780 to 940 in the longitudinal direction and stringer 7R down to stringer 35R circumferentially. This piece contained five window frames, one in the 2R



passenger entry door. Three of the window frames, including the door window frame, still contained window panes. Little overall deformation was found in the stringers and skin above the door. The structure did contain a significant amount of damage and fractures in the skin and stringers beneath the window level. In the area beneath the level of the windows, the original convex outward shape of the surface had been deformed into an inward concave shape. Further inward concavity was found in the skin between many of the stringers below stringer 28R. The skin at the forward edge of the piece was folded outward and back between stringers 25R and 30R. Over most of the remaining edges of the piece a relatively small amount of overall deformation was noted in the skin adjacent to the edge separations. Twelve holes or damage areas were numbered and are further described.

No.1 : Hole, 5 inches by 9 inches with two large flaps and one smaller curl, all folded outward. Reversing slant fractures, small area missing.

No.2 : Hole, 2 inches by 3/4 inch, one flap folded outward, reversing slant fractures, one curled sliver, no missing metal.

No.3 : Triangular shaped hole about 2 inches on each side. One flap, folding inward, with one area with a serrated edge. No missing metal, extensive cracking away from corners of the hole, reversing slant fracture.

No.4 : Tear area, 8 inches overall, with deformation inward in the centre of the area. Reversing slant fracture.

No.5 : Fracture area with two legs measuring 14 inches and about 24 inches. Small triangular shaped piece missing from a position slightly above stringer 27R. Inward fold noted near the joint of the legs. An area of 45<sup>o</sup> scuff marks extend onto this fold.

No.6 : Hole about 2.5 inches by 3 inches with a flap folded outward, reversing slant fracture. Approximately half the metal from the hole is missing.

No.7 : Hole about 3 inches by 1 inch, all metal from the hole is missing. Fracture edges are deformed outward.

No.8 : Forward edge of the skin is deformed into an "S" shaped flap. Three inward curls noted on an edge.

No.9 : Inwardly deformed flap of metal between stringers 11R and 12R at a frame splice separation. No evidence of an impact on the outside surface.

No.10 : Door lower sill fractured and deformed downward at the aft edge of the door.

No.11 : Frame 860 missing above stringer 14R. Upper auxiliary frame of the door has its inner chord and web missing at station 860. A 10 inch piece of stringer 12R is missing aft of station 860.

No.12 : Attached piece of floor panel (beneath door) has one half of a seat track attached. The floor panel is perforated and the lower surface skin is torn.

3.2.11.28 Target 362/396 Forward Cargo Skin This piece included the station 815 electronic access door, portions of seven longitudinal stringers to the left of bottom centre and five longitudinal stringers to the right of bottom centre. The original shape of the piece (convex in the circumferential direction) had been deformed to a concave inward overall shape. Multiple separations were found in the skin as well as in the underlying stringers. Further inward concavity was found in the skin between most of the stringers.

3.2.11.29 The two sides of this piece are shown in Fig. 362-1 and 362-2. This piece has 25 holes or damaged areas in most of which there are multiple petals curling outwards. These holes are numbered 1 to 3, 4a, 4b, 4c and 5 to 23. These are described below. Unless otherwise noted, holes did not have any material missing :

- No.1 : Hole with a large flap of skin, reversing slant fracture.
- No.2 : Hole with multiple curls, reverse slant fracture.
- No.3: Hole with multiple flaps and curls, reversing slant fracture, one area of spikes (ragged sawtooth)
- No.4A: One large flap, reverse slant fracture, one area of spikes.
- No.4B : Hole with two flaps.
- No.4C : Hole with two flaps, one area of spikes
- No.5 : Hole with two flaps
- No.6 : Branching tear from the left side of the piece, reversing slant fracture.
- No.7 : Hole, with one flap, one curl and one area of spikes.
- No.8: Very large tear from the left side of the piece with multiple flaps and curls, reversing slant fracture and at least two areas of spikes.
- No.9 : Hole with multiple flaps, one curl.
- No. 10: 2.5 inch tear
- No.11: One flap
- No. 12: Grip hole, plus a curl with spikes on both sides of the curl.
- No.13: "U" shaped notch with gouge marks in the inboard/outboard direction. Three curls are nearby with one are of spikes. Gouges found on a nearby stringer and on a nearby flap.
- No. 14 : Nearly circular hole, 0.3 inch to 0.4 inch in diameter. Small metal lipping on outside surface of the skin. Most of the metal from the hole is missing.
- No. 15 : Hole in the skin beneath the first stringer to the left of centre bottom. Small piece missing.
- No. 16 : Hole in the stringer above hole No. 15. Most of the metal from this hole is missing.
- No. 17 : Hole through the second stringer to the left of centre bottom, 0.4 inch in diameter. The hole encompassed a rivet which attached the stringer to the outer skin. Small pieces of metal missing.
- No. 18 : Hole at the aft end of the piece between the third and fourth stringers to the left of centre bottom. The hole consisted of a circular portion (0.4 inch diameter), plus a folded lip extending away from the hole. The metal from the circular area was missing.
- No. 19 : Hole with metal folded from the outside to the inside, about 0.6 inch by 1.5 inch. Flap adjacent to the hole contained a heavy gouge mark on the outside surface of the skin.
- No. 20 : Hole containing a piece of extruded angle.
- No. 21 : Hole containing a piece of extruded angle.
- No. 22 : Hole with one flap.
- No. 23 : Hole about 0.3 inch in diameter, with tears away from the hole. Small piece missing.

Air India Flight 182 forward cargo door was ruptured, split and shattered.

Pan Am Flight 103 has no text information about the forward cargo door although it was near the location of the explosion in the forward cargo compartment. The reconstruction drawing shows the forward cargo door split longitudinally at the midspan latches at the initial event start time.

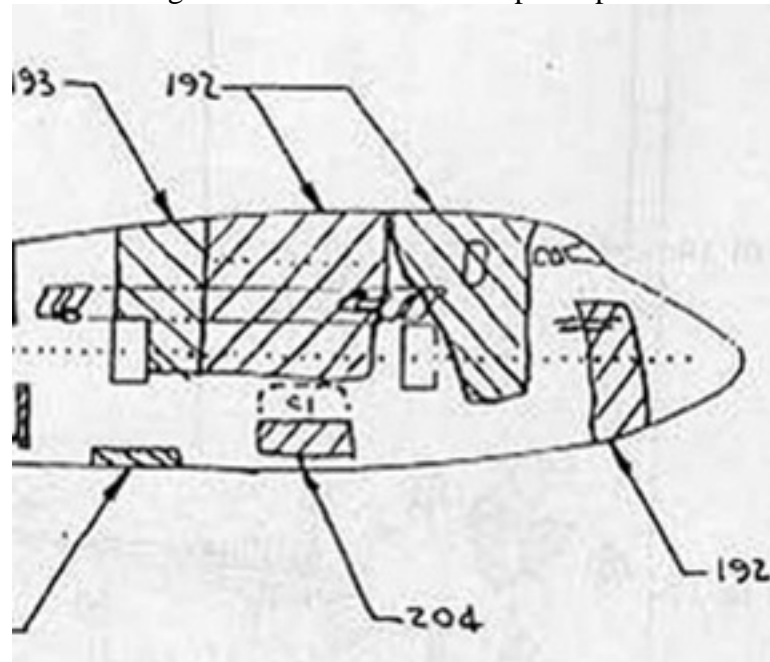


Above AAIB photograph of forward cargo door area of Pan Am Flight 103 shows the peeled back skin, vertical tear lines, and general shattered appearance.

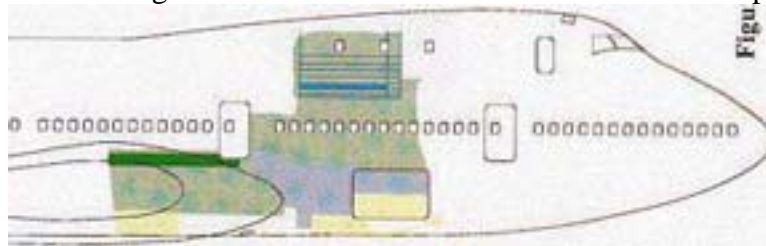
United Airlines Flight 811 gives a detailed report on the ruptured and split forward cargo door.

Trans World Airlines Flight 800 photographs show the ruptured, split and shattered forward cargo door.

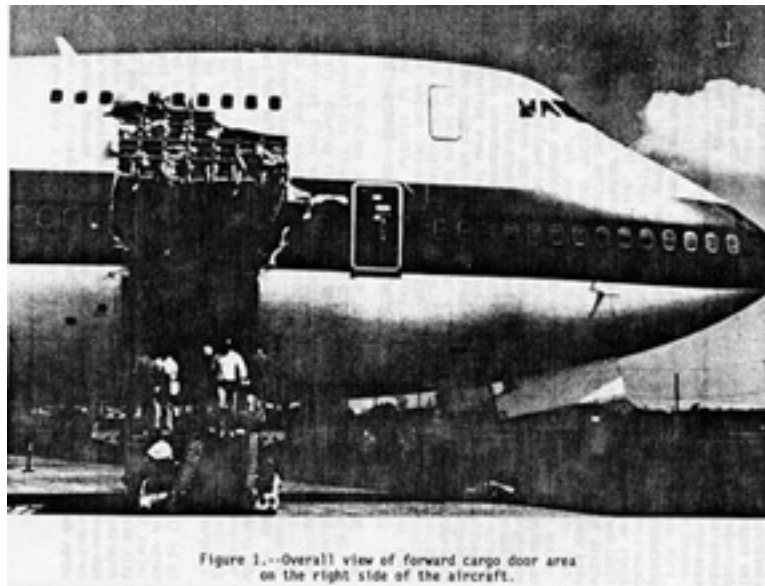
Excerpts of official corroborative drawings and photographs to support all aircraft had similar shattered skin in and around the forward cargo door. Air India Flight 182 from the Indian Kirpal Report:



Pan Am Flight 103 below from AAIB Aircraft Accident Report No 2/90



United Airlines Flight 811 below from NTSB AAR 92/02

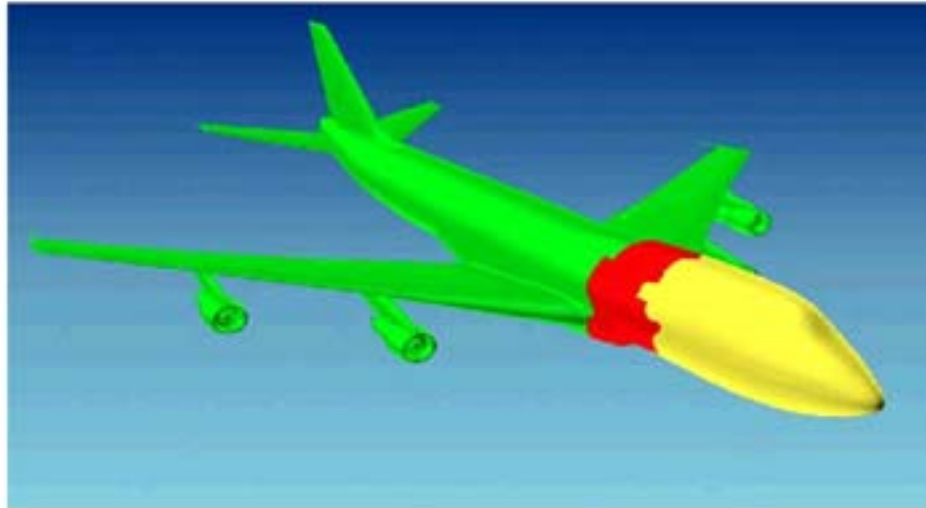


Trans World Airlines Flight 800 below from NTSB public docket and AAR 00/03:





Below illustration shows the red zone of Trans World Airlines Flight 800 which is where all the first debris left the aircraft. The red zone includes the forward cargo door area but the zone is forward of the center fuel tank.



**14. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had relatively mild damage on the port side of the nose forward of the wing directly opposite the shattered zone around the forward cargo door at the same initial event time.**

Air India Flight 182 concentrated on the starboard side since it had unusual damage on the fuselage wreckage. No photographs are yet available of the port side. There is no report of any damage on the port side of the aircraft. Only a few parts of the port side were retrieved and nothing unusual was reported about those pieces.

Pan Am Flight 103 had large areas of skin torn away on the starboard side during the first instants of the initial event while immediately opposite at the same time only a few pieces were torn off.

United Airlines Flight 811 had no damage to the port side of the airframe. All of the damage was on the starboard side from the explosive decompression and the ejected objects. The vertical stabilizer in the middle of the aircraft was damaged.

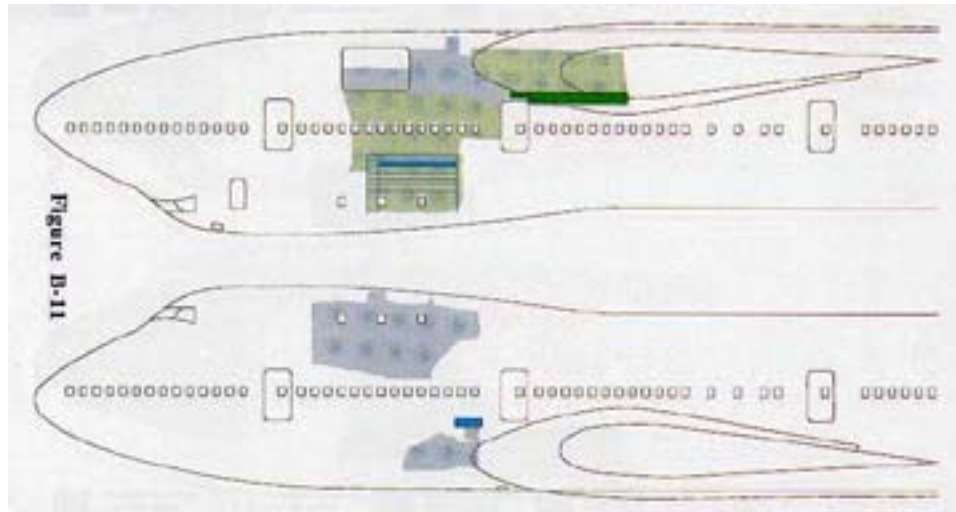
Trans World Airlines Flight 800 had no inflight damage on the port side while the starboard side directly opposite is shattered and torn.

Excerpts of official corroborative statements to support the match that all four flights had relatively mild damage on the port side of the nose forward of the wing directly opposite the shattered zone around the forward cargo door at the same initial event time.

Air India Flight 182: From the Indian Kirpal Report and the Canadian Aviation Occurrence Report: Five frames and door-port side aft# 5 left door (iii) Section of fuselage between B S 510 to B S 700, including the passenger window belt right side, up and over crown to include upper deck windows left side (Target No. 218). (iv) Section of fuselage between B S 720 to B S 840 including left side passenger

window belt, up and over crown to right side passenger window belt. Forward and upper edges of L H No.2 door cutout can be seen (Target No. 193). (v) Large section of fuselage between B S 1000 to B S 1460 including left side passenger window belt, up and over crown to right side passenger window belt. This section was found lying on its right side (Target No. 137). There was no reported in flight damage to engines Nos. 1 and 2.

Pan Am Flight 103: From UK AAIB Report 2/90



Above drawing from Figure B-11 of the AAIB report shows the large amounts of fuselage skin around the forward cargo door (top drawing) torn away at initial event time while on the port side (bottom drawing) at the same time, only a few pieces are torn off. The dark blue rectangle is the very small 'bomb explosion' shatter zone which is purported to have caused the aircraft to break in two.

United Airlines Flight 811: From NTSB AAR 92/02: 1.3 Damage to the Airplane  
 The primary damage to the airplane consisted of a hole on the right side in the area of the forward lower lobe cargo door, approximately 10 by 15 feet large. The cargo door fuselage cutout lower sill and side frames were intact but the door was missing (see figures 1 and 2). An area of fuselage skin measuring about 13 feet lengthwise by 15 feet vertically, and extending from the upper sill of the forward cargo door to the upper deck window belt, had separated from the airplane at a location above the cargo door extending to the upper deck windows. The floor beams adjacent to and inboard of the cargo door area had been fractured and buckled downward. Examination of all structure around the area of primary damage disclosed no evidence of preexisting cracks or corrosion. All fractures were typical of fresh overstress breaks. Debris had damaged portions of the right wing, the right horizontal stabilizer, the vertical stabilizer and engines Nos. 3 and 4. No damage was noted on the left side of the airplane, including engines Nos. 1 and 2.

Trans World Airlines Flight 800: From NTSB Public Docket photograph



Above photograph shows the smooth port side forward of the wing (nose to left in photograph), while directly opposite the starboard side is shattered and torn. There was no inflight damage to engines Nos. 1 or 2, both on the port side of the aircraft.

**15. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had similar damage to their airframe structures from inflight ejected debris.**

Air India Flight 182 had inflight damage to the right wing root, number three engine and cowling, engine number four cowling, vertical stabilizer, and the right horizontal stabilizer.

Pan Am Flight 103 had inflight damage to number three engine and cowling, the vertical stabilizer, and the right horizontal stabilizer. The wing was destroyed and examination for inflight damage was not possible.

United Airlines Flight 811 had inflight damage to the leading edge of the right wing, engine number three and cowling, engine number four and cowling, the vertical stabilizer, the right horizontal stabilizer.

Trans World Airlines Flight 800 had inflight damage to the right wing, engine number three and cowling, and the right horizontal stabilizer.

Excerpts of official corroborative statements to support the match that all four flights had similar inflight damage to their airframe structures.

**Air India Flight 182:**

From the Canadian Aviation Occurrence Report 3.4.1 Aircraft Break-up The examination of the floating wreckage indicates that the right wing root leading edge, the number 3 engine inboard fan cowling, the right inboard midflap leading edge, and the right horizontal stabilizer root leading edge all exhibit damage consistent with objects striking the right wing and stabilizer before water impact. page 49. The fan cowls of the number 4 engine show evidence of being struck by a portion of the turbine from number 3 engine. page 49 The right wing root fillet which faired the leading edge of the wing to the fuselage ahead of the right spar had a vertical dent similar to that which would have resulted had the fillet run into a soft cylindrical



object with significant relative velocity. page 30. The fan cowls of the number 4 engine had a series of five marks in a vertical line across the centre of the Air India logo on the inboard facing side of the fan cowl. These marks had the characteristic airfoil shape of a turbine blade tip. It is possible that a portion of the turbine parted from the number 3 engine and struck the cowl of the number 4 engine.

#### Pan Am Flight 103:

UK AAIB Report 2/90 1.14 Fire Of the several large pieces of aircraft wreckage which fell in the town of Lockerbie, one was seen to have the appearance of a ball of fire with a trail of flame. Its final path indicated this was the No 3 engine, which embedded itself in a road in the north-east part of the town. page 31 During this process the lower nose section struck the No 3 engine intake causing the engine to detach from its pylon. This fuselage separation was apparently complete within 3 seconds of the explosion. page 44. Containers and items of cargo ejected from the fuselage aperture in the forward hold, together with pieces of detached structure, collided with the empennage severing most of the left tailplane, disrupting the outer half of the right tailplane, and damaging the fin leading edge structure. page 57 Examination of the structure of the fin revealed evidence of in-flight damage to the leading edge caused by the impact of structure or cabin contents. 1.12.3.3 General damage features not directly associated with explosive forces. (v) A large, clear, imprint of semi-elliptical form was apparent on the lower right side at station 360 which had evidently been caused by the separating forward fuselage section striking the No 3 engine as it swung rearwards and to the right (confirmed by No 3 engine fan cowl damage)

#### United Airlines Flight 811:

From NTSB AAR 92/02: 1.3 Damage to the Airplane The primary damage to the airplane consisted of a hole on the right side in the area of the forward lower lobe cargo door, approximately 10 by 15 feet large. The cargo door fuselage cutout lower sill and side frames were intact but the door was missing. An area of fuselage skin measuring about 13 feet lengthwise by 15 feet vertically, and extending from the upper sill of the forward cargo door to the upper deck window belt, had separated from the airplane at a location above the cargo door extending to the upper deck windows. The floor beams adjacent to and inboard of the cargo door area had been fractured and buckled downwards. Debris had damaged portions of the right wing, the right horizontal stabilizer, the vertical stabilizer and engines Nos.3 and 4. The right wing had sustained impact damage along the leading edge between the No. 3 engine pylon and the No. 17 variable camber leading edge flap. Slight impact damage to the No. 18 leading edge flap was noted. The external surfaces of the No. 3 engine inlet cowl assembly exhibited foreign object damage including small tears, scuffs and a large outwardly directed hole. The entire circumference of all the acoustic (sound attenuator) panels installed on the inlet section of the cowl had been punctured, torn, or dented. The leading edges of all fan blade airfoils on the No. 3 engine exhibited extensive foreign object damage. External damage to the No 4 engine inlet and core cowls was confined to the inboard side of the inlet cowl assembly. The No. 4 engine fan blade airfoils had sustained both soft and hard object damage from foreign objects. NTSB/AAR 92/02 Page 7 NTSB/AAR 92/02 Page 8

#### Trans World Airlines Flight 800:

From NTSB TWA 800 Public Docket Exhibit 7A 3.1 Right Wing The right wing

had separated into two major sections. The wing structure between the inboard and outboard sections (WS 1224 to WS 1482) had broken into several pieces. Fire and soot damage was observed mainly on the inboard wing section, with some limited fire and soot damage on the other pieces. Docket No. SA-516, Exhibit No. 7A, Structures Group Report, page 33: 5.1 Horizontal Stabilizer, Some of the items found in the horizontal stabilizer are sections of seat track, a stator blade from turbine section, and glitter. On 5.1.1 Right Horizontal Stabilizer, page 34, An engine stator blade from turbine section penetrated the upper honeycomb surface near the outboard trailing edge.

**16. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had foreign object damage to engine number three.**

Engine number three is the engine closest to the fuselage on the starboard side and the engine closest to the forward cargo door. Any debris ejected from a sudden opening in the forward cargo compartment or cabin nearby will be ingested into the large fan of the engine. Foreign object damage to an engine inflight generally results in fire and bent or broken fan turbine blades. Sufficient ingestion of objects may result in an uncontainment where parts of the engine depart the nacelle and sometimes strike other parts of the aircraft such as the adjacent number four engine and cowling or the right horizontal stabilizer. Engine number three is directly in front of the right wing leading edge, the right wing fillet, and the right horizontal stabilizer.

Air India Flight 182 examination showed that an internal turbine part of engine number three departed and impacted the adjacent engine.

Pan Am Flight 103 examination showed engine number three ingested debris from within the aircraft.

United Airlines Flight 811 examination showed engine number three exhibited extensive foreign object damage.

Trans World Airlines Flight 800 examination showed that engine number three had many fan blades missing, soft body impacts on a partial airfoil, impact damage to the leading and trailing edges of the fan blades, and fan blade airfoils were bent rearward and the tips were bent forward. Foreign object damage is a cause for those damages.

Excerpts of official corroborative statements to support the match that all four flights had foreign object damage to engine number three.

Air India Flight 182:

From the Canadian Aviation Occurrence Report: The fan cowls of the number 4 engine show evidence of being struck by a portion of the turbine from number 3 engine. page 49 These marks had the characteristic airfoil shape of a turbine blade tip. It is possible that a portion of the turbine parted from the number 3 engine and struck the cowl of the number 4 engine.

Pan Am Flight 103:

UK AAIB Report 2/90 1.12.4 Examination of engines (ii) No 3 engine, identified on site as containing ingested debris from within the aircraft, nonetheless had no evidence of the type of shingling seen on the blades of No 2 engine.

United Airlines Flight 811: From NTSB AAR 92/02: 1.3 Damage to the Airplane  
The leading edges of all fan blade airfoils on the No. 3 engine exhibited extensive foreign object damage.

Trans World Airlines Flight 800:

From NTSB TWA 800 Public Docket Exhibit 8A, Page 11, paragraph 3, discussing results of engine 3 disassembly: Of the 46 fan blades in the fan rotor, 21 blades with complete or partial airfoils and 6 root sections were recovered. All of the fan blades had sooting on the convex airfoil surfaces. Most of the full length airfoils were bent rearward and the tips outboard of the outer midspan shroud were bent forward slightly. About half of the fan blades had impact damage to the leading and trailing edges. Almost all of the impact damage to the airfoils could be matched to contact with the midspan shroud on an adjacent blade. One full length blade had four soft body impacts along the leading edge and a partial airfoil had a soft body impact, which had some streaking extending rearward.

**17. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 had incomplete reports of the status of the forward cargo door.**

In particular, the status of the two midspan latches of the forward cargo door is omitted even though the door is close to the site of the initial explosion and the latched status of the other doors is usually given. There is evidence of ruptures at the midspan latches of all the forward cargo doors. There are two identically sized cargo doors on Boeing 747s with twenty latches and sixteen locking sectors. There are two midspan latches for each door. The aft cargo door, the bulk cargo door, and the CRAF door is often reported as intact and latched. The eight midspan latches for the forward cargo doors on the four accident aircraft have not been discovered, nor retrieved, nor examined, nor evaluated, nor status reported. The whereabouts of those eight midspan latches in the four forward cargo doors is a mystery.

Air India Flight 182 forward cargo door was shattered with no status reported for any of the ten latches yet the aft cargo door was intact and latched at the bottom. There is a description and drawing of a longitudinal split of the forward cargo door near the midspan latches.

Pan Am Flight 103 omitted the latch status of the forward cargo door which was split in two while the aft cargo door (frames 1800-1920) is reported as latched. A reconstruction drawing shows a longitudinal split at the midspan latches of the forward cargo door.

United Airlines Flight 811 reports on the split forward cargo door discuss the latching pins but omits the status of the midspan latch cams while the aft cargo door is intact and latched. The midspan latch area had a rupture at the aft midspan latch of the forward cargo door, giving the characteristic outward petal shaped explosion of metal.

Trans World Airlines Flight 800 reports on only the bottom eight latches of the forward cargo door and omits any discussion of the midspan latches which are missing from the wreckage database while the aft cargo door status is unreported. Trans World Airlines Flight 800 photographs show clearly the large petal shaped ruptures at both the midspan latches of the forward cargo door.

Excerpts of official corroborative statements to support the match that all four flights had incomplete reports of the status of the forward cargo door while status of aft cargo door is usually reported.

**Air India Flight 182**

From the Canadian Aviation Occurrence Report 2.11.4.6 Section 42 All cargo doors were found intact and attached to the fuselage structure except for the forward cargo door which had some fuselage and cargo floor attached. This door, located on the forward right side of the aircraft, was broken horizontally about one-quarter of the distance above the lower frame. The damage to the door and the fuselage skin near the door appeared to have been caused by an outward force. The fractured surface of the cargo door appeared to have been badly frayed. 2.4.3.6 From the video films of the wreckage it was found that the complete aft cargo door was intact and in its position except that it had come adrift slightly. The door was found latched at the bottom.

**Pan Am Flight 103**

From AAIB Aircraft Accident Report No 2/90 1.12.1.2 The Rosebank Crescent site Other items found in the wreckage included both body landing gears, the right wing landing gear, the left and right landing gear support beams and the cargo door (frames 1800-1920) which was latched. The CRAF door itself (latched) apart from the top area containing the hinge.

**United Airlines Flight 811:**

From NTSB AAR 92/02: 1.16.1.1 Before Recovery of the Door The forward mid-span latch pin was relatively undamaged. The aft mid-span latch pin had definite areas of damage. Both pins had wear areas where the cams would contact the pins during latching.

**Trans World Airlines Flight 800:**

From NTSB AAR 00/03: 1.16.4.4 Metallurgical Examination of the Forward Cargo Door The Safety Board also considered the possibility that the forward cargo door (the forward edge of which is located several feet aft of STA 520 on the lower right side of the fuselage) separated from the accident airplane in flight and that this separation initiated the breakup sequence. The Board examined the pieces of the forward cargo door, which were recovered from the yellow zone. All eight of the latching cams at the bottom of the door were recovered attached to pieces of the lower end of the door and were in the latched position. Additionally, the latching cams and pieces of the cargo door remained attached to the pins along the lower door sill. The hinge at the top of the door was broken into several pieces, but the hinge pin still held the various pieces of the hinge together. There was no evidence to suggest that this hinge separated. The forward cargo door exhibited severe crushing deformation and fragmentation, very similar to damage observed on the adjacent fuselage structure.

Public Docket Exhibit No. 15C, Report Number 97-82, Section 41/42 Joint, Forward Cargo Door, Examination of the lower lobe forward cargo door showed that all eight of the door latching cams remain attached (along with pieces of the door itself) to the pins along the lower door sill.

**18. Air India Flight 182, Pan Am Flight 103, and Trans World Airlines Flight 800, and United Airlines Flight 811 to a much lesser extent, had similar debris patterns on the surface of the ground or sea bottom.**

There was a denser, tight debris zone for the forward part of the aircraft and then scattered

in a trail for the rest of aircraft. The forward part of the aircraft debris was closest to the initial event site. United Airlines Flight 811 had limited wreckage and it was found by tracking radar information of the debris to the surface of the ocean. The similar debris patterns are to be expected because of the similar breakup amidships in flight.

Air India Flight 182 had the nose section and wing land in a localized zone with the rest of the aircraft spread out in a trail.

Pan Am Flight 103 had the forward fuselage fall in short trail and the aft fuselage in a loose trail with nose in one tightly packed zone.

United Airlines Flight 811 had pieces from the partial breakup of the forward fuselage fall to the sea.

Trans World Airlines Flight 800 had a tightly packed forward part of the fuselage fall in a zone and a looser trail for the aft fuselage.

Excerpts of official corroborative statements to support the match that all four flights had similar debris patterns.

#### Air India Flight 182

From the Canadian Aviation Occurrence Report 3.3 Aircraft Break-up Sequence The forward portion of the aircraft was highly localized, which indicates that it struck the water in one large mass. page 49. Although badly damaged, sections 41, 42, and 44, and the wing structure were located in a relatively localized area ... page 32. Section 46 and 48, including the vertical fin and horizontal stabilizer, extended in a west to east pattern... page 32. A third area which had some distinctive pattern was that of the engines, engine struts, and components and was localized ... page 32.

#### Pan Am Flight 103:

From AAIB Aircraft Accident Report No 2/90 1.12.1 General distribution of wreckage in the field The wreckage was distributed in two trails which became known as the northern and southern trails...page 15. The northern trail contained mainly wreckage from the rear fuselage, fin and the inner regions of both tailplanes together with structure and skin from the upper half of the fuselage forward to approximately the wing mid-chord position. page 17. The southern trail was easily defined...The trail contained numerous large items from the forward fuselage. page 18. 1.12.2.4 Baggage containers Discrimination between forward and rear cargo hold containers was relatively straightforward as the rear cargo hold wreckage was almost entirely confined to Lockerbie, whilst that from the forward hold was scattered along the southern wreckage trail.

#### United Airlines Flight 811:

From NTSB AAR 92/02: 1.12 Wreckage and Impact Information Navy radar near Honolulu tracked debris that fell from the airplane when the cargo door was lost. Refinement of the radar data led to a probable "splashdown" point in the ocean.

#### Trans World Airlines Flight 800:

From NTSB AAR 00/03: 1.12 Wreckage Recovery and Documentation Information Pieces of the wreckage were distributed along a northeasterly 123 path

about 4 miles long by 3 1/2 miles wide in the Atlantic Ocean off the coast of Long Island.

1.12.1 Wreckage Recovered from the Red Zone The red zone was the largest of the three zones and was located farthest west (closest to JFK) in the wreckage distribution. Pieces recovered from the red zone generally included pieces from between about fuselage STA 840 and about fuselage STA 1000 (the aft portion of section 42 see figure 3a for station references); the structure from the aft end of the forward cargo compartment; and pieces from the WCS, including most of the front spar, a large portion of SWB3, and the manufacturing access door from SWB2.

1.12.2 Wreckage Recovered from the Yellow Zone The yellow zone was the smallest of the three zones and was contained within the red zone on its northeastern side (see figure 22a). This zone contained pieces of the airplane's forward fuselage, from about STA 840 to the nose of the airplane (STA 90). The wreckage recovered from the yellow zone included nearly all of fuselage section 41 (the nose section) and the forward portions of fuselage section 42.

1.12.3 Wreckage Recovered from the Green Zone The green zone was located farthest east (farthest from JFK) in the wreckage distribution. Most of the airplane wreckage was recovered from this zone, including most of the pieces of both wings, all four engines, and the fuselage aft of about STA 1000 (fuselage sections 44, 46, and 48 see figures 3a and 3b for reference).

## 19. Summary of matching evidence for all aircraft:

There is overwhelming circumstantial and tangible evidence from the five aircraft accident reports that all four aircraft suffered a breakup in flight amidships caused by an explosion in the forward cargo compartment. One aircraft had a partial breakup, United Airlines Flight 811, and was fortunately able to land with its invaluable evidence for a positive incontrovertible explanation for the tremendous explosion of explosive decompression which created the tangible evidence of CVR, FDR, inflight damage, engine damage, and injuries to passengers which matches the other other three accidents in many significant ways as detailed below in Table 1:

Significant Direct and Tangible Evidence Obtained for Four B747 Breakups in Flight

	AI 182	PA103	UAL 811	TWA 800
Boeing 747	Yes	Yes	Yes	Yes
Early model -100 or -200	Yes	Yes	Yes	Yes
Open or jammed pressure relief doors	Maybe	Yes	Yes	Yes
Sudden airframe breakup in flight (partial or total)	Yes	Yes	Yes	Yes
Breakup occurs amidships	Yes	Yes	Yes	Yes
High flight time (over 55,000 flight hours)	No	Yes	Yes	Yes
Aged airframe (over 18 years of service)	No	Yes	Yes	Yes
Previous maintenance problems with forward cargo door	Yes	Maybe	Yes	Maybe
Initial event within an hour after takeoff	No	Yes	Yes	Yes
Initial event at about 300 knots while proceeding normally in all parameters	Yes	Yes	Yes	Yes
Initial event has unusual radar contacts	Maybe	Yes	Yes	Yes
Initial event involves hull rupture in or near forward cargo door area	Yes	Yes	Yes	Yes
Initial event starts with sudden sound	Yes	Yes	Yes	Yes
Initial event sound is loud	Yes	Yes	Yes	Yes
Initial event sound is audible to humans	Yes	Yes	Yes	Yes
Initial event followed immediately by abrupt power cut to data recorders	Yes	Yes	Yes	Yes
Initial event sound matched to explosion of bomb sound	No	No	No	No

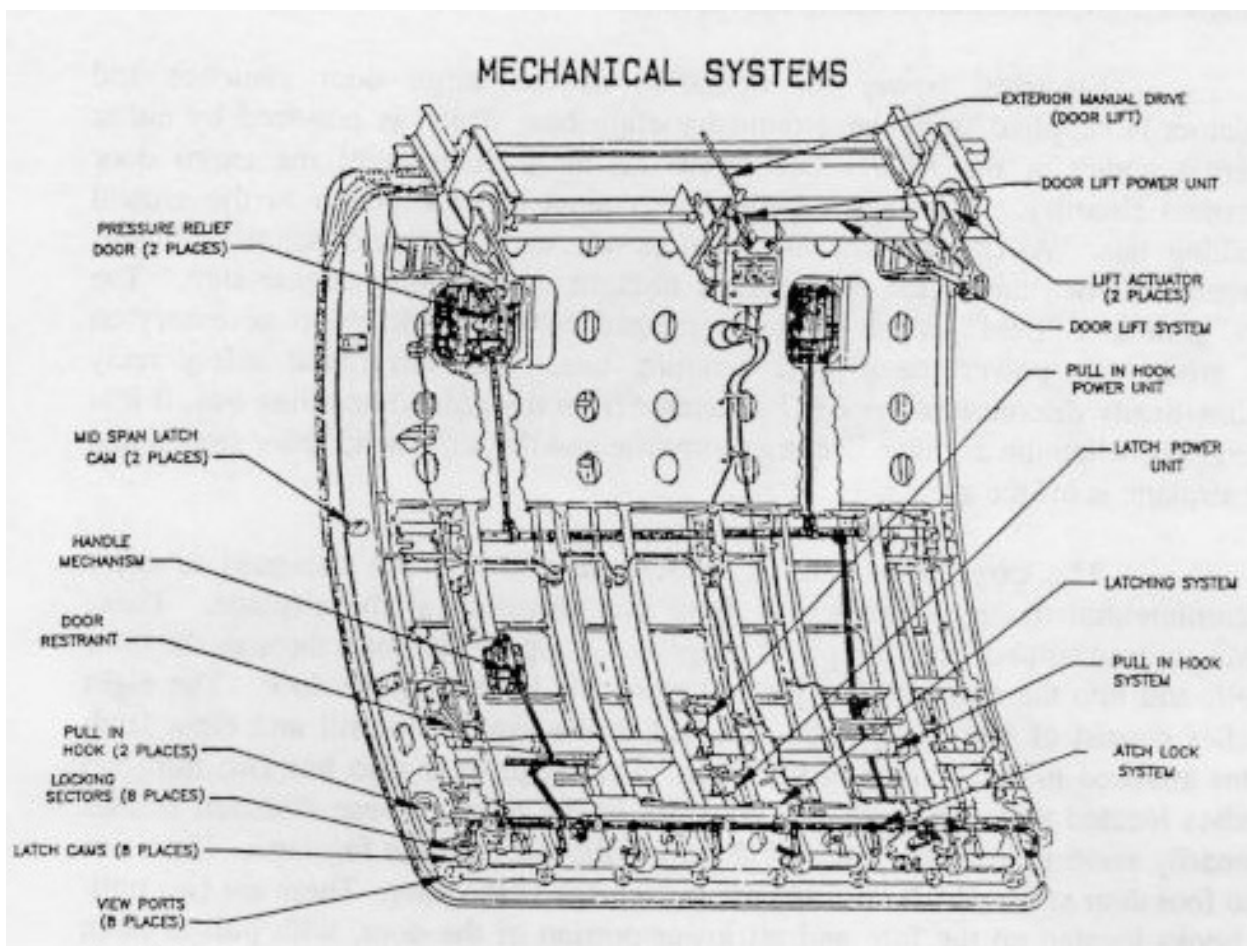
Initial event sound matched to explosive decompression sound in wide body airliner	Yes	Yes	Yes	Yes
Torn off skin on fuselage above forward cargo door area	Yes	Yes	Yes	Yes
Unusual paint smears on and above forward cargo door	Maybe	Maybe	Yes	Yes
Evidence of explosion in forward cargo compartment	Yes	Yes	Yes	Yes
Foreign object damage to engine or cowling of engine number three	Yes	Yes	Yes	Yes
Fire/soot in engine number three	Maybe	Yes	Yes	Yes
Foreign object damage to engine or cowling of engine number four	Yes	Yes	Yes	Yes
Right wing leading edge damaged in flight	Yes	Maybe	Yes	Maybe
Vertical stabilizer damaged in flight	Yes	Yes	Yes	Maybe
Right horizontal stabilizer damaged in flight	Yes	Yes	Yes	Yes
More severe inflight damage on starboard side than port side	Yes	Yes	Yes	Yes
Port side relatively undamaged by inflight debris	Yes	Yes	Yes	Yes
Vertical fuselage tear lines just aft or forward of the forward cargo door	Yes	Yes	Yes	Yes
Fracture/tear/rupture at a midspan latch of forward cargo door	Maybe	Yes	Yes	Yes
Midspan latching status of forward cargo door reported as latched	No	No	No	No
Airworthiness Directive 88-12-04 implemented (stronger lock sectors)	No	No	No	Yes
Outwardly peeled skin on upper forward fuselage	Yes	Yes	Yes	Yes
Rectangular shape of shattered area around forward cargo door	Yes	Yes	Yes	Yes
Forward cargo door fractured in two longitudinally	Yes	Yes	Yes	Maybe
Status of aft cargo door as intact and latched	Yes	Yes	Yes	Maybe
Passengers suffered decompression type injuries	Yes	Yes	Yes	Yes
At least nine missing and never recovered passenger bodies	Yes	Yes	Yes	Yes
Wreckage debris field in two main areas, forward and aft sections of aircraft	Yes	Yes	No	Yes
Initial official opinion of probable cause as bomb explosion.	Yes	Yes	Yes	Yes
Initial official opinion modified from bomb explosion	Yes	Yes	Yes	Yes
Structural failure considered for probable cause	Yes	Yes	Yes	Yes
Inadvertently opened forward cargo door considered for probable cause	Yes	No	Yes	Yes
Official probable cause as bomb explosion	Yes	Yes	No	No
Official probable cause as 'improvised explosive device'	No	Yes	No	No
Official probable cause as explosion by unstated cause	Yes	No	No	No
Official probable cause as explosion in center fuel tank with unknown ignition source	No	No	No	Yes
Official probable cause as improper latching of forward cargo door	No	No	Yes	No
Official probable cause as switch /wiring inadvertently opening forward cargo door	No	No	Yes	No
Significant Direct and Tangible Evidence Obtained for Four B747 Breakups in Flight				
	AI 182	PA103	UAL 811	TWA 800

## 20. Summary of matching evidence between Trans World Airlines Flight 800 and United Airlines Flight 811 specifically:

aged  
high flight time  
poly x wired  
early model Boeing 747  
and shortly after takeoff  
experienced hull rupture forward of the wing  
foreign object damage to starboard engines #3  
fire in number three engine  
more severe inflight damage on starboard side,  
at least nine never recovered bodies,  
torn off skin in forward cargo door area on starboard side,  
post side smooth forward of the wing.  
rupture at forward cargo door at aft midspan latch,

outward peeled skin on upper forward fuselage,  
 downward bent floor beams in cargo door area,  
 bare wire found in cargo door area.  
 vertical fuselage tear lines forward of the wing  
 parts initially shed from just forward of the wing.  
 first pieces of structure to leave aircraft in flight from forward cargo bay.  
 forward cargo door frayed  
 hoop stress found in cargo door area  
 door skin shattered outward.  
 sudden sound on CVR  
 loud sound on the CVR  
 short duration sound on the CVR  
 abrupt data loss to FDR  
 inadvertent opening of forward cargo door in flight considered  
 initially thought to be a bomb  
 but later ruled out.

**21. Cargo Door Operation for Boeing 747:** Drawing below of Boeing 747 cargo door from NTSB AAR 92/02



From AAR 92/02 United Airlines Flight 811: 1.6.2 Cargo Door Description



and Operation: Normally, the cargo doors are operated electrically by means of a switch located on the exterior of the fuselage, just forward of the door opening. The switch controls the opening and closing and the latching of the door. If at any time the switch is released, the switch will return to a neutral position, power is removed from all actuators, and movement of the actuators ceases.

In order to close the cargo door, the door switch is held to the "closed" position, energizing the closing actuator, and the door moves toward the closed position. After the door has reached the near closed position, the hook position switch transfers the electrical control power to the pull-in hook actuator, and the cargo door is brought to the closed position by the pull-in hooks. When the pull-in hooks reach their fully closed position, the hook-closed switch transfers electrical power to the latch actuator. The latch actuator rotates the eight latch cams, mounted on the lower portion of the door, around the eight latch pins, attached to the lower door sill. At the same time, the two midspan latch cams, located on the sides of the door rotate around the two midspan latch pins located on the sides of the door frame. When the eight latch cams and the two mid-span cams reach their fully closed position, electrical power is removed from the latch actuator by the latch-closed switch. This completes the electrically powered portion of the door closing operation. The door can also be operated in the same manner electrically by a switch located inside the cargo compartment adjacent to the door.

The final securing operation is the movement of lock sectors across the latch cams. These are manually moved in place across the open mouth of each of the eight lower cams through mechanical linkages to the master latch lock handle. The position of the lock sectors is indicated indirectly by noting visually the closed position of the two pressure relief doors located on the upper section of each cargo door. The pressure relief doors are designed to relieve any residual pressure differential before the cargo doors are opened after landing, and to prevent pressurization of the airplane should the airplane depart with the cargo doors not properly secured. The pressure relief doors are mechanically linked to the movement of the lock sectors. This final procedure also actuates the master latch lock switch, removing electrical control power from the opening and closing control circuits, and also extinguishes the cockpit cargo door warning light through a switch located on one of the pressure relief doors. Opening the cargo door is accomplished by reversing the above procedure.

The cargo door and its associated hardware are designed to carry circumferential (hoop) loads arising from pressurization of the airplane. These loads are transmitted from the piano hinge at the top of the door, through the door itself, and into the eight latches located along the bottom of the door. The eight latches consist of eight latch pins attached to the lower door sill and eight latch cams attached to the bottom of the door. The cargo door also has two midspan latches located along the fore and aft sides of the door. These midspan latches primarily serve to keep the sides of the door aligned with the fuselage. There are also four door stops which limit inward movement of the door. There are two pull-in hooks located on the fore and aft lower portion of the door, with pull-in hook pins on the sides of the door frame.' (Appendix F, Cargo Door Incidents)

## **22. Inadvertent Cargo Door Opening Causes:**

Once the direct and tangible evidence established that all four aircraft suffered a breakup in flight caused by an explosive decompression in the forward cargo compartment at the forward cargo door, the question became, "What made the forward cargo door suddenly rupture open in flight?"

There are many ways for an explosion to occur in the forward cargo compartment at the forward cargo door: (Current official opinion in parentheses)

- A. Bomb explosion. (Partially accepted for two flights, ruled out for two flights.)
- B. Crew or passenger error. (Ruled out for all flights.)
- C. Electrical fault in switch or wiring. (Accepted for two flights, ruled out for two flights.)
- D. Pneumatic overpressure. (Ruled out for all flights.)
- E. Cargo shift. (Ruled out for all flights.)
- F. Compressed air tank explosion. (Ruled out for all flights.)
- G. Fire in compartment. (Ruled out for all flights.)
- H. Missile strike. (Ruled out for all flights.)
- I. Midair collision. (Ruled out for all flights.)
- J. Fuel tank explosion. (Accepted for one flight, ruled out for three flights.)
- K. Stowaway. (Ruled out for all flights.)
- L. Electromagnetic interference. (Ruled out for all flights.)
- M. Comet or meteor. (Ruled out for all flights.)
- N. Space debris. (Ruled out for all flights.)
- O. Turbulence. (Ruled out for all flights.)
- P. Out of rig door. (Ruled out for all flights.)
- Q. Lightning. (Ruled out for all flights.)
- R. Metal fatigue. (Ruled out for all flights.)
- S. Improperly latched. (Initially accepted for one flight, then ruled out for all flights.)
- T. Design error. (Accepted for one flight, ruled out for three flights.)
- U. Repair error. (Ruled out for all flights.)
- V. Maintenance error. (Accepted for one flight, ruled out for three flights.)
- W. Collision with terrain. (Ruled out for all flights.)

The four aircraft have had most of these probable causes considered at one time or the other by the authorities in varying degrees of attention. The initial answers were wrong twice for United Airlines Flight 811 and Trans World Airlines Flight 800 and modified for Air India Flight 182 and Pan Am 103. United Airlines Flight 811 was at first explained as a bomb explosion, then it was changed to an improperly latched forward cargo door, then finally it was determined to be an electrical switch or wiring to cause the forward cargo door to open in flight. Trans World Airlines Flight 800 was at first explained as a bomb explosion, then a missile strike, and currently a center fuel tank explosion by an undetermined ignition source.

The current official probable causes for all four are ambiguous or mysterious:

- A. Air India Flight 182 Explosion of unstated cause or explosion of a bomb.
- B. Pan Am Flight 103: Improvised explosive device or a bomb.
- C. United Airlines Flight 811: Electrical switch or wiring causing forward cargo door to open in flight.
- D. Trans World Airlines Flight 800: Center fuel tank explosion by unknown ignition source with wiring the main suspect.

In all the cases, based upon the evidence now available to this investigator, an explosion occurred in the forward cargo compartment on the starboard side at event start time; in all cases explosive decompression in the forward cargo compartment caused a tremendous explosion which

mimics a bomb or fuel tank explosion; and in all cases there is much matching direct, tangible and circumstantial evidence to the one accident which has the irrefutable probable cause, United Airlines Flight 811, with the electrical switch or wiring causing the forward cargo door to rupture open inflight causing an explosion of explosive decompression in the forward cargo compartment.

Time has allowed this investigator to add further refinements to the confirmed probable cause of United Airlines Flight 811 in two ways; the location in the forward cargo door that ruptures first has been identified as one or both of the midspan latches and that the wiring has now been shown to be faulty in that it cracks and chafes to bare wire easily, especially in the presence of moisture.

The midspan latch area of the forward cargo door of United Airlines Flight 811, the reference accident, had a rupture at the aft midspan latch, showing the characteristic outward petal shaped explosion of metal. Air India Flight 182 describes the entire door in shattered terms of outward curled metal which would include the midspan latches and describes a longitudinal split near the latches. Pan Am Flight 103 shows a reconstruction drawing of a longitudinal split at the midspan latches and a photograph showing the characteristic peeled out and down skin from the aft midspan latch. Trans World Airlines Flight 800 shows clearly the large petal shaped ruptures at both the midspan latches of the forward cargo door.

The midspan latches have no locking sectors to prevent the inadvertent backdriving of the latching cams while the bottom eight latching cams do have the eight safety locking sectors. Each midspan latch holds together an eight foot slice of fuselage skin at the aft and forward edges of the cargo door against the tens of thousands of pounds of internal pressure exerted outward in flight.

The matching evidence of missing midspan latches, the large slice of fuselage the latches hold together, the lack of locking sectors on those midspan latches, the lack of a status report on the latches, and drawings and photographs of ruptures at those latch locations on the actual doors on all four aircraft indicates the ruptures in the forward cargo door on all four aircraft occurred at one or both of the midspan latches as the initial event leading to the explosive decompression and airframe breakup.

The investigation authorities in 1985/1986/1989/1990/1992/1996 also did not know of the faulty Poly X wiring because the faults of that type insulated wire only became apparent years later. That defective type of wiring, which was on Air India Flight 182, was implicated in the explosive decompression of United Airlines Flight 811. Also, the investigators of 1985 did not have the sound of the explosive decompression in the forward cargo compartment of a early model Boeing 747 which occurred in 1989 to match with Air India Flight 182 in 1985. They would have discovered the sounds of the Boeing 747 that was United Airlines Flight 811 matched the sudden loud sound of Air India Flight 182, just as the DC-10 explosive decompression sound matched Air India Flight 182.

If the 1985 CASB and AAIB and Indian investigators for Air India Flight 182 had had the UAL 811 NTSB AAR 92/02 and wiring records to review, they would have quickly discovered the many significant similarities and would probably have made the match between the two flights, and thus been able to make the right choice among an explosion of unstated cause, or a bomb explosion, or structural failure, or inadvertent rupture of the forward cargo door at one or both of the midspan latches due to faulty wiring causing the door to open in flight leading to explosive decompression.

### 23. Wiring:

The discovery of the faulty Poly X wiring, which was installed in all four aircraft, further narrows down the probable cause of the inadvertent door rupture to defective wiring. Cargo holds of Boeing 747s are known to have condensed water in them which accumulates in the bilges. The wire is of an aromatic polyimide type of insulation called Poly X. All four aircraft had this type of faulty wiring.

Excerpts of official corroborative statements to support the claim that Poly X wiring is defective: (Appendix G, Wiring)

Quote from Trans World Airlines Flight 800 Public Docket 516A, Exhibit 9A Systems Group Chairman's Factual report of Investigation, Page 47, "A Boeing telefax of June 25, 1997, stated that: The Poly-X wire was used as general purpose wire on the RA164 (TWA 800) aircraft. Wire insulation known as Poly-X had three in-service problems:

- Abrasion of the insulation in bundles installed in high vibration areas.

(This problem was corrected by Boeing Service Bulletin No. 747-71-7105, Dated July 19, 1974)

- Random flaking of the topcoat.

- Insulation radial cracks in tight bend radii.

Radial cracking phenomenon of the Poly-X wire was mainly associated with mechanical stress. Bend radius is the largest contributor to mechanical stress in installed wire or cable. Presence of moisture in conjunction with mechanical stress is also a contributor."

Trans World Airlines Flight 800 Public Docket 516A, Page 57, Letter from Commander Naval Air Systems Command to National Electrical Manufacturers Association, 1 Oct 82, "As you know, the problems with poly-x wire are well known to headquarters and its use had been curtailed."

From NTSB AAR 00/03 Trans World Airlines Flight 800: The results of these reviews are discussed in this section. Wiring-Related Accidents/Incidents In an October 21, 1996, fax, the Civil Aviation Authority of Singapore described an event that occurred on October 12, 1996, in which an operator reported that arcing in a wire bundle on a 747-200 cargo airplane had resulted in a fire at the aft bulkhead of the forward cargo compartment about STA 1000. The airplane was undergoing maintenance at the time of the fire, and subsequent inspection revealed damage to wire bundles W834, W846, W1524, and W370; the insulation blanket; the aft bulkhead of the forward cargo compartment; and (possibly) the CWT sealant. The operator removed the affected components from the airplane and shipped them to Boeing for examination and evaluation. A December 16, 1996, letter from Boeing stated that X-ray microanalysis and chemical identification of the damaged wire suggest that the insulation of the wire was damaged and that arcing had occurred between the damaged wires or that arcing between the damaged wires and ground had occurred.

### 24. Comment:

Aging aircraft problems such as cracking wiring do not get better with age; they get worse. Design problems such as inadequately latched non plug doors which open outward in flight can not

be fixed by putting more latches on them. Aircraft accidents will happen and most are caused by mechanical problems or pilot error. A very small percent are caused by sabotage in the air. (Appendix H, Accidents). Subsequent problems to 1985 discovered in and around the forward cargo door of Boeing 747s were expressed as Airworthiness Directives (AD) or service bulletins (SB).

- A. The locking sectors on the bottom eight latches of both cargo doors needed to be strengthened.
- B. The lower sill of the forward cargo door needed strengthening.
- C. Section 41 needed to be strengthened.
- D. Instructions needed to be made clearer to ground personnel to not backdrive the latches.
- E. Caution placards needed to be easily understandable.
- F. Wire bundles alongside the forward cargo door needed to be rerouted so they would not bind and chafe.

## **25. General Conclusions for Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800:**

When all the evidence is objectively considered using the hindsight of seventeen years, it is apparent that Air India Flight 182, Pan Am Flight 103, and Trans World Airlines Flight 800 have the same and only confirmed and irrefutable probable cause for the explosion of the explosive decompression in the forward cargo compartment that led to the breakup in flight, that of United Airlines Flight 811.

It is apparent that all four aircraft are related by direct, tangible, and circumstantial evidence to have suffered an amidships breakup in flight which occurred after an explosion on the starboard side in the forward cargo compartment which caused an explosive decompression, the cause of which was a suddenly ruptured open forward cargo door in flight probably at one or both of the midspan latches and probably caused by faulty wiring which turned on the door unlatch motor. The implications of these conclusions raises many questions which are addressed in Appendix I, Questions.

Based on the direct, tangible and circumstantial evidence of the four accidents, and using the benefit of hindsight, the conclusion of this investigator and author of this report is that the probable cause of the forward cargo door rupturing open in flight for the four aircraft was faulty wiring shorting on the door unlatch motor causing the forward cargo door to inadvertently rupture open in flight at one or both of the midspan latch leading to explosive decompression in the forward cargo compartment.

- A. Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800 experienced inflight breakups.
- B. The breakup was caused by an explosion in the forward cargo compartment on the starboard side.
- C. The explosion was a severe and sudden explosive decompression.
- D. The explosive decompression was caused by the suddenly ruptured open forward cargo door probably at one or both of the midspan latches.
- E. The ruptured open forward cargo door was probably caused by faulty wiring which turned on the door unlatch motor which unlatched the latching cams from around the latching pins in flight.
- F. The wiring fault was probably the Poly X wiring with inferior insulation which easily cracked to bare wire especially in the presence of moisture.

G. There were no bomb explosions in any cargo compartment, crew cabin, passenger cabin, or anywhere else in any of the aircraft.

## **26. Specific Conclusions for Trans World Airlines Flight 800:**

A. While proceeding normally, an inflight breakup of Trans World Airlines Flight 800 occurred suddenly and catastrophically at 13700 feet at 300 knots TAS. There were no survivors.

B. The breakup was caused by an explosion in the forward cargo compartment.

C. The explosion was a severe and sudden explosive decompression.

D. The explosive decompression was caused by the suddenly ruptured open forward cargo door probably at one or both of the midspan latches.

E. The ruptured open forward cargo door was probably caused by faulty wiring which turned on the door unlatch motor which unlatched the latching cams from around the latching pins in flight.

F. The wiring fault was probably the Poly X wiring with inferior insulation which easily cracked to bare wire especially in the presence of moisture.

G. There was no bomb explosion in any cargo compartment, crew cabin, passenger cabin, or anywhere else on the aircraft.

H. There was no explosion in the aft cargo compartment.

I. The sudden loud sound on the cockpit voice recorder was the sound of the air rushing out during the explosive decompression in the forward cargo compartment.

J. The abrupt power cut to the recorders was caused by the explosive effects of the decompression affecting the power cables in the adjacent main equipment compartment to the forward cargo compartment.

K. The explosion in the Center Wing Tank was not the initial event but happened after the nose had separated from the rest of the aircraft.

L. The ignition source for the explosion of the CWT was probably the on fire engine number three igniting the fuel vapors from the disintegrating fuel tank as both fell to the ocean.

M. The streak was probably evening orange sunlight reflecting off the pieces of the forward fuselage as they tore away from the aircraft and were reflected to the observers on the ground to the west.

## **27. Contributing causes:**

A. Water or moisture in the forward cargo compartment.

B. Weak locking sectors on the bottom eight latches of the cargo doors.

C. Poor design of one midspan latch per each eight foot side of the cargo doors.

D. Poor design of no locking sector for each midspan latch of the cargo doors.

E. Poor design of outward opening nonplug type large, squarish cargo doors in a highly pressurized hull.

## **28. Recommendations:**

A. An emergency airworthiness directive for immediate compliance should be issued for all operators of early model Boeing 747s to visually and electrically wire check all the wiring for integrity in the forward cargo door area as well as all wiring involved with operation of the forward cargo door.

B. All unnecessary electrical equipment on early model Boeing 747s should be turned off and remain off during flight.

C. All early model Boeing 747s should have the Poly X insulated wiring removed or isolated and replaced as soon as practicable.

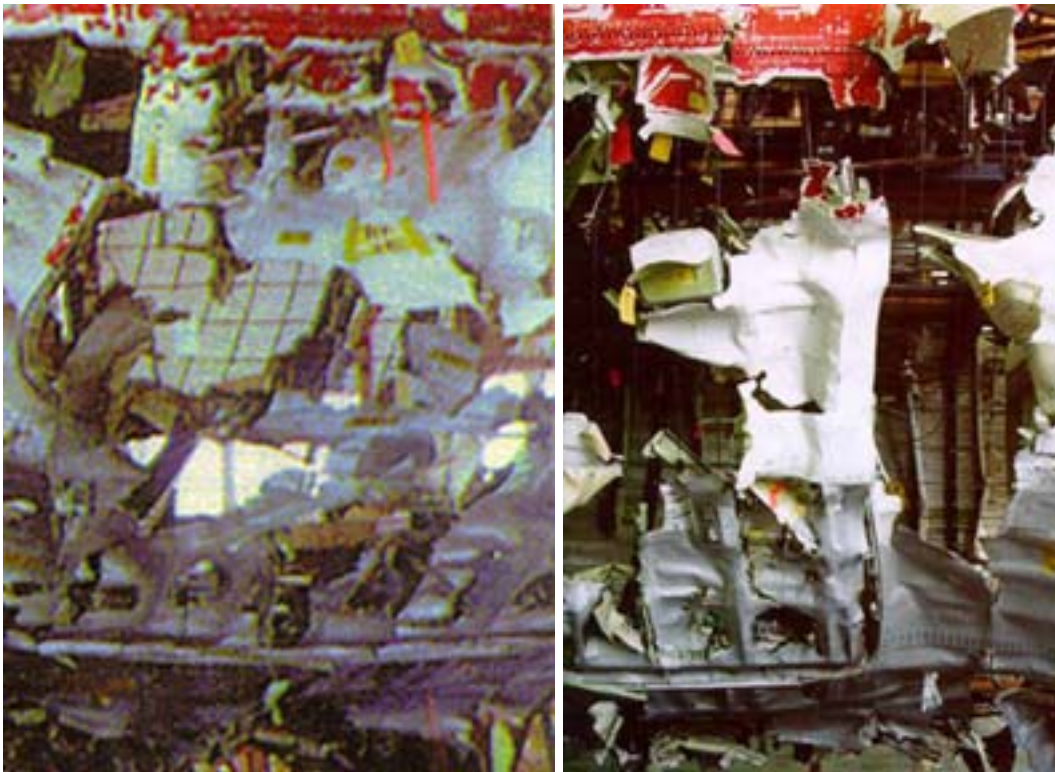
D. All early model Boeing 747s should have the aft and forward outward opening

nonplug cargo doors sealed shut permanently or modified into plug type doors.

E. The cargo door power circuit breaker may be pulled out at crew's discretion.

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**AIRCRAFT  
ACCIDENT  
REPORT  
Trans World Airlines Flight 800  
Part III  
Door Story**



**Report on the accident to  
Trans World Airlines Flight 800  
Boeing 747-131, N93119  
Near East Moriches, New York  
July 17, 1996  
by John Barry Smith,  
Independent Aircraft Accident Investigator**



### **Part III: Door Story**

#### **Forward Cargo Door Areas Compared for United Airlines Flight 811, Pan Am Flight 103, Air India Flight 182, and Trans World Airlines Flight 800.**

##### **Table of Contents**

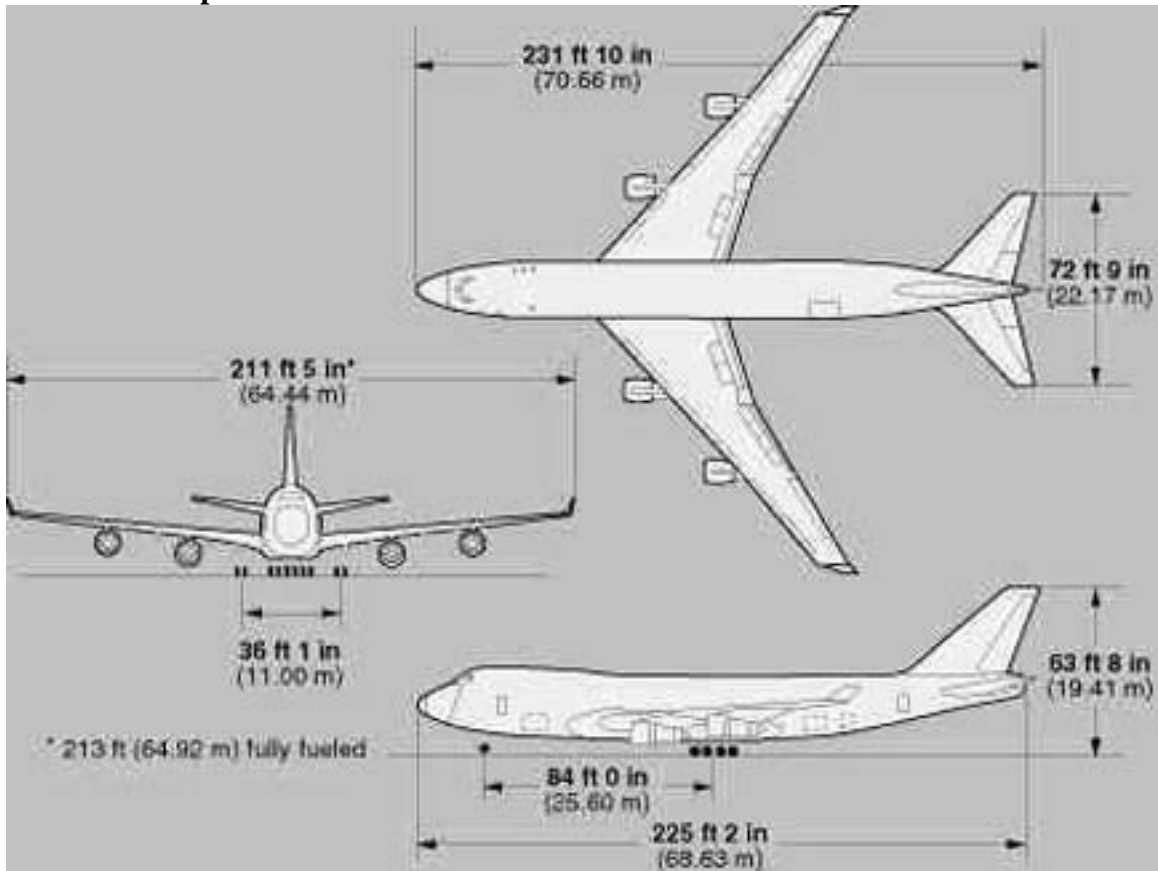
1. Introduction.
2. Normal Operation.
3. United Airlines Flight 811.
4. Air India Flight 182.
5. Pan Am Flight 103.
6. Trans World Airlines Flight 800
7. Forward cargo door areas examined in detail.
8. Pressure relief doors examined in detail.
9. Port and Starboard sides of Trans World Airlines Flight 800 examined in detail.
10. Conclusions.

##### **1. Introduction.**

The forward cargo door areas of four fatal Boeing 747 inflight accidents are examined and analyzed in schematics, photographs, and drawings from official government aircraft accident reports, press reports, and private files. The aircraft are Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800. The similarities of location of damage are revealed in the vertical tear lines above the cargo door, the outwardly peeled fuselage skin and door skin, jammed or missing pressure relief doors, the essential missing parts of the door such as latches and locking handle, petal shaped ruptures, and the general overall appearance of a shattered fuselage forward of the wing on the right side only. The relatively smooth port sides are shown also when available. A conclusion may be made that one cause may have been the initial event for all four accidents and that cause is the shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup explanation.

In addition, the normal operation of the forward cargo door is shown in pictures and described in text.

2. Normal operation.



Layout of Boeing 747 dimensions.



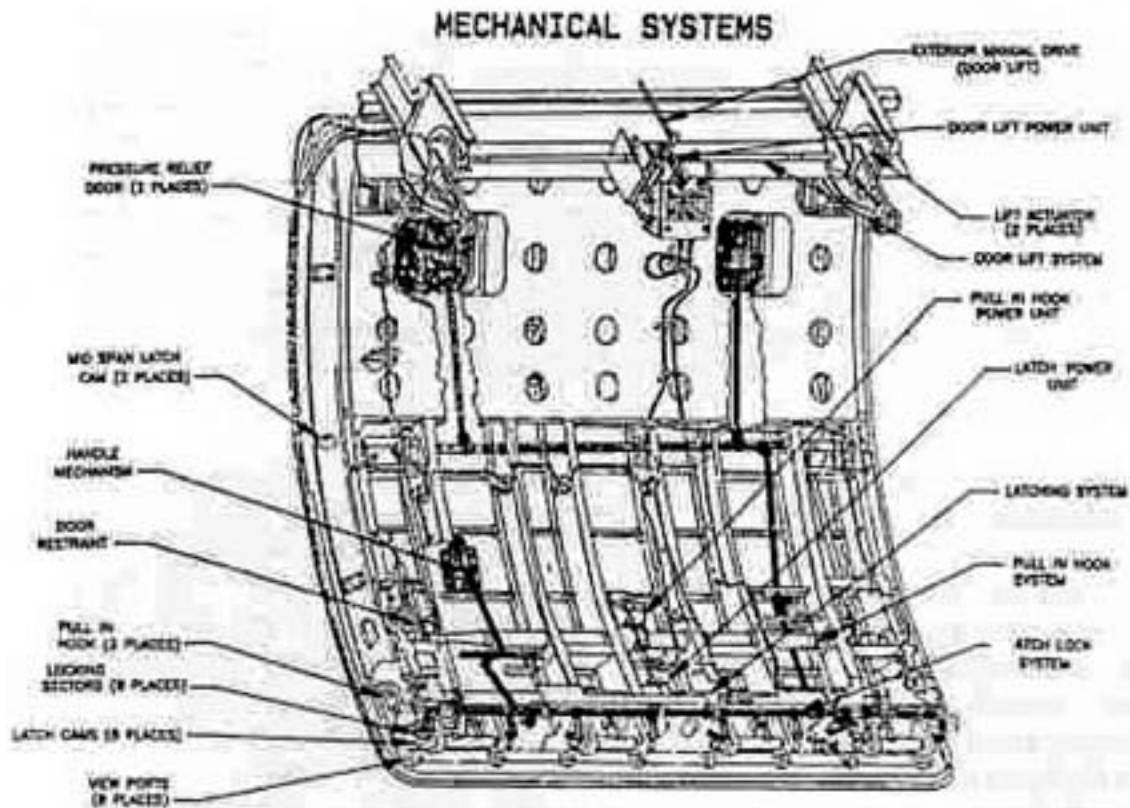
Above: Boeing 747 on ground loading cargo through opening outward nonplug forward cargo door. The tiny dot of the one midspan latch on the leading edge of the door can be seen.



Above: Closeup of Boeing 747 closed forward cargo door showing manual locking handle, upper hinge, over pressure relief doors, passenger windows above door, and R2 door.



Above: Closeup of open forward cargo door showing open manual locking handle, several of the bottom eight latches, forward leading edge midspan latch, and the aft leading edge midspan latch pin.



Drawing of Boeing 747 cargo door from NTSB AAR 92/02.

#### 1.6.2 Cargo Door Description and Operation

Both the forward and aft lower cargo doors are similar in appearance and operation. They are located on the lower right side of the fuselage and are outward-opening. The door opening is approximately 110 inches wide by 99 inches high, as measured along the fuselage.

Electrical power for operation of the cargo door switches and actuators is supplied from the ground handling bus, which is powered by either external power or the APU. See figure 17 for a diagram of the cargo door electrical circuitry. The engine generators cannot provide power to the ground handling bus. APU generator electrical power to the ground handling bus is interrupted when an engine generator is brought on line after engine start. The APU generator "field" switch can be reengaged by the flightcrew, if necessary on the ground, to power the ground handling bus. The air/ground safety relay automatically disconnects the APU generator from the ground handling bus, if it is energized, when the airplane becomes airborne and the air/ground relay senses that the airplane is off the ground. The cargo door and its associated hardware are designed to carry circumferential (hoop) loads arising from pressurization of the airplane. These loads are transmitted from the piano hinge at the top of the door, through the door itself, and into the eight latches located along the bottom of the door. The eight latches consist of eight latch pins attached to the lower door sill and eight latch cams attached to the bottom of the door. The cargo door also has two midspan latches located along the fore and

aft sides of the door. These midspan latches primarily serve to keep the sides of the door aligned with the fuselage. There are also four door stops which limit inward movement of the door. There are two pull-in hooks located on the fore and aft lower portion of the door, with pull-in hook pins on the sides of the door frame.

The cargo doors on the B-747 have a master latch lock handle installed on the exterior of the door. The handle is opened and closed manually. The master latch lock handle simultaneously controls the operation of the latch lock sectors, which act as locks for the latch cams, and the two pressure relief doors located on the door. Figure 5 depicts a lock sector and latch cam in an unlocked and locked condition.

The door has three electrical actuators for opening/closing and latching of the door. One actuator (main actuator) moves the door from the fully open position to the near closed position, and vice versa. A second actuator (pull-in hook actuator) moves the pull-in hooks closed or open, and the third actuator (latch actuator) rotates the latch cams from the unlatched position to the latched position, and vice versa. The latch actuator has an internal clutch, which slips to limit the torque output of the actuator. Normally, the cargo doors are operated electrically by means of a switch located on the exterior of the fuselage, just forward of the door opening. The switch controls the opening and closing and the latching of the door. If at any time the switch is released, the switch will return to a neutral position, power is removed from all actuators, and movement of the actuators ceases.

In order to close the cargo door, the door switch is held to the "closed" position, energizing the closing actuator, and the door moves toward the closed position. After the door has reached the near closed position, the hook position switch transfers the electrical control power to the pull-in hook actuator, and the cargo door is brought to the closed position by the pull-in hooks. When the pull-in hooks reach their fully closed position, the hook-closed switch transfers electrical power to the latch actuator. The latch actuator rotates the eight latch cams, mounted on the lower portion of the door, around the eight latch pins, attached to the lower door sill. At the same time, the two midspan latch cams, located on the sides of the door rotate around the two midspan latch pins located on the sides of the door frame. When the eight latch cams and the two mid-span cams reach their fully closed position, electrical power is removed from the latch actuator by the latch-closed switch. This completes the electrically powered portion of the door closing operation. The door can also be operated in the same manner electrically by a switch located inside the cargo compartment adjacent to the door.

The final securing operation is the movement of lock sectors across the latch cams. These are manually moved in place across the open mouth of each of the eight lower cams through mechanical linkages to the master latch lock handle. The position of the lock sectors is indicated indirectly by noting visually the closed position of the two pressure relief doors located on the upper section of each cargo door. The pressure relief doors are designed to relieve any residual pressure differential before the cargo doors are opened after landing, and to prevent pressurization of the airplane should the airplane depart with the cargo doors not properly secured. The pressure relief doors are mechanically linked to the movement of the lock sectors. This final procedure also actuates the master latch lock switch, removing electrical control power from the opening and closing control circuits, and also extinguishes the cockpit cargo door warning light through a switch located on one of the pressure relief doors. Opening the cargo door is accomplished by reversing the above procedure.

The B-747 cargo door has eight (8) view ports located beneath the latch cams for

direct viewing of the position of the cams by means of alignment stripes. Procedures for using these view ports for verifying the position of the cams were not in place or required by Boeing, the FAA, or UAL (see 1.17.5 for additional information).

Closing the door manually is accomplished through the same sequence of actions without electrical power. The door actuator mechanisms are manually driven to a closed and latched position by the use of a one-half inch socket driver. The door can also be opened manually with the use of the socket driver. There are separate socket drives for the door raising/lowering mechanism, the pull-in hooks, and the latches.

**3. United Airlines Flight 811**



United Airlines Boeing 747 in colors of 1989 with normally closed forward cargo door.



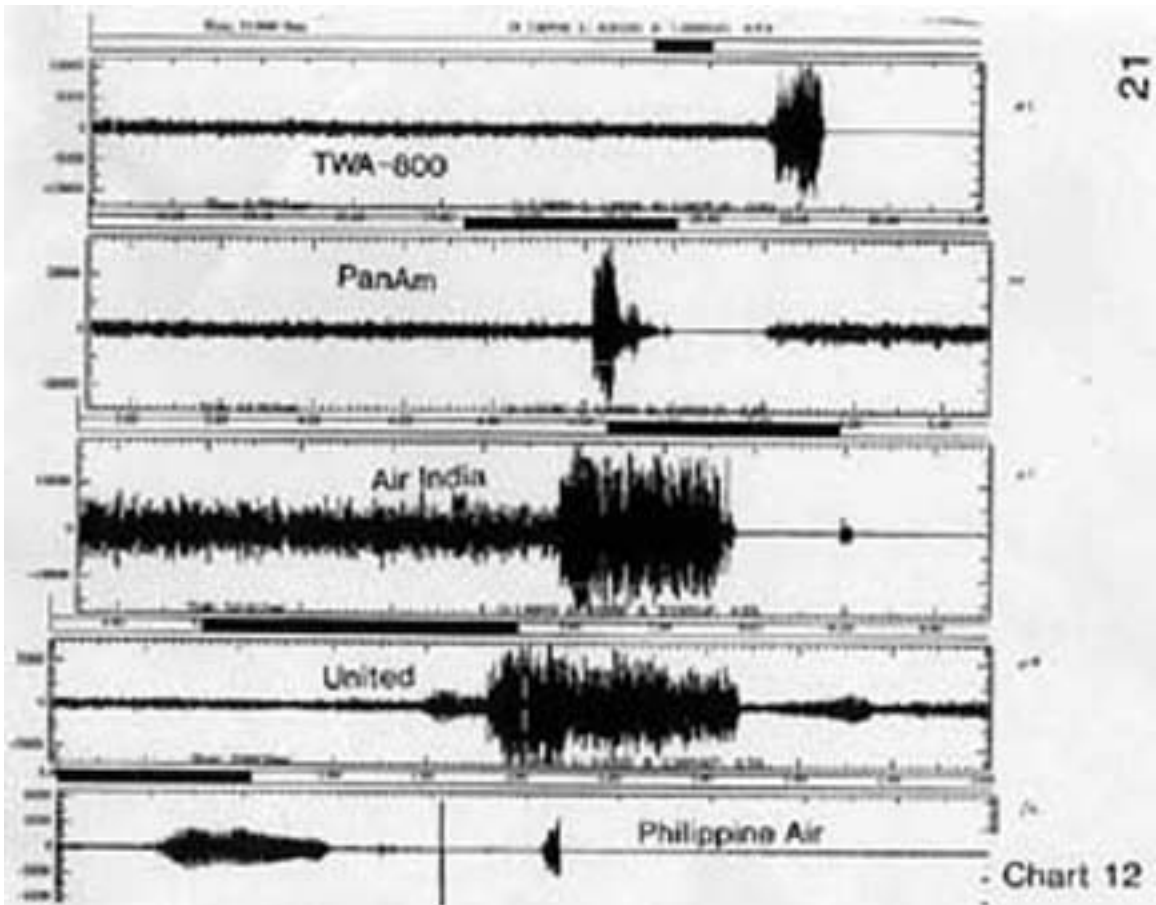


Chart 12 from Public Docket for Trans World Airlines Flight 800 comparing the sudden loud sounds from the inflight CVRs of Trans World Airlines Flight 800, Pan Am Flight 103, Air India Flight 182, United Airlines Flight 811 and a Boeing 737 on the ground.





Melodramatic artist's impression on cover of June 1989 Popular Mechanics showing United Airlines Flight 811 as it descends to land after inadvertent opening of forward cargo door in flight.



Photo of hole in United Airlines Flight 811 made by inadvertent opening of forward cargo door in flight. Note rectangular shape.



Photo of hole in United Airlines Flight 811 made by inadvertent opening of forward cargo door in flight.



Photo from NTSB AAR 92/02 of hole in United Airlines Flight 811 made by inadvertent opening of forward cargo door in flight.

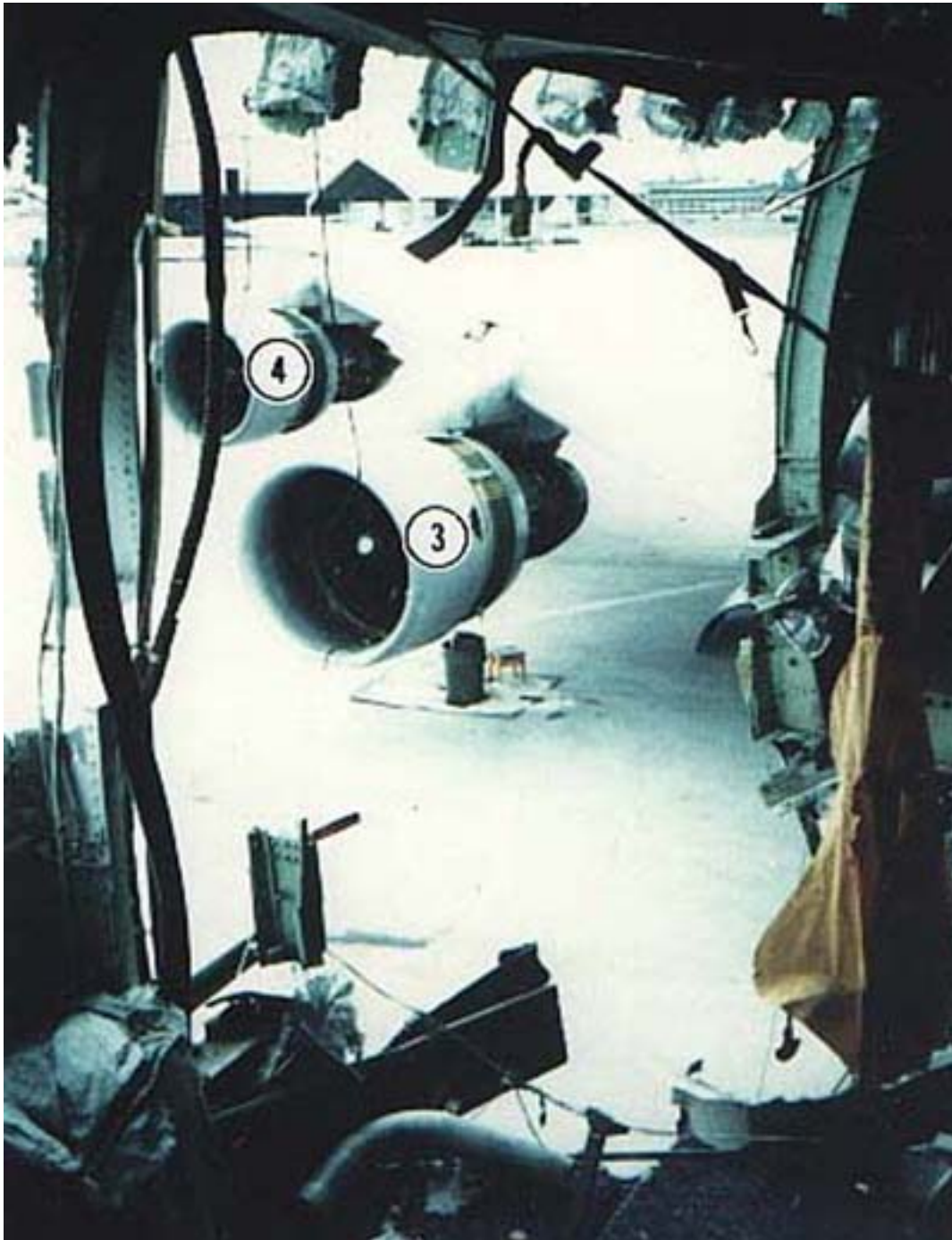


Photo from inside United Airlines Flight 811 showing the hole caused by inadvertent opening of forward cargo door in flight revealing engine numbers three and four which received the ejected foreign objects which caused the fire and internal engine damage.



## Sea surrenders Flight 811 culprit



Navy photo by Omar Hasan

The bottom half of the cargo door from United Flight 811 is examined on board a Navy contract support ship after it was retrieved from a depth of nearly three miles. The crew of the mini-sub Sea Cliff hopes to recover the top half this weekend. See story on Page A3.

Photo of newspaper article and photograph showing the lower half of retrieved forward cargo door, loose wiring, the longitudinal split at midspan latches, and the peeled away skin from the aft midspan latch.



Photo from NTSB AAR 92/02 for United Airlines Flight 811 showing both halves of the retrieved door, the longitudinal split at midspan latches, and the peeled away skin from the aft midspan latch.



Closeup photo from NTSB AAR 92/02 for United Airlines Flight 811 showing bottom half of the retrieved door, the longitudinal split at midspan latches, and the peeled away skin from the aft midspan latch.

United Airlines Flight 811:

"The CVR revealed normal communication before the decompression. At 0209:09:2 HST, a loud bang could be heard on the CVR. The loud bang was about 1.5 seconds after a "thump" was heard on the CVR for which one of the flightcrew made a comment. The electrical power to the CVR was lost for approximately 21.4 seconds following the loud bang. The CVR returned to normal operation at 0209:29 HST, and cockpit conversation continued to be recorded in a normal manner. NTSB Accident Report 92-02 Page 25

United Airlines Flight 811:

"However, the decompression event caused a data loss of approximately 2 1/2 seconds. When the data resumed being recorded, all values appeared valid with the exception of the pitch and roll parameters. Lateral acceleration showed a sharp increase immediately following the decompression. Vertical acceleration showed a sharp, rapid change just after the decompression and a slight increase as the airplane began its descent." NTSB AAR 92/02. page 25

Regarding United Airlines Flight 811 from NTSB AAR 92/02 to explain the above evidence:

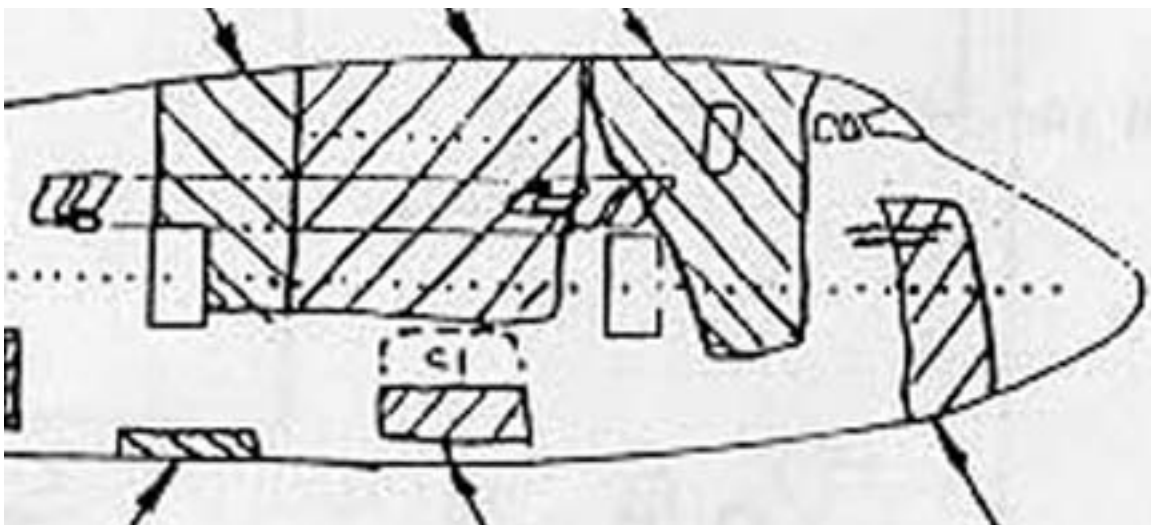
'The National Transportation Safety Board determines that the probable cause of this accident was the sudden opening of the forward lower lobe cargo door in flight and the subsequent explosive decompression. The door opening was attributed to a faulty switch or wiring in the door control system which permitted electrical actuation of the door latches toward the unlatched position after initial door closure and before takeoff. Contributing to the cause of the accident was a deficiency in the design of the cargo door locking mechanisms, which made them susceptible to deformation, allowing the door to become unlatched after being properly latched and locked.'



#### 4. Air India Flight 182



Photograph of Air India Boeing 747.



Reconstruction drawing from the Kirpal Report and the CASB report on Air India Flight 182 showing the longitudinal split of the forward cargo door and the vertical tearing of the skin above the door.

From the Kirpal report:

"2.11.4.6 All cargo doors were found intact and attached to the fuselage structure except for the forward cargo door which had some fuselage and cargo floor attached. This door, located on the forward right side of the aircraft, was broken horizontally about one-quarter of the distance above the lower frame. The damage to the door and the fuselage skin near the door appeared to have been caused by an outward force. The fractured surface of the cargo door appeared to have been badly frayed."

From private correspondence: "After lunch with them I [Mr. Campbell] asked " in light of what we now know on 811 do you still think that Air India was a bomb ?" The reply was that we [NTSB] never thought that Air India was a bomb in fact the video shows a cargo door exactly the same as 811. I [Mr. Campbell] wrote to both Air India and the Canadian Safety Board with my findings on 811 but did not even have the courtesy of a reply ."

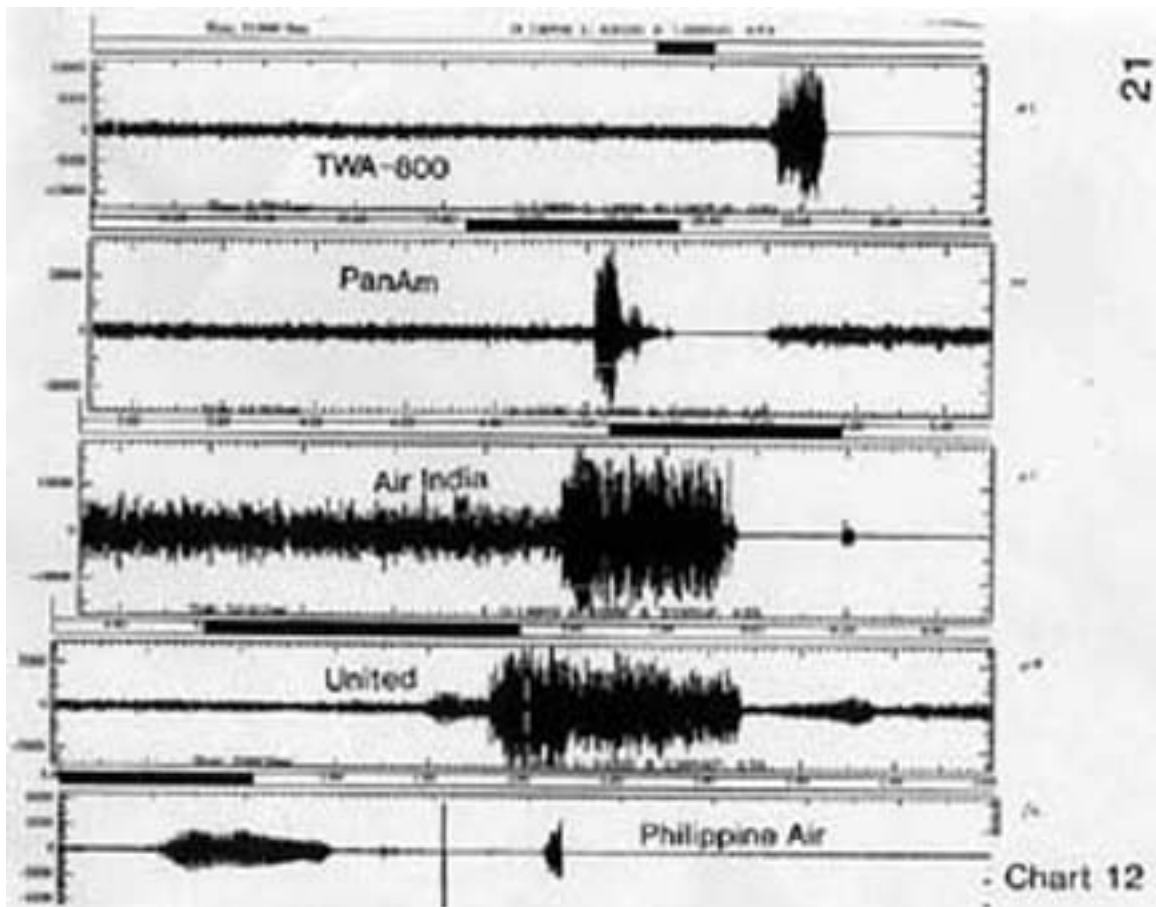
Quote above from correspondence of Mr. and Mrs Campbell discussing comments from NTSB



officials matching United Airlines Flight 811 forward cargo door to Air India Flight 182 forward cargo door.

B737, and a gun shot on the flight deck of a B737. Considering the different acoustic characteristics between a DC-10 and a B747, the AIB analysis indicates that there were distinct similarities between the sound of the explosive decompression on the DC-10 and the sound recorded on the AI 182 CVR.

Excerpt above from the Kirpal report and CASB report on Air India Flight 182 giving an explanation for the sudden loud sound which matches an explosive decompression open cargo door event on a DC-10, a widebody passenger airliner.



Air India Flight 182:

"From the CVR and DFDR, AI 182 was proceeding normally en route from Montreal to London at an altitude of 31,000 feet and an indicated airspeed of 296 knots when the cockpit area microphone detected a sudden loud sound. The sound continued for about 0.6 seconds, and then almost immediately, the line from the cockpit area microphone to the cockpit voice recorder at the rear of the pressure cabin was most probably broken. This was followed by a loss of electrical power to

the recorder." Canadian Aviation Safety Board Air India 23 June 1985, page 21  
Canadian Aviation Safety Board Air India 23 June 1985, page 21 "When  
synchronized with other recordings it was determined, within the accuracy that the  
procedure permitted, that the DFDR stopped recording simultaneously with the  
CVR." "Canadian Aviation Safety Board Air India 23 June 1985, page 22

#### 4.0 CONCLUSIONS

The Canadian Aviation Safety Board respectfully submits as follows:

##### 4.1 Cause-Related Findings

1. At 0714 GMT, 23 June 1985, and without warning, Air India Flight 182 was subjected to a sudden event at an altitude of 31,000 feet resulting in its crash into the sea and the death of all on board.
2. The forward and aft cargo compartments ruptured before water impact.
3. The section aft of the wings of the aircraft separated from the forward portion before water impact.
4. There is no evidence to indicate that structural failure of the aircraft was the lead event in this occurrence.
5. There is considerable circumstantial and other evidence to indicate that the initial event was an explosion occurring in the forward cargo compartment. This evidence is not conclusive. However, the evidence does not support any other conclusion.

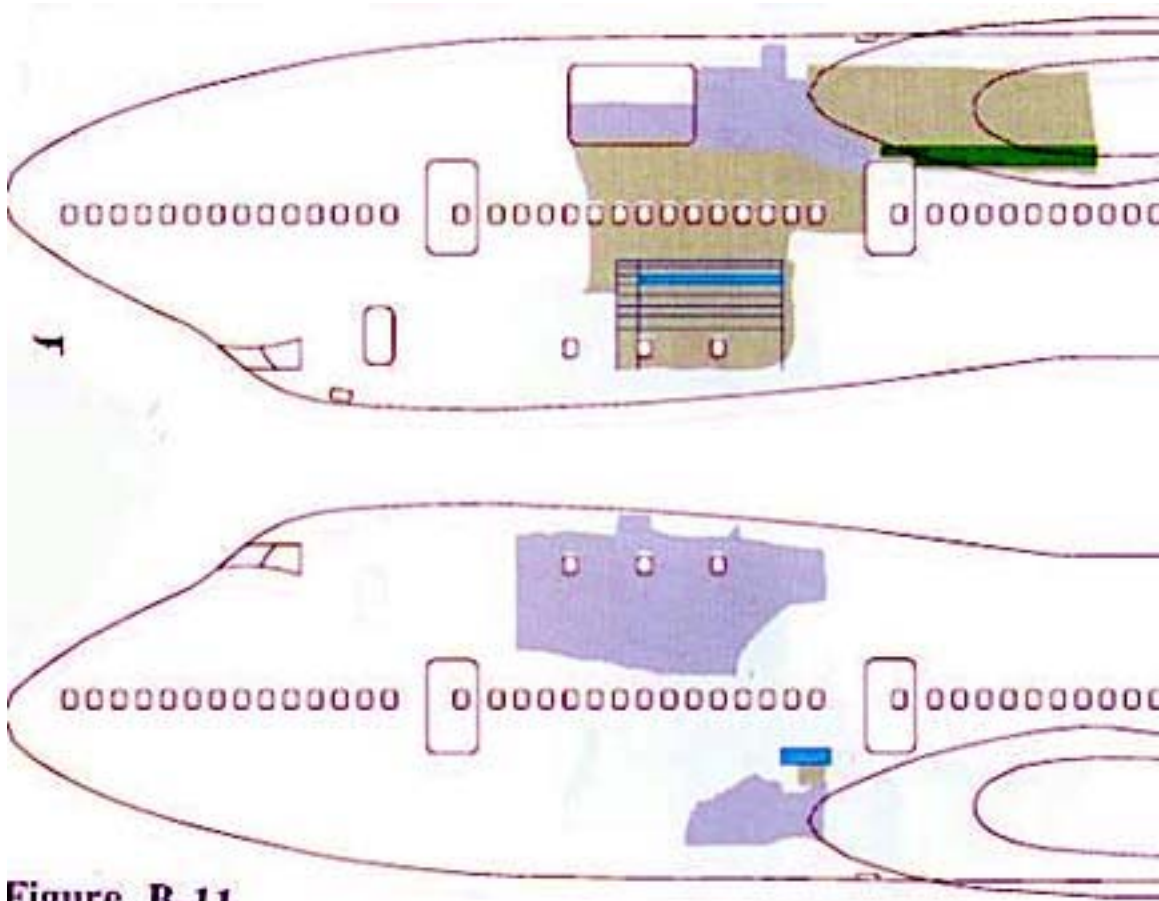
5. **Pan Am Flight 103**



Pan Am 747 showing colors of 1988 and open forward cargo door.



Staged bombing of a Boeing 747 at Bruntingthorpe UK showing the massive damage which occurs when a real bomb goes on in a Boeing 747.



**Figure B-11**

Figure B11 from AAIB 2/90 for Pan Am Flight 103 showing initial event time fuselage destruction with small 'bomb' hole rectangle on port side and huge rectangular destruction around forward cargo door on starboard side.



Port side of Pan Am Flight 103 forward of the wing showing the small 'bomb' hole and relatively smooth and intact fuselage skin around it.

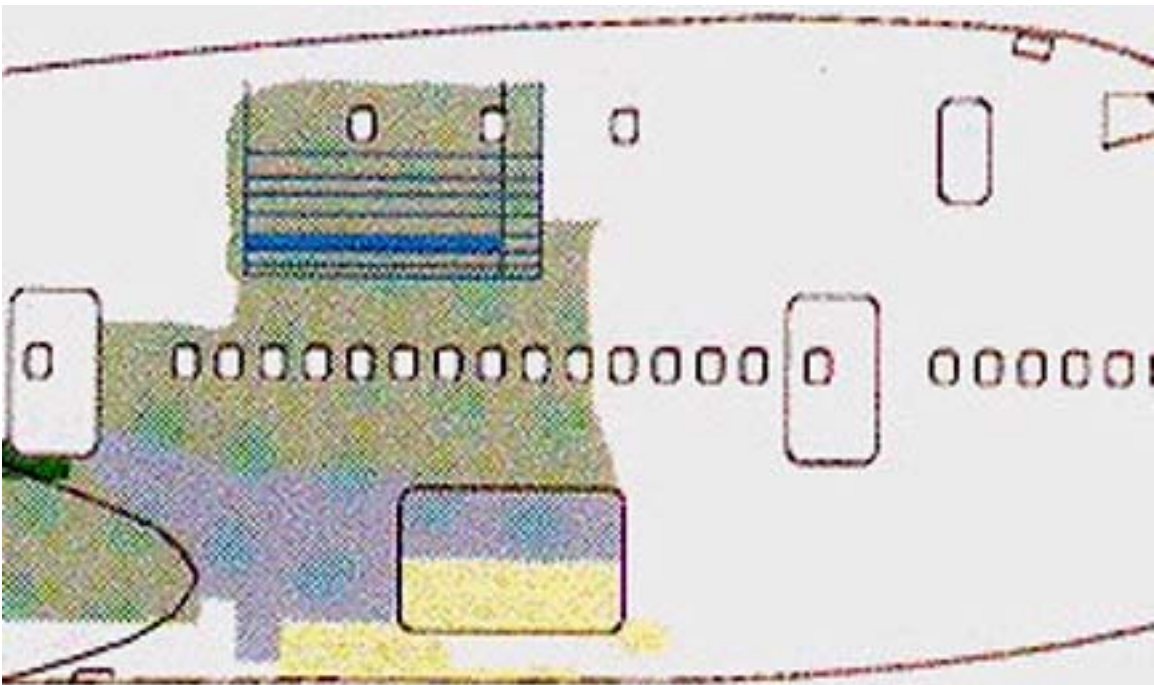




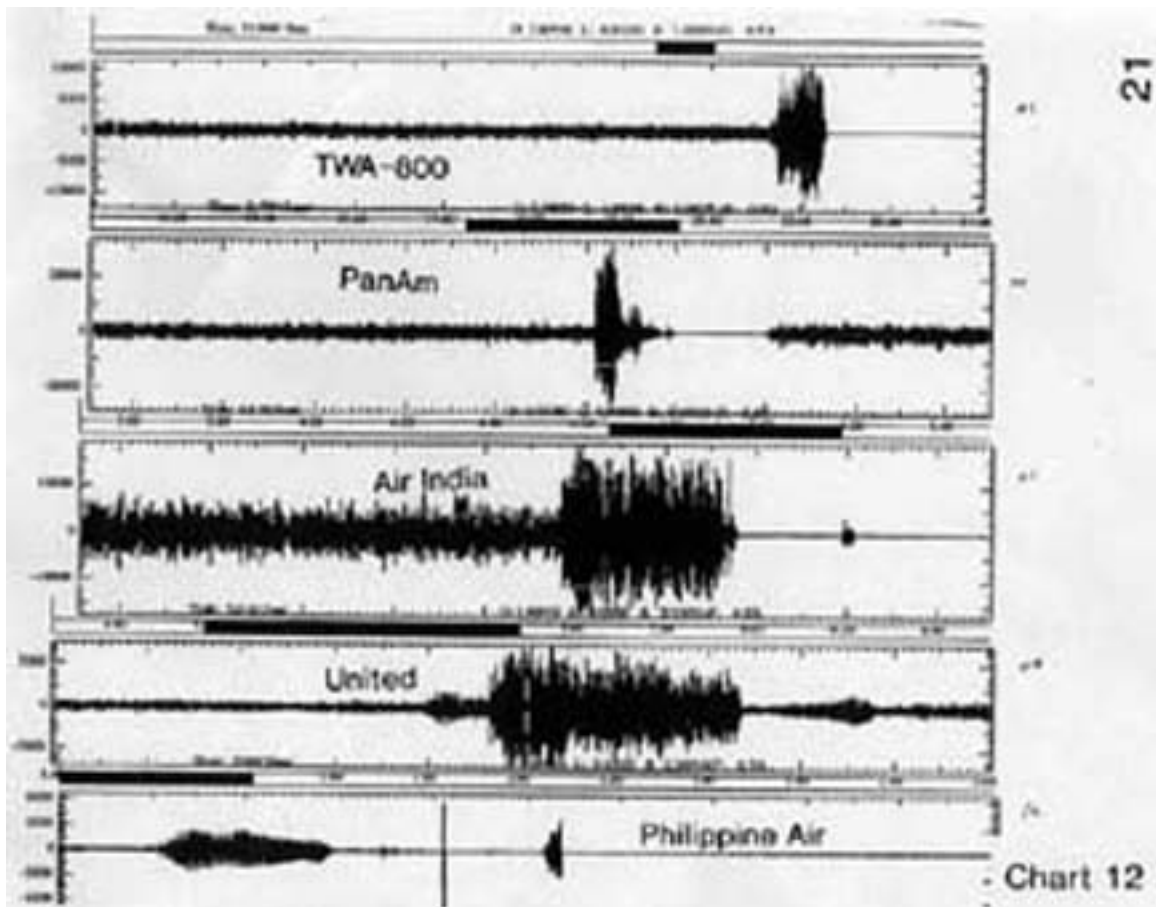
Photograph from AAIB showing Pan Am Flight 103 forward cargo door area revealing the vertical torn skin above door, peeled back and down skin from the aft midspan latch, generally shattered area, and mostly missing lower half of door which includes the manual locking handle and the eight bottom latches.



Closeup of the peeled back skin from the aft midspan latch of the forward cargo door of Pan Am Flight 103.



Reconstruction drawing from the AAIB 2/90 report on Pan Am Flight 103 showing the large area of torn off skin around the forward cargo door, the longitudinal split of the door, and the vertical tearing of the skin above the door.



**Pan Am Flight 103:**

"The CVR tape was listened to for its full duration and there was no indication of anything abnormal with the aircraft, or unusual crew behaviour. The tape record ended, at 19:02:50 hrs +/- second, with a sudden loud sound on the CAM channel followed almost immediately by the cessation of recording whilst the crew were copying their transatlantic clearance from Shanwick ATC." UK AAIB Report 2/90 Page 15

**Pan Am Flight 103:**

"The analysis of the recording from the DFDR fitted to N739PA, which is detailed in Appendix C, showed that the recorded data simply stopped. Following careful examination and correlation of the various sources of recorded information, it was concluded that this occurred because the electrical power supply to the recorder had been interrupted at 19:02:50 +/- second." UK AAIB Report 2/90 Page 37

'The report concludes that the detonation of an improvised explosive device led directly to the destruction of the aircraft with the loss of all 259 persons on board and 11 of the residents of the town of Lockerbie'



6. Trans World Airlines Flight 800



Photograph of Trans World Airlines Boeing 747 in 1996 colors.



Photograph of the port side of Trans World Airlines Flight 800 showing the relatively undamaged skin forward of the wing, nose to left.



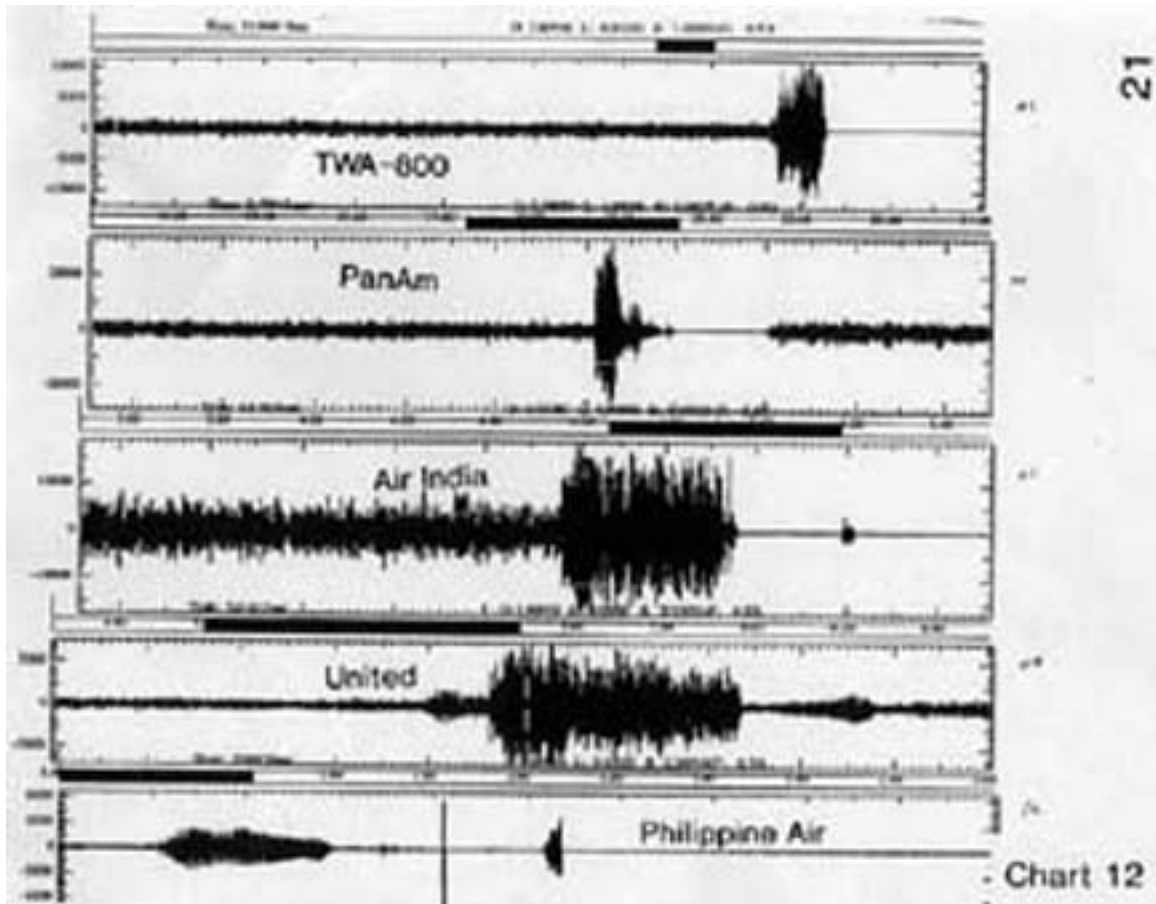
Shattered starboard side around forward cargo door of Trans World Airlines Flight 800 revealing outwardly and petaled shaped skin around aft midspan latch.





Photograph above showing outwardly and petaled shaped skin around forward midspan latch.

3. Docket Number SA-516, Exhibit No. 15C, Report Number 97-82, Section 41/42 Joint, Forward Cargo Door, "Examination of the lower lobe forward cargo door showed that all eight of the door latching cams remain attached (along with pieces of the door itself) to the pins along the lower door sill."



From NTSB: The CVR then recorded a very loud sound for a fraction of a second (0.117 second) on all channels immediately before the recording ended. The accident airplane's last recorded radar transponder return occurred at 2031:12, and a review of the FDR data indicated that the FDR lost power at 2031:12. '

From NTSB AAR 00/03 for Trans World Airlines Flight 800. 'The National Transportation Safety Board determines that the probable cause of the TWA flight 800 accident was an explosion of the center wing fuel tank (CWT), resulting from ignition of the flammable fuel/air mixture in the tank. The source of ignition energy for the explosion could not be determined with certainty, but, of the sources evaluated by the investigation, the most likely was a short circuit outside of the CWT that allowed excessive voltage to enter it through electrical wiring associated with the fuel quantity indication system.'

**7. Forward cargo doors compared in detail for the four aircraft, Air India Flight 182, Pan Am Flight 103, United Airlines Flight 811, and Trans World Airlines Flight 800.**

A. United Airlines Flight 811

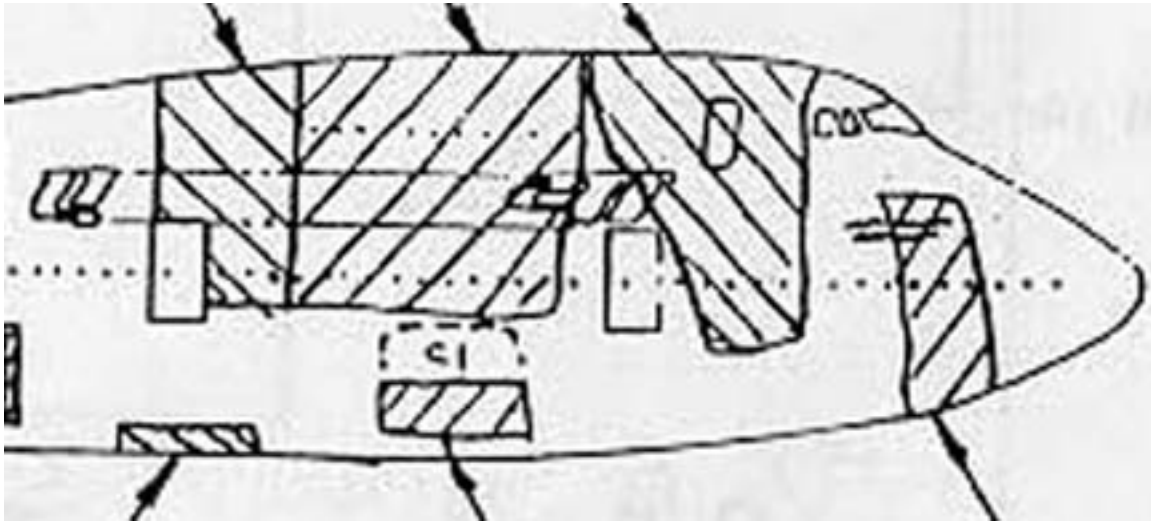




Photos from NTSB AAR 92/02 for United Airlines Flight 811 showing bottom half of the retrieved door, the longitudinal split at midspan latches, and the peeled away and down skin from the aft midspan latch.

B. Air India Flight 182. From Kirpal and CASB AAR: 2.11.4.6 Section 42  
All cargo doors were found intact and attached to the fuselage structure except for the forward cargo door which had some fuselage and cargo floor attached. This door, located on the forward right side of the aircraft, was broken horizontally about one-quarter of the distance above the lower frame. The damage to the door and the fuselage skin near the door appeared to have been caused by an outward force. The fractured surface of the cargo door appeared to have been badly frayed. Because the damage appeared to be different than that seen on other wreckage pieces, an attempt to recover the door was made by CCGS John Cabot. Shortly after the wreckage broke clear of the water, the area of the door to which the lift cable was attached broke free from the cargo door, and the wreckage settled back onto the sea bed. An attempt to relocate the door was unsuccessful.





Reconstruction drawing above from the Kirpal Report and the CASB report on Air India Flight 182 showing the longitudinal split of the forward cargo door and the vertical tearing of the skin above the door.

C. Pan Am Flight 103.



Closeup of the peeled back and down skin from the aft midspan latch of PA 103 forward cargo door.



Photograph from AAIB showing Pan Am Flight 103 forward cargo door area revealing the vertical torn skin above door, peeled back and down skin from the aft midspan latch, generally shattered area, and mostly missing lower half of door which includes the manual locking handle and the eight bottom latches.



D. Trans World Airlines Flight 800



Shattered starboard side around forward cargo door of Trans World Airlines Flight 800 revealing outwardly and petaled shaped skin around aft midspan latch.

## 8. Pressure relief doors in forward cargo door examined in detail.



Normal Boeing 747 forward cargo door showing aft and forward pressure relief doors near top hinge.

From NTSB AAR 92/02 for United Airlines Flight 811: 'The cargo doors on the B-747 have a master latch lock handle installed on the exterior of the door. The handle is opened and closed manually. The master latch lock handle simultaneously controls the operation of the latch lock sectors, which act as locks for the latch cams, and the two pressure relief doors located on the door. The final securing operation is the movement of lock sectors across the latch cams. These are manually moved in place across the open mouth of each of the eight lower cams through mechanical linkages to the master latch lock handle. The position of the lock sectors is indicated indirectly by noting visually the closed position of the two pressure relief doors located on the upper section of each cargo door. The pressure relief doors are designed to relieve any residual pressure differential before the cargo doors are opened after landing, and to prevent pressurization of the airplane should the airplane depart with the cargo doors not properly secured. The pressure relief doors are mechanically linked to the movement of the lock sectors. This final procedure also actuates the master latch lock switch, removing electrical control power from the opening and closing control circuits, and also extinguishes the cockpit cargo door warning light through a switch located on one of the pressure relief doors.'



United Airlines Flight 811 forward cargo door showing missing aft pressure relief door and jammed open status of forward pressure relief door according to NTSB AAR 92/02.

Below excerpts for NTSB AAR 92/02 for United Airlines Flight 811:

‘The ramp service personnel said that they had verified that the forward cargo door was flush with the fuselage of the airplane, that the master door latch handle was stowed, and that the pressure relief doors were flush with the exterior skin of the cargo door. The dispatch mechanic stated that, in accordance with UAL procedures, he had performed a "circle check" prior to the airplane's departure from the HNL gate. This check included verification that the cargo doors were flush with the fuselage of the airplane, that the master latch lock handles were stowed, and that the

pressure relief doors were flush or within 1/2 inch of the cargo door's exterior skin. He said a flashlight was used during this inspection.'

SB-747-52-2097, "Pressure Relief Door Shroud Installation--Lower Lobe and Side Cargo Doors," was issued on June 27, 1975. Revision 1 to SB-747-52-2097 was issued November 14, 1975. In general, the SB recommended the installation of shrouds on the inboard sides of the cargo door pressure relief door openings. The purpose of the shrouds was to prevent the possibility of the pressure relief doors being rotated (blown) to the closed position during the pressurization cycle. This condition could only occur if the master latch lock handle had been left open and the flightcrew failed to note the cargo door open warning before takeoff.'

'UAL records for N4713U indicated that SB-747-52-2097 had been complied with and the shrouds had been installed on the forward and aft cargo doors. However, examination of the aft cargo door on N4713U revealed that the shrouds were not in place. UAL could not find records to verify if the shrouds had been installed or if they had been removed from either door.

There was no evidence of the pressure relief door shrouds found on the forward door; however, most of the inner door lining to which the shrouds attach was missing.'

'The lower two connecting rods between the lock sector torque tube and the torque tube below the pressure-relief doors were undamaged; however, the upper connecting rod had separated at the upper, tapered end. The torque tube below the pressure-relief doors were missing, and the pressure-relief door connecting rods had separated at the lower, tapered end. The remaining portion of each rod was undamaged, but the forward pressure-relief door was jammed open into the cutout.'

'The examination of the recovered forward cargo door did not provide confirmation that the pressure relief door shrouds were actually installed on the forward door, although UAL records showed that they had been installed on both cargo doors of N4713U, in accordance with SB-747-52-2097. However, the shrouds were found not to be installed on the aft door, contrary to UAL records, and therefore may not have been installed on the forward door. Without the shrouds, the pressure relief doors could have rotated shut during the pressurization cycle. Because the closure of the pressure relief doors would back-drive the lock sectors, this scenario would presume previous damage to the sectors, which would permit the sectors to move over the unlatched cams.'





Pan Am Flight 103 Forward cargo door showing missing aft and forward pressure relief doors.

No reference is made in AAIB AAR 2/90 for Pan Am Flight 103 to any pressure relief door in any cargo door for Pan Am Flight 103.



Trans World Airlines Flight 800 Forward cargo door showing missing aft pressure relief door.

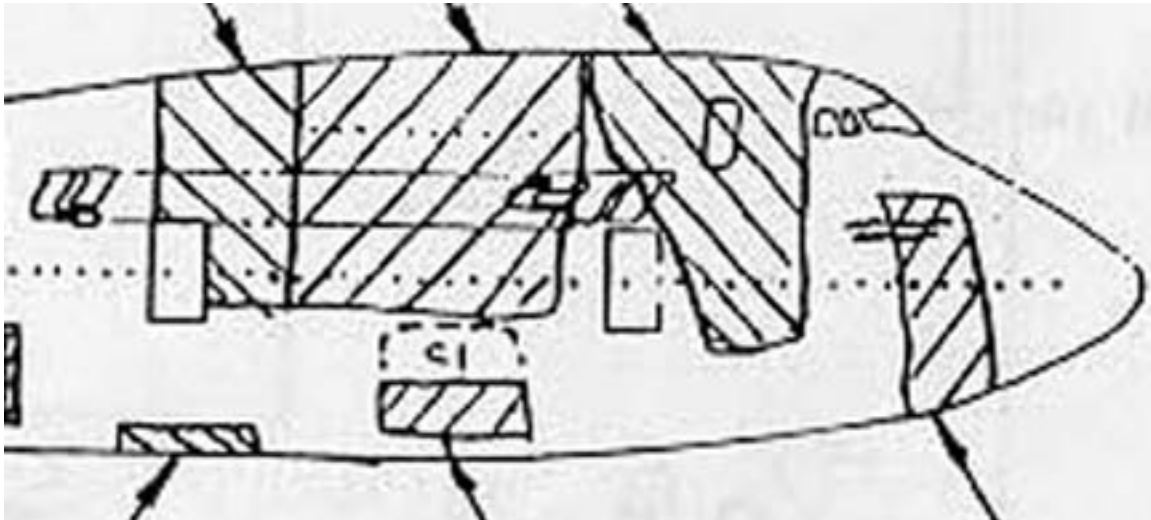
No reference is made to any pressure relief door in any cargo door in NTSB AAR 00/03 for Trans World Airlines Flight 800.





Trans World Airlines Flight 800 Forward cargo door showing separated and replaced forward pressure relief door.

No reference is made to any pressure relief door in any cargo door in NTSB AAR 00/03 for Trans World Airlines Flight 800.



Air India Flight 182 Forward cargo door showing missing top half of door including the aft and forward pressure relief doors.

No reference to any pressure relief door in any cargo door in CASB and Kirpal AAR for Air India Flight 182

From the Canadian Aviation Occurrence Report: '2.11.4.6 All cargo doors were found intact and attached to the fuselage structure except for the forward cargo door which had some fuselage and cargo floor attached. This door, located on the forward right side of the aircraft, was broken horizontally about one-quarter of the distance above the lower frame. The damage to the door and the fuselage skin near the door appeared to have been caused by an outward force. The fractured surface of the cargo door appeared to have been badly frayed. Because the damage appeared to be different than that seen on other wreckage pieces, an attempt to recover the door was made by CCGS John Cabot. Shortly after the wreckage broke clear of the water, the area of the door to which the lift cable was attached broke free from the cargo door, and the wreckage settled back onto the sea bed. An attempt to relocate the door was unsuccessful.'



**9. Port and Starboard side of Trans World Airlines Flight 800 examined in detail.**

Below photographs from NTSB sources reveal in detail the relatively smooth port side forward of the wing and the shattered starboard side of Trans World Airlines Flight 800 which rules out a center explosion event and rules in an explosive decompression forward of the wing on the right side.



The left side of the plane

Nose to left.



The left front of the reconstruction at LF4

Nose to left.



Left front of the plane

Nose to left.





The right side of the plane

Nose to right



The right side of plane, nose to right.



Right front of the plane

Nose to right.



The right front of the reconstruction

Nose to right.





**The front cargo bay area in the red zone**

Red zone is area where pieces departed Trans World Airlines Flight 800 first.



Right side of aircraft, nose to right, forward cargo door area revealing red paint smears found only in this area of Trans World Airlines Flight 800.



Two pictures of forward cargo door forward midspan latch area right side of aircraft, nose to right revealing outward peeled in petal shape and strange red paint smears.





Right side of plane, aft midspan latch of forward cargo door area revealing outward, petal shaped rupture at aft midspan latch and red paint smears.



Right side above forward cargo door hinge, nose to right.

## 10. Conclusions:

A. The four forward cargo door areas on the starboard side just forward of the wing on the four aircraft reveal in photographs and text outwardly peeled skin, vertical tears in fuselage skin, missing critical pieces, and a generally shattered appearance which is unlike any other damage seen in the wreckage of the four aircraft and not seen in any other hull loss of a Boeing 747.

B. The four door areas show a rupture in flight by an outward force. The door itself appears to be at the start of the breakup. The specific location in the door that ruptures first appears to be at the midspan latches with the aft midspan latch the most likely to rupture first.

C. The port side opposite the forward cargo door is stated in text and photographs to be relatively smooth which rules against a bomb explosion on the port side or a center fuel tank explosion in the center of Trans World Airlines Flight 800.

D. The shattered areas of the forward cargo door occurred at the initial event time as determined by the sudden loud sound on the cockpit voice recorder on all four aircraft. The sudden loud sound cause has been linked from Air India Flight 182 to a DC-10 explosive decompression event of an opened cargo door in flight. Pan Am Flight 103 has been linked to Air India Flight 182. Trans World Airlines Flight 800 has been linked to Pan Am Flight 103. These links establish a probable cause of the sudden loud sound as an explosive decompression when a cargo door inadvertently ruptured open in flight probably caused by faulty wiring or switch.

E. The missing and jammed pressure relief doors in the forward cargo doors of aircraft that suffer an explosive decompression in the forward cargo compartment indicate that the mechanical linkage has turned them to the open position at the same time the linkage was turning the locking sectors to the open position. The pressure relief doors are not designed to blow out if abnormal internal pressure detected. They are mechanically linked to the latching mechanisms. If the latches inadvertently turn towards the unlatched position in flight, the pressure relief doors would slightly open also.

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**AIRCRAFT  
ACCIDENT  
REPORT**  
**Trans World Airlines Flight 800**  
**Part IV**  
**Anomalies within the NTSB investigation, the public docket, and NTSB AAR  
00/03 for Trans World Airlines Flight 800**



**Report on the accident to  
Trans World Airlines Flight 800  
Boeing 747-131, N93119  
Near East Moriches, New York  
July 17, 1996  
by John Barry Smith,  
Independent Aircraft Accident Investigator**



**Part IV: Anomalies within the NTSB investigation, the public docket, and NTSB AAR 00/03 for Trans World Airlines Flight 800**

**Table of Contents:**

1. CVR sound matches United Airlines Flight 811.
2. First parts to leave aircraft were forward of the wing.
3. Engine number 3 was uncontained.
4. Unilateral damage to aircraft and not bilateral.
5. Unusual red paint smears on airframe.
6. Trans World Airlines Flight 800 not matched to United Airlines Flight 811.
7. Ruptured open forward cargo door ruled out without proper consideration.
8. Only aft cargo door still recovered.
9. Wreckage debris tags in database changed.
10. Wiring faulty in cargo door area but not considered as initial event.
11. Mysteries solved: Streak Ignition source, red paint smears, no burns on passengers, and sudden loud sound on CVR.
12. Never interviewed by authorities although requested many times.
13. Typical response from NTSB to an inquiry and author's reply.

**1. Cockpit Voice Recorder information reveals a the sudden loud sound on Trans World Airlines Flight 800:**

The best and only direct evidence available to understand the cause of the Trans World Airlines Flight 800 destruction is the cockpit voice recorder information.

This recorded information is essentially a very short time of a sudden loud sound. This best evidence for Trans World Airlines Flight 800 does not match the initial event sound of a CWT fire/explosion sound as would be expected. The NTSB staged fuel explosions and then examined the staged sound to try for a match but failed.

The sudden loud sound of Trans World Airlines Flight 800 does match most closely that sudden loud sound of United Airlines Flight 811, an event which was caused by the electrical/forward cargo door rupture/explosive decompression/inflight breakup event. (The Philippines Airlines aircraft was a Boeing 737 on the ground; United Airlines Flight 811 was a Boeing 747 in flight as was Trans World Airlines Flight 800.)

From AAR 00/03:

The TWA flight 800 CVR recorded noise characteristics that were most similar to those recorded by the CVRs on board the United flight 811 and Philippine Airlines airplanes.

In addition, the CVR sound analysis in NTSB AAR 00/03 is very skimpy. It does not have the extensive spectrum analysis and conclusions which the AARs of other Boeing 747 inflight breakups have in their reports.

The analysis of the sound for Trans World Airlines Flight 800 has two false conclusions about those inflight breakups: From AAR 00/03: "...the Pan Am and Air India CVR recordings exhibited

very fast rise times, very short durations, and very fast fall times.”

The sudden loud sound on the CVRs of those two aircraft had an abrupt power cut immediately after the sound started which cut off the machine recording the sound. The actual duration and fall time of the sound is unknown because the sound did not stop, just the recording of it. These basic types of errors are not to be expected by the professional CVR analysts at NTSB. These errors are insidious as they attempt to rebut the match of the two accidents, Air India Flight 182 and Pan Am Flight 103 to Trans World Airlines Flight 800 when in fact, they do match.

From AAR 00/03:

For further comparisons, the Safety Board plotted the CVR recordings from other known in-flight explosions/breakups (such as Pan Am flight 103, a 747-100 airplane that crashed at Lockerbie, Scotland, after a bomb on board exploded; an Air India 747-100 that crashed in the Atlantic Ocean southwest of Ireland after a bomb on board exploded; and United flight 811, a 747-100 that lost its forward cargo door in flight.

The TWA flight 800 CVR recorded noise characteristics that were most similar to those recorded by the CVRs on board the United flight 811 and Philippine Airlines airplanes. The loud noise events recorded by these three CVRs were characterized by longer rise times, durations, and fall times than the loud noises recorded by the CVRs on board the Pan Am and Air India airplanes; the Pan Am and Air India CVR recordings exhibited very fast rise times, very short durations, and very fast fall times.

CVR information in AAR 00/03:

1.11.1.2 Cockpit Voice Recorder-Related Airplane Tests The Safety Board documented the CVRs response to various types of explosive events during a series of controlled tests on a decommissioned 747-100 airplane. The test series included the following conditions: detonation of four simultaneous explosions in four different cargo container locations on board the pressurized airplane, controlled high explosive detonations at various locations inside and outside the unpressurized fuselage, and fuel/air mixture explosions at various locations on board the unpressurized airplane. The fuel/air mixture explosion tests included one test in which a known fuel/air mixture was exploded in the airplanes CWT. Sound spectrum analysis plots from these airplane tests were compared with those from the TWA flight 800 CVR recording. For further comparisons, the Safety Board plotted the CVR recordings from other known in-flight explosions/breakups (such as Pan Am flight 103, a 747-100 airplane that crashed at Lockerbie, Scotland, after a bomb on board exploded; an Air India 747-100 that crashed in the Atlantic Ocean southwest of Ireland after a bomb on board exploded; and United flight 811, a 747-100 that lost its forward cargo door in flight. The Board also plotted the CVR recording from a Philippine Airlines 737-300 that experienced a fuel/air mixture explosion in the CWT as it was being pushed back from the gate at Ninoy Aquino International Airport, Manila, Philippines, on May 11, 1990.

The CVRs recovered from these airplanes all recorded very loud sound events just before they stopped recording. The sound signatures from these events were compared with the sound signatures recorded at the end of the TWA flight 800 CVR recording. Generally, the sound signatures could be characterized based on



how quickly the loud noise event rose from the background noise (rise time), the duration of the loud noise event, and how quickly the loud noise event decreased (fall time). The TWA flight 800 CVR recorded noise characteristics that were most similar to those recorded by the CVRs on board the United flight 811 and Philippine Airlines airplanes. The loud noise events recorded by these three CVRs were characterized by longer rise times, durations, and fall times than the loud noises recorded by the CVRs on board the Pan Am and Air India airplanes; the Pan Am and Air India CVR recordings exhibited very fast rise times, very short durations, and very fast fall times. The TWA flight 800 CVR was the only CVR that recorded the change in the airplanes electrical system background noise described in section 1.11.1.1. This sound cannot be discerned simply by listening to the CVR but was identified through the sound spectrum study; therefore, it is not indicated in the CVR transcript. This airplane was obtained by the FAA and the British Civil Aeronautic Administration to conduct explosive hardening trials on cargo containers. The airplane fuselage was structurally intact, with all exterior doors and windows in place; therefore, it could be pressurized. However, the airplane's engines, the cabin interior, and the cockpit instruments had been removed. For the Safety Boards tests, the airplane was equipped with additional instrumentation (including multi axis accelerometers, pressure sensors, flash or detonation sensors, cabin microphones, and Cams) and several CVRs, one of which approximately duplicated the CAM and recorders that were installed on TWA flight 800. For the CWT fuel/air mixture explosion test, additional instrumentation was added to record the acceleration, pressures, and the gas mixture inside the tank. For additional information regarding these tests, see section 1.16.5.6.

See Air Accidents Investigation Branch. 1990. Report on the Accident to Boeing 747-121, N739PA at Lockerbie, Dumfriesshire, Scotland, on 21 December 1988. Aircraft Accident Report 2/90. 118 See Report of the Court Investigating. February 26, 1986. Accident to Air India Boeing 747 Aircraft VT-EFO, Kanishka on 23 June 1985. Honorable Mr. Justice B. N. Kirpal, Judge, High Court of Delhi.

Exhibit 12A From Public Docket:

The recording consisted of four channels of good quality audio information. One channel contained the cockpit area microphone audio information. The other three channels contained the Captain's, the First Officer's, and the Second Officer's radio/intercom information.

The recording starts at 1959:40 EDT and continues uninterrupted until 2031:12 EDT when electrical power was removed from the unit. When the recording starts, the Kennedy gate agent is in the cockpit telling the crew that they are ready for departure. The aircraft's door is closed and the crew request push-back from the gate at 2001:42 EDT. During the push-back and before taxi the crew starts the number 1,2,and 4 engines. The flight contacts ground control at 2008:13 EDT and requests taxi clearance. During the taxi the crew starts the number 3 engine at 2014:29 EDT. The flight is cleared for takeoff on runway 22 right at Kennedy at 2018:21 EDT.

The takeoff and climb appear normal. The flight contacts Kennedy departure control at 2020:14 EDT. They are subsequently turned over to Boston Center at 2023:37 EDT. Boston Center instructs the crew to continue their climb and maintain fifteen

thousand feet at 2030:15 EDT. The acknowledgment of this transmission at 2030:19.2 EDT is the last radio transmission received from the aircraft. The recording stopped at 2031:12 EDT.

**2. First aircraft parts to leave Trans World Airlines Flight 800 were just forward of the wing.**

The wreckage distribution shows that parts were initially shed from the area just forward of the wing.

The CWT is just aft of the wing. The CWT fire/explosion explanation would have the first parts to depart Trans World Airlines Flight 800 to be initially shed from just aft of the wing and they were not.

The forward cargo door is just forward of the wing. The shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup explanation would have the first parts to depart Trans World Airlines Flight 800 to be initially shed from just forward of the wing that they were.

NTSB AAR 00/03:

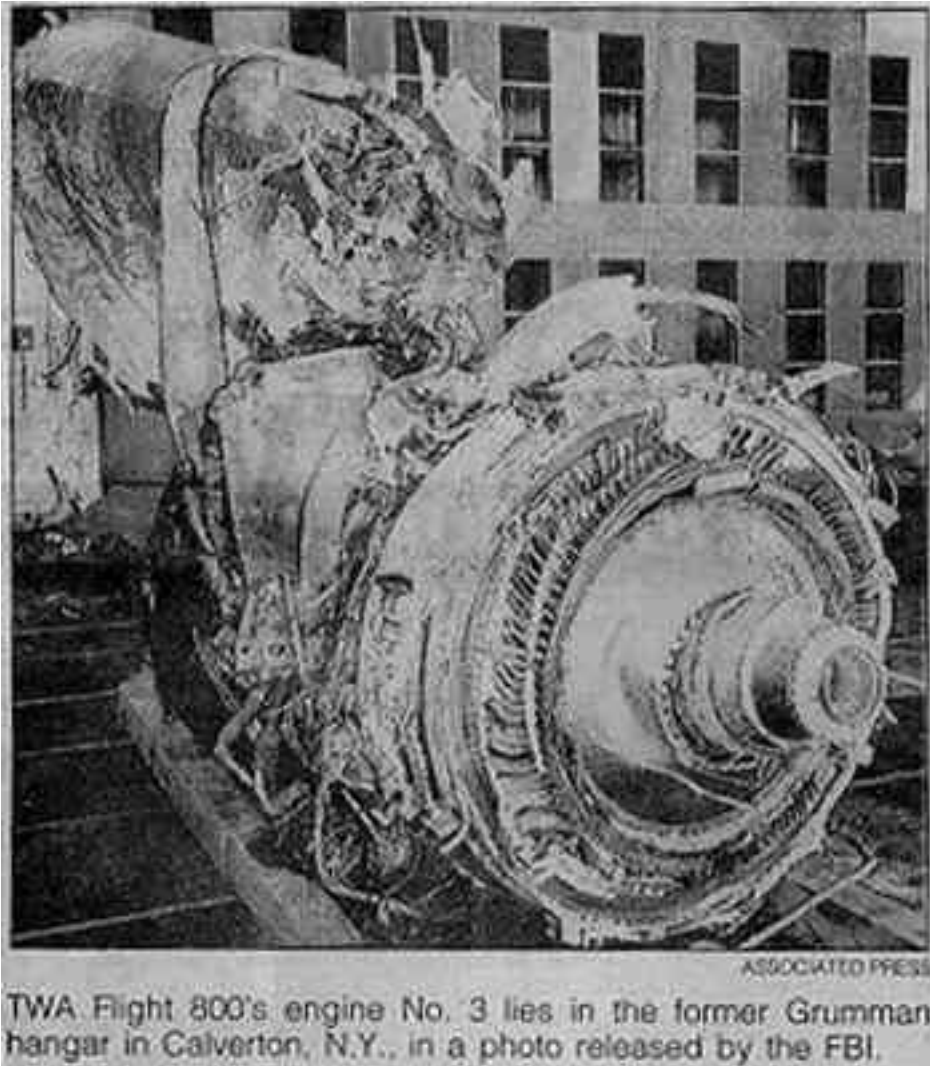
1.16.2 Trajectory and Main Wreckage Flightpath Studies 1.16.2.1 Trajectory Study Description and Results

In general, the trajectory study indicated that pieces of wreckage recovered from the red zone departed the airplane during the first few seconds after the initial event, followed shortly thereafter by the separation of the forward fuselage (recovered from the yellow zone). As outlined in the following section, the remainder of the airplane flew for a time in crippled flight and did not exhibit ballistic behavior until about 40 seconds after the initial event (when the WCS failed);

7. Docket Number SA-516, Exhibit No. 22A, Trajectory Study, page 3: "The wreckage distribution shows that parts were initially shed from the area just forward of the wing."

Docket No. SA-516, Exhibit No. 22B, Trajectory Study Supporting Material, page 45. One chart that shows the first items to go is A489, fwd lower cargo bay struct, FS 900. The next item to go is A470, R fwd lower cargo bay struct, FS 820. There are five other forward cargo bay structures which left soon thereafter.

**3. Engine number three was uncontained, missing blades, and sooted:**



NTSB Docket SA 516, Exhibit 8A, Powerplants Group Chairman's Factual Report,

Page 2, paragraph 2, "After the engines were recovered, they were transported to the former Grumman facility at Calverton, New York, for disassembly. The disassembly of the engines commenced on August 12, 1996, in the presence of the Powerplants Group. The disassembly was completed on August 16, 1996."

It took five days for a breakdown of four engines. One day and a quarter per engine is incredibly fast to disassemble one of the most complex and precise machines ever made. A forensic powerplant teardown is likely to require several hundred hours per engine with several hundred hours of metallographic back up work. Additionally, many specialized tools are required to do this. Haste is evident in a one day teardown per engine in an empty hangar with only one engine specialist present.

Page 2, paragraph 3, "The disassembly of the engines consisted of removing the cowling, external components, fan, and low pressure compressor (LPC) to expose the high pressure compressor (HPC), diffuser, combustor, high pressure turbine

(HPT), low pressure turbine (LPT), and turbine exhaust cases. Engine No. 3 was disassembled further to remove and partially disassemble the HPC. The disassembly of the engines did not show any indications that any of the engines had sustained any uncontainments, case ruptures, fires, or penetrations."

Engine number was 3 disassembled further because of some evidence was seen in No. 3 to warrant further investigation. The other three engines were not disassembled further. The conclusion statement of no uncontainments is contradicted by another exhibit which states a 'stator blade' was found in the right horizontal stabilizer. The conclusion statement of no fires in any engines is contradicted later in this same report with raw data indicating sooting in engine number 3. The conclusion statement of no penetrations of any engine is contradicted by raw data in this report indicating soft body impacts on blades.

Docket No. SA-516, Exhibit No. 7A, Structures Group Report, page 33: "5.1 Horizontal Stabilizer, "Some of the items found in the horizontal stabilizer are sections of seat track, a stator blade from turbine section, and glitter." On 5.1.1 Right Horizontal Stabilizer, page 34, "An engine stator blade from turbine section penetrated the upper honeycomb surface near the outboard trailing edge.

Exhibit 8A, Page 11, paragraph 3, discussing results of engine 3 disassembly, "Of the 46 fan blades in the fan rotor, 21 blades with complete or partial airfoils and 6 root sections were recovered. All of the fan blades had sooting on the convex airfoil surfaces. Most of the full length airfoils were bent rearward and the tips outboard of the outer midspan shroud were bent forward slightly. About half of the fan blades had impact damage to the leading and trailing edges. Almost all of the impact damage to the airfoils could be matched to contact with the midspan shroud on an adjacent blade. One full length blade had four soft body impacts along the leading edge and a partial airfoil had a soft body impact, which had some streaking extending rearward."

Less than half of complete fan blades in the fan rotor were recovered which means most were broken. Only 58% of the fan blades were recovered which means some were missing, so it is very possible the 'stator blade' found in the right horizontal stabilizer was from engine number three which is directly in front of the right horizontal stabilizer. "Almost all' of the 'impact damage,' was explained which implies some wasn't. All blades had soot. Soot means fire. Only engine number three had any sooting inside engine. One full blade and one partial blade had 'soft body impacts'. There is nothing normally soft inside a jet engine. Soft body impact means foreign object damage (FOD). FOD may mean fire. Fire means soot. Missing blades in the engine and one blade found directly aft in the right horizontal stabilizer means uncontainment. Uncontainment means that blades flew apart from inside the engine to the outside.

An analysis on the raw data from engine breakdown report in Exhibit 8A gives conclusions that engine number three alone had foreign object damage in flight, had an internal fire, missing blades, and had partial disintegration. Engine 3 was the only engine to give such evidence. Engine number three is next to the forward cargo hold, an area known to give FOD to engine 3 when that cargo door inadvertently opens in flight. A fodded and on fire engine number three could provide the mystery ignition source for the center tank fire/explosion/fireball.

AAR 00/03  
1.12.4 Engines

The four engines were found in the green zone separated from the wings. The No. 1 engine had crushing damage along the bottom of the nacelle and the low-pressure compressor (LPC), high-pressure compressor (HPC), and diffuser cases; the No. 2 engine had crushing damage along the right side of the nacelle and the LPC, HPC, and diffuser cases; the No. 3 engine inlet and fan blades were crushed rearward, and the LPC and HPC cases had crushing damage from the front and along the bottom; and the No. 4 engine inlet was crushed rearward, the LPC and HPC cases were crushed axially from the front and inward from the right side, and the diffuser case was crushed along the right side. All of the fan cases and cowls were separated from their respective engines. All engine thrust reversers were also separated from their respective engines; however, examination of the recovered thrust reverser actuators showed that the drive mechanisms were at the head end of the jackscrew, consistent with a thrust reverser stowed position at the time of impact. The Safety Boards disassembly and examination of the four engines revealed LPC damage consistent with a minimal amount of low-pressure rotor rotation (if any) at the time of impact and HPC damage consistent with some high-pressure rotor rotation at the time of impact. No evidence of uncontainment, case rupture, fire, penetration of an object from outside into the engine, or preimpact damage was found in any of the engines.

‘No evidence of uncontainment, case rupture, fire, penetration of an object from outside into the engine, or preimpact damage was found in any of the engines.’

The above statement by NTSB is flatly contradicted by the Powerplant report Exhibit 8A. This contradiction is insidious because as it attempts to refute the shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup explanation.

A CWT fire/explosion initial event would give equal inflight damage to engine 2 and 3 which did not happen.

A shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup event would give damage to engine number 3 such as fire, missing and sooted blades, and an uncontainment, which did happen.

**4. Trans World Airlines Flight 800 wreckage showed unilateral damage:** The port/left side was relatively smooth while starboard/right side was shattered and suffered more inflight damage.

The starboard side of the fuselage, the starboard engine, and the starboard tailplane were much more severely damaged by inflight events than the port side.

A CWT fire/explosion initial event would create a bilateral damage appearance which is not evident.

A shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup would give unilateral damage to the starboard side which was evident.

The most probable answer to this observation is offered by the shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup explanation in which the starboard forward cargo door ruptures open in flight and ejects cargo bay material, passengers and their seats out into the slipstream on the starboard side. The debris gives the shattered appearance to a forty foot by

thirty foot rectangle of skin, foreign object damage to engine number three, inflight damage to the right wing leading edge and also to the right horizontal stabilizer.



The left side of the plane

Nose to left.



The left front of the reconstruction at LF4

Nose to left.





Left front of the plane

Nose to left.



The right side of the plane

Nose to right.



The right side of plane, nose to right.





Right front of the plane

**5. Red paint smears above the forward cargo door area are unique and found nowhere else along the entire five hundred feet of red painted livery along the fuselage.**

A CWT fire/explosion initial event would give red paint smears on both sides of the fuselage and that is not evident.

A shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup would give red paint smears above the forward cargo door area and that is evident.

The probable explanation is that when the forward cargo door ruptured open in flight, the top half of the door blew open, outward, up, and slammed into the fuselage skin above it, transferring paint from the door to the fuselage and vice versa. The red paint smears reveal there was some contact from the fuselage skin below to create the disrupted paint scheme.

To put it another way; after the rupture at aft midspan latch the door fractured and the upper piece of the red painted door was pushed outward, rotated on its hinge, slammed upward and smashed into the white painted fuselage skin above, transferring red paint to the white painted area between the passengers windows, as shown by the TWA 800 reconstruction. UAL 811 also had paint transfer from door to fuselage when its door opened in flight.



There is no discussion of this important evidence in any of the NTSB reports.

**6. Trans World Airlines Flight 800 was not matched to the obvious candidate, United Airlines Flight 811.** An established technique in aircraft accident investigation is to learn from the lessons created from prior accidents. When machines such as aircraft react in strange ways, they do so by following the law of physics.

Trans World Airlines Flight 800 was essentially an inflight hull rupture/breakup of an early model Boeing 747. Prior to 1996, this type solo event had occurred four previous times, Air India Flight 182, JAL 123, United Airlines Flight 811, and Pan Am Flight 103.

The FBI tried unsuccessfully to match Trans World Airlines Flight 800 to Air India Flight 182 or

Pan Am Flight 103 since both of those were ascribed to a bomb explosion. NTSB tried to match Trans World Airlines Flight 800 to a Boeing 737 fuel tank explosion while on the ground.

The most obvious match was United Airlines Flight 811 because of the following overwhelming matches of evidence:

- aged
- high flight time
- poly x wired
- early model Boeing 747
- and shortly after takeoff
- experienced hull rupture forward of the wing
- foreign object damage to starboard engines #3
- fire in number three engine
- more severe inflight damage on starboard side,
- at least nine never recovered bodies,
- torn off skin in forward cargo door area on starboard side,
- post side smooth forward of the wing.
- rupture at forward cargo door at aft midspan latch,
- outward peeled skin on upper forward fuselage,
- downward bent floor beams in cargo door area,
- bare wire found in cargo door area.
- vertical fuselage tear lines forward of the wing
- parts initially shed from just forward of the wing.
- first pieces of structure to leave aircraft in flight from forward cargo bay.
- forward cargo door frayed
- hoop stress found in cargo door area
- door skin shattered outward.
- sudden sound on CVR
- loud sound on the CVR
- short duration sound on the CVR
- abrupt data loss to FDR
- inadvertent opening of forward cargo door in flight considered
- initially thought to be a bomb
- but later ruled out.

One of the few times that United Airlines Flight 811 is mentioned in NTSB AAR 00/03 is when it is matched to the CVR sudden loud sound to Trans World Airlines Flight 800. All of the other matching evidence was ignored.

From AAR 00/03: Note absence of match to United Airlines Flight 811:

See Air Accidents Investigation Branch. 1990. Report on the Accident to Boeing 747-121, N739PA at Lockerbie, Dumfriesshire, Scotland, on 21 December 1988. Aircraft Accident Report 2/90. 118 See Report of the Court Investigating. February 26, 1986. Accident to Air India Boeing 747 Aircraft VT-EFO, Kanishka on 23 June 1985. Honorable Mr. Justice B. N. Kirpal, Judge, High Court of Delhi.

The matching evidence of United Airlines Flight 811 to Trans World Airlines Flight 800 contradicts the CWT fire/explosion explanation as an initial event while it corroborates the shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup explanation.

## 7. Ruptured open forward cargo door ruled out without proper consideration.

1. The shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup explanation for Trans World Airlines Flight 800 was ruled out erroneously because an assumption was made that if the lower eight latches were latched and locked and attached to fuselage skin, then the entire door was latched and locked. That assumption is wrong because:

- A. Middle of door could have ruptured open leaving the bottom and top of the door intact.
- B. The sill which was examined was probably the aft cargo door sill, not the forward cargo door sill.
- C. The middle of the cargo door has two lone latches, each to hold eight foot of fuselage slice closed. Those two latches have no locking sectors, unlike the bottom eight latches.
- D. The door is outward opening non plug which means as the aircraft climbs higher, the pressure against the door to open in flight grows higher and thus more likely to burst.
- E. The midspan latches were assumed to be for alignment only which is incorrect as they are identical to the bottom eight latches and the door has alignment devices called, "pull in hooks".

2. The shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup was ruled out contrary to the plain to see and hear evidence of:

- A. Outward opened petal shaped ruptured door skin shapes at both the midspan latches.
- B. Red paint smears indicating inflight opening of the door smashing upward transferring paint.
- C. Sudden loud sound of the explosive decompression matching an open cargo door sound and absence of a bomb sound or a center tank explosion sound.
- D. Downward moved floor beams which occurs in an inflight decompression in the cargo compartment.
- E. Hoops stresses in cargo door area which occur when cargo door opens in flight.
- F. Nearby engine suffering foreign object damage.
- G. First parts to leave the aircraft were just forward of the wing and the parts were from the forward cargo compartment.
- H. Shatter zone of twenty foot by thirty foot rectangular shape around the forward cargo door matches the shape of the shatter zone of three other Boeing 747 inflight breakup events which were not center fuel tank explosion caused events.
- I. Inflight damage to airframe was directly aft in the right hand stabilizer and right wing leading edge and adjacent to the forward cargo door with engine number three while the port side was relatively inflight damage free.

3. The shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup was ruled out hastily without proper consideration:

- A. The decision was made that the forward cargo door was latched and locked until water impact only a few days after the accident and before the wreckage reconstruction was even attempted.
- B. The door was shattered into many pieces and was not one 'door.'
- C. The essential pieces required to conclusively determine the status of the forward cargo door are missing, not in the wreckage database, never recovered, and thus never examined for proper locked positions:
  - 1. Manual locking handle.
  - 2. Pressure relief doors.
  - 3. Torque tubes.
  - 4. Midspan latches and pins.
  - 5. Much door internal and external skin.
  - 6. Door wiring.



4. The shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup was ruled out without proper comparison of Trans World Airlines Flight 800 to the one accident it most closely mimics, United Airlines Flight 811 which is not a center tank explosion event for an electrical/cargo door event.

From NTSB statement:

It was also suggested that the breakup could have been initiated by the in-flight separation of the forward cargo door. However, all eight of the latching cams along the bottom of the door (and some pieces of the cargo door itself) remained attached to the pins along the lower door sill, and there were no indications of preimpact failure of the hinge at the top of the door. This evidence indicates that the door was closed and locked at impact. Further, deformation and fracture patterns on the door matched damage to the adjacent fuselage structure, confirming that the door was in the closed position at the time of impact. Therefore, the Safety Board concludes that the in-flight breakup of TWA flight 800 was not initiated by a preexisting condition resulting in a structural failure and decompression.

**8. There is only one cargo door sill in the wreckage database and that is the aft cargo door sill.** A cargo door sill is hung on the wreckage reconstruction and that is on the forward cargo door.

There were two identical cargo door sills on board Trans World Airlines Flight 800, the forward cargo door sill and the aft cargo door sill.

The aft cargo door sill, latches and locks were recovered. The forward door sill, latches and locks were not recovered. The aft door sill, latches and locks are in the wreckage database as found on page 14 of 71 pages, "C122, RF45A 40 39 47.00 latitude, 72 37 27. 90 longitude, aft cargo door-lower sill latches & locks."

The aft sill was found with the companion aft cargo door skin in the terminal debris field as expected which is where the wings and rest of fuselage were found and far away from the nose debris field where the forward sill would be expected to be found but wasn't. The forward cargo door hinge and a few pieces of top forward door skin were found as expected in the area where parts forward of the wing were found, but there was no forward door latches and locks or sill found there.

The aft cargo door sill was found where it was expected, with other aft door skin, in the expected location of the wing and aft fuselage debris field. The forward sill was not found where it was expected in the nose debris field; in fact it was not found at all.

The only mention of a cargo door sill in NTSB AAR 00/03:

1.16.4.4 Metallurgical Examination of the Forward Cargo Door All eight of the latching cams at the bottom of the door were recovered attached to pieces of the lower end of the door and were in the latched position. Additionally, the latching cams and pieces of the cargo door remained attached to the pins along the lower door sill.

The wreckage reconstruction shows a cargo door sill placed in the forward cargo door sill location. All wreckage databases, updated wreckage location forms, and addendums to the TAGS database

were searched with no results for any other cargo door sill. There is a great likelihood that the wrong cargo door sill was placed in the reconstruction and the conclusion that the forward cargo door was latched on the bottom and therefore all latched may be based on observations of the wrong cargo door sill.

Below excerpts from NTSB wreckage database for Trans World Airlines Flight 800 of cargo door supplied by NTSB on CD ROM:

8/18/96-6 40 39 47.00 -72 37 27.90 FS XXXX frame 40 39 46.90 -72 37 27.90  
aft cargo door - lower sill latches & locks

8/26/96-36 40 39 46.40 -72 37 27.80 FS 1800 RIB 40 39 46.40 -72 37 27.80 FS  
1810; outer frame aft cargo door panel stringer STR 24R-28R (aft upper main cargo  
door sill)

8/4/96 0:00:00,,"C111",,,"40 39 46.90", "-72 37 27.90", "aft cargo door cutout  
(#1860)/seats/fuselage",,,"Green",,.

8/5/96 0:00:00,,"C122",,,"40 39 46.90", "-72 37 27.90", "aft cargo door - lower  
sill latches and locks", "RF45A", "L16", "Fuselage", "Green", "FS 1880",

8/21/96 0:00:00,,"C644",,,"40 39 46.89", "-72 37 26.59", "aft cargo door lower  
aft section", "RF45F", "L15.5", "Fuselage", "Green", "FS 1910",

8/25/96 0:00:00,,"C2155",,"C714", "40 39 46.40", "-72 37 27.80", "FS 1810,  
outer frame aft cargo door panel STR 24R-28R (aft upper main cargo door  
sill)", "RF98", "16L", "Fuselage", "Green", "FS 1810"

8/9/96-37" ,,"C2133",,"C673", "40 39 47.04", "-72 37 26.90", "aft cargo door  
fragment", "RF45G", "L16", "Fuselage", "Green", "FS 1810",

8/25/96 0:00:00,,"C1080",,,"40 39 46.40", "-72 37 27.80", "FS 1900-1940 aft  
cargo door surround, STR 41R-44R", "RF45E", "L 15.8", "Fuselage", "Green", "FS  
1900-1940",

8/4/96 0:00:00,,"C2252",,"C114", "40 39 46.90", "-72 37 27.90", "FS 1820-1840  
STR 23R - 27R with aft cargo door  
hinge", "RF30A", "L16", "Fuselage", "Green", "FS 1820-1840"

8/19/96 0:00:00,,"C2336",,"C932", "40 39 47.36", "-72 37 27.71", "FS 1780-  
1840 STR 38R-46R forward lower corner of aft cargo door cut-  
out", "RF54E", "L16", "Fuselage", "Green", "FS 1780-1840",

8/4/96 0:00:00,,"C2340",,"C112", "40 39 46.90", "-72 37 27.90", "FS 1810-1836  
STR 27R-30R, forward right upper corner of aft cargo  
door", "RF99", "L16", "Fuselage", "Green", "FS 1810-1836",

8/4/96 0:00:00,,"C111",,,"40 39 46.90", "-72 37 27.90", "aft cargo door cutout  
(#1860)/seats/fuselage",,,"Green",,.

8/21/96 0:00:00,,"C644",,,"40 39 46.89", "-72 37 26.59", "aft cargo door lower  
aft section", "RF45F", "L15.5", "Fuselage", "Green", "FS 1910",

There are no references to any aft or forward cargo door parts in the addendum to  
the TAGS database, Exhibit 21F Appendix 5: Updated Wreckage Not Included in  
Tags Table.

Wreckage database for Trans World Airlines Flight 800 is attached to this Smith AAR in Appendix  
N: Appendix M: NTSB TAGS database for Trans World Airlines Flight 800.

## 9. Wreckage debris tags in database changed. The wreckage of Trans World Airlines

Flight 800 was retrieved at great expense with particular attention paid to the latitude and longitude of the located items using sophisticated mapping equipment. Much care by FBI and NTSB personnel was shown in creating a wreckage database of the items which were tagged and logged. However, much later, hundreds of items were changed from having been located at one location to having been located at different location because there were 'found to be at odds with the debris field in which the object was actually found.'" The explanation for changing important information about the evidence after the fact is bewildering.

Public Docket SA-516, Exhibit No. 7A, Structures Group Chairman's Factual Report of Investigation, page 5, "In addition, an area 2.7. nautical miles in radius, centered at 40 degrees 38 minutes 54 seconds North, 072 degrees 40 minutes 23 seconds West, was defined. The portions of this area that did not already lie in either the Red, Yellow or Green zone were designated the Orange Zone. The center of this zone corresponds to the last secondary radar return from the aircraft."

TWA 800 Tags System Procedure  
Tag La?-Long Sources & QA Plan  
OTECH CAJ 9/26/96

Purpose:

Explain the sources for latitude & longitude values for TWA wreckage, and the procedures for ensuring them to be as accurate as possible, Position Sources:

The Tags Database exists to provide and maintain a record of where TWA debris was found on the ocean floor. To understand how these positions are arrived at requires some understanding of the recovery process. The recovery effort is based on the target system. Briefly, a target is an anomaly revealed by side scan, laser line scan or ROV, and deemed worthy of investigation as possibly related to TWA 800. Targets are initially entered in the Target Database (maintained by Oceanering / SupSalv at East Moriches). When investigated (by diver or ROV), reports are generated; the contents of these reports are summarized in the Target Database. Sometimes the target is biologic (clams), geologic (terrain), or non-related (trash, boat parts, etc.); often it is indeed a piece of wreckage from TWA 800, or even a victim. Regardless, all such information is recorded in the Target Database, and presented on Target Plots, for purposes of recovery management. When TWA wreckage is recovered, it generally gets tagged on the ship, and a Wreckage Log is completed for the object. On this log sheet, the lat/long of the ship position at the time is written. While not the exact location of where the object was on the ocean floor (it was moved some distance by diver, ROV or winch to get it aboard), it is still fairly close, i.e., within \_ meters. However, the Wreckage Log often associates a target with the debris, providing a position prior to moving the object to the ship. The Tags Database was developed to maintain a record of wreckage logs for tagged debris (hence the name, tags database). Lat long positions are, by default, those written on the Wreckage Logs (e.g., the ship position). But when the Wreckage Log refers to a specific target for the object, the lat/long of the target is used instead, being more precise. "The database created to track recovered parts is known as the TAGS database. A series of metal tags were issued to be attached to the recovered parts as durable identification tags. The metal tags were colored one of six possible colors."

"Orange Recovered from areas other than Areas 1, 2 or 3 during the trawling operation."

"9000-9999 Issued by the trawlers working the western half of the Orange zone."

TWA 800 Tags System Procedure

Tag Re-Numbering

OTECH CAJ 9/25/96

Applicability:

When a tag number needs to be changed. Primarily reason: when the tag alpha designator (A B C or X Y Z) or color code (RED, YELLOW, GREEN) is found to be at odds with the debris field in which the object was actually found. Such tags are referred to as out-of-area tags. Re-tagging may also be necessary~ for debris field locations which cannot be verified. If database validation processes indicate that existing tag location information is not verifiable, then re-tagging to WHITE will be accomplished using this procedure and associated documentation. For those situations where documentation indicates that re-tagging would revise the debris field location (i.e., the tag color should be changed), back-up documentation will be maintained to support the re-tag action.

Docket No. Sa-516 Exhibit No. 211

National Transportation Safety Board Washington, D.C.

Appendix 11: Out-of-Area Corrections Made During Hangar Tag Audit (8 pages)

Appendix 11: Out-of-area corrections made during hangar tag audit o

Part 1: Lat long Corrections (tag is correct) TAG MT LONG DESCRIPTION ACTION

A2049 403945.10 -723628.75 bulkhead instl segment underwing, front spar FS source tag is A696, which has had UL corrections per FBI lot A2053 403945.10 -723628.75 FS 855-938 stringer segment 3L source tag is A696, which has had UL corrections per FBI lot A709 403944.95 -723631.34 FS 920 frame; stringer 33L-35L; (rib assy WL cites LLS5685 which does not exist; dbase used LLS568 #65001736-401) which has UL not matching WL; target dbase correctly cites I I I ILLS685, which has UL matching ~; correct source ~arget& UL to LLS685 and leave tag number& color as-as - CI070 403946.89 -723926.59 flooring Longitude typo in minutes: change from 39 to 37; leave tagged as- C770 403904,07 -723223.90 Various (7 bags and various piping) all in metal box dbase matches WI-; but FBI log has correction to longitude from I I I 1723227.9to 72 3827.9; DB also has typo in long. s~conds XII02 403752.79 ,-723006.79 black and white plastic (23.9); correct per this longitude and re-tag to yelkw dbase matches WL; but FBI log links XI 102 to tamet PS181. dove by SCPD on the correct date. PSI 81 / DL 93o-7 ~atches - description. Change to DL UL: 403757.79 / -7238 06.79; use I Z1784 403921.92 !-72 3526.16 debris

PS181 as source target; leave target number& color as-is dbase cites incorrect target PS20959, should be PS20359 (which I Ihas UL matching WL; the former is way off); correct source target . \_\_ l\_\_.. \_\_ & UL per PS20359; leave tag number & color as-is ~Z2778(CW part) sources 23420; both go to green field, but stay ?3603 ~ -----\*-----

tagged as-is.

Change UL for 23603 to those listed for it in W/L. 23675 1403946.00 --723755.18 2 pieces of small plastic; pe~onal effects !3>89 ~040 46.40

~ -- Lcitesps20627

~-723746.50 structural framing sourced to target PS4435, confirmed by DL; Lat has ROV 42 sec li from boat, which is impossible; must be handwriting error; use

40 4004.4 for latitude; leave tag number& color as-is IPart 2: UL Confirmed; Re-Tag For Orange Area I [TAG [MT

1

I LONG IDESCRIPTION - IActIObi 1

XI 142 403954.07 -723842.15 debris

re-tag to orange

X1144 403943.84 -723826.69 debris re-tag to orange xl 145 403943.07 -723823.84 debris re-tag to orange xl146 403943.07 -723823.84 photo re-tag to orange xl 147 403948.51 -723823.86 plastic bag of debris re-tag to orange XI 148 403948.63 -723822.91 plastic bag of debris re-tag to orange xl 149 403947.95 -723826.27 plastic bag of unknown contents re-tag to orange X1154 403954.37 -723819.39 debris re-tag to orange X1155 403954.91 -723755.42 debris re-tag to orange X1156 403954.41 -723824.47 debris re-tag to orange X1157 403954.59 -723831.07 bag (blue/green/gold/red) international orange debris re-tag to orange Z1790 404012.10 -723716.67 debris re-tag to orange Z1791 404008.00 -723717.97 personal effects re-tag to orange Z1792 404008.63 -723712.14 stainless steel debris re-tag to orange Z2553 403919.96 -723832.32 mist clothing (bagged) re-tag to orange Z2792 403948.50 -723752.80 seat 24 (8); seat 24 (9) partial replacement tag for Z3592; re-tag to orange Z3055 403922.01 -723839.97 clothing re-tag to orange .- .-

IZ3056 1403919.74 I-723838 .52 Iclothing Ire-tag to orange 103922.01 I-723839.97 Imisc. Plastic Diece (trav) Ire-taa to oranae :r seat

1. 1 r. - 65B02424-53 I[~-ldy LU UIEIIIYIS IZ3602 ]4040 09.16 I-7237 36.54 ]2 sma~pieces of wreckage, s/n 65B82330 on larger Ire-tag to orange piece

Z3611 403945.93 I-72 3802.22 plastic piece 18X 8 - re-tag to orange Z3613 403949.11

--.-

-723830.69 fabric lining re-tag to orange . Z3663 403956.44 -723759.54 misc. metal and skin (5 pieces) re-tag to orange . - Z3674 403946.12 -723801.88 4 x 4 twisted piece of green metal re-tag to orange Z3675 403946.00 -723755.18 2 pieces of small plastic; misc. photos re-tag to orange Z3676 403946.12 1723801.88 sm plastic piece, rubber part pln 69B70220-1 re-tag to orange . . Z3701 403928.72 -723941,03 mist.plastic

. . . . .

re-tag to orange

Z3746 403931.00 -723753,50 aircraft skin

. . . . .

re-tag to orange

---.-

Z3758 404006.10 -723733.79 long piece of stringer \_\_.

re-tag to orange

Q/

Z3775 404005.60 -723810.74 twisted aircraft metal re-tag to orange Z3776 404001.28 -723804.10 twkted aircraft metal (approx 2 length) re-tag to orange Z3778 403942.45 -723832.30 luggage re-tag to orange Z3779 403941.88 -723753.88 skin WIpartial honeycomb& strip of metal framing re-tag to orange Z3780 403948.47 -723805.74 aluminum tubing and crushed honeycomb fiber re-tag to orange (aluminum)

Z3781 403949.19 -723829.94 tangled electrical wiring with assorted fabric re-tag to orange Z3782 403959.51 -723758.22 aluminum tubing - aluminum framing strip

re-tag to orange Z3784 403939.90 -723812.44 skin (white) approx 6 of twisted metal colored green re-tag to orange Z3785 404007.60 -723747.90 metal ribbing re-tag to orange Z5002 403921.05 -723938.64 small pieces of insulation re-tag to orange Z5003 404007.85 -723710.95 window frame re-tag to orange Z5009 403945.78 -723829.87 piece of plastic I personal effects re-tag to orange Z5010 403942.97 -723812.92 piece of rubber re-tag to orange Z5011 403953.33 -723920.22 oxygen mask bag re-tag to orange Z5012 403947.88 -723816.83 piece of cabin liner re-tag to orange Z5013 403944.45 -723804.94 piece of plastic liner re-tag to orange Z5014 403947.00 -723812.58 3 pieces cabin liner re-tag to orange Z5015 403947.75 -723826.30 honeycomb metal, wiring , O2 mask , plastic tube , re-tag to orange I I /rope , sm pc metal , pc green metal , personal [ I effects Z5021 404006.70 -723729.13 small piece of fiberglass honeycomb re-tag to orange Z5035 403924.54 -723815.55 1 piece burnt plastic re-tag to orange Z5036 403927.14 -723840.87 clothing re-tag to orange Z5078 403955.61 -723822.43 4 piece of metal re-tag to orange Z5079 403956.10 -723839.23 rubber tubing re-tag to orange Z5080 404006.31 -723714.64 3 piece of metal (yellow) re-tag to orange Z5083 403942.66 -723838.40 gray plastic cover like object re-tag to orange Z5093 403936.83 -723818.16 alc skin re-tag to orange Z5122 403932.55 -723809.08 1 plastic bag containing debris re-tag to orange Z5123 403938.93 -723759.70 1 plastic bag containing debris -.  
re-tag to orange  
~5124 403936.81 - -723813.00 1 plastic bag containing debris .  
re-tag to orange  
Z5125-- 4T%-2576 -

... .  
-723850.77 white piece of plastic& black nylon string ,. -- Te-tag to orange Z51~6 403934.91 -723839.37 white r)iece of dastic re-taa to oranae Part 3: UL Confirmed; Re-Tag for Green Area I TAG LAT LONG DESCRIPTION ACTION  
A3119 403945.10 -723724.60 no info found; if there are no documents, delete from database? A403 403936.47 -723702.70 2x1x1angle iron, small bundle of wires W1295- re-tag to green I I ]2CC48 I  
A407 403945.05 -723704.78 metal parts and tubing re-tag to green A430 403948.15 -723709.58 5 light framing I various piping & light edging; re-tag to green waterline 100 RBL 55 Support  
A431 403948.13 -723705.51 overhead bin I various light framing I speaker frame re-tag to green A433 403947.95 -723707.80 forward lower cargo bay structure FS 920 right hand re-tag to green side  
A443 403950.17 -723703.35 2.5 framing re-tag to green A864 403950.80 -723723.47 seat part  
A874 1403950.80  
no info found; if there are no documents, delete from database? -723723.47 fuselaae section. areen. 4 x 3, charred no info found: if there are no documents, delete from database? A875 403950.80 -723723.47 fusela~e bulkhea~parts 8 x 2 no info found; if there are no documents, delete from database? W2000 403931.26 -723532.36 FS 1670-1710, stringer 30R-33R, fuselage skin re-tag to green I I I I I  
Iseament I I  
W5008 ~4039 31.26 !-723532.36 I metal structure with many wires, 1S long x 2 wide, Ire-tag to green I I I #s available STA 2280, STA 2200 -03923.59 !-7235 45.51 luggage, clothing, personal effects re-tag to green W5010 ~403931.71 I-72 3532.43 aluminum structure, circular with 3 protrusions re-tag to green XI 113 ~403850.27 -723641.71 personal effects re-tag to green X1115 403855.45 -



723608.34 metal debris

- L. re-tag to green

X1116 ~403852.33 -723702.64 some kind of gray tray - re-tag to green X1124  
403857.83 -723537.23 parachute & metal cylinder re-tag to green X1158  
403913.30 -723748.31 pictures re-tag to green Note: the following taas are just east  
of areen: they will stay as-is. and NOT be changed to orange: Z5041. Z5038.  
Z3791 IPart 4: UL Confirmed; Re-Tag for Red Area I 403857.40 -723910.60 food  
cart w/4 drawers re-tag to red B088 403816.53 -723812.68 seat tray re-tag to red  
6089 403824.03 -7238

16090 J40 3821.45 J-72 3826.09 Ialun angk 16.17 /seat back re-tag to red 1

: w/wires 1.5x3 (#65B521 12-76) re-tag to red 16091 [40 3821.02 I-72 3822.57  
Ialun angle 2x1; 1 u shape angle; alum sheet re-tag to red w/brackets & hole 18x12;  
flex hose 10; plastic window frame

6092 1403817.94 I-72 3818,42 5/16 socket drive~ phenolic latch; alum metal re-tag  
to red =+=+

w/bolts; alum angle 5(X1Orib

-723842.75 plastic box wltubing rectangular metal tube 3 re-tag to red ~-723824.90  
assy part 65B54209-5; 2X5 green alum folded re-tag to red w/holes

6095 403828.55 I-723822.39 luggage, personal effects re-tag to red 6097

403845.30 J-72 3858.10 luggage carrier, personal effects; Boeing p/n re-tag to red;  
B2022 & B2023 use B097 as source, and may need 60640125-10 to go red also

6098 403834.09 -723837.28 clothing; assy #493780-OOOIA (19) light box; 5x2 1

re-tag to red

alum angle FS 820

B358 403835.22 -723850.32 personal effects, clothing re-tag to red 6556

403815.00 -723816.16 rubber window gasket . . re-tag to red 6557

... ..

403807.32 :723800.70- plastic piece pln 65B50174 breathing oxygen .- re-tag to

red 0558 4038-26.69 -7238 17.8? luggage, personal effects re-tag to red 6559

403826.69 ,-723817.81 plastic tube #B1 8-53 1; metal green; 5x5 metal pln re-tag  
to red 65B54114-9SK; white insulation

403827.78 -723832.88 strut 5x3 pln 65604366-145; 4x3 pln 864638 sln re-tag to  
red AC668

403902.50 -723807.25 clothing

=+% ---

re-tag to red

403825.47 -723818.91 multi color wires re-tag to red B709 4038 58.2Q-72

3839.40 mist pieces re-tag to red B756 403806.10 -723810,80 human remains re-  
tag to red

6758 403852,70 -1-723824.20 e=fic b3i-ildSbRA- ACmSITION UNIT re-tag to  
red I part # 2222228 mod dav-70-1 01 ser. 30 TWA part # .

B-759 403853.30 1\*~3824~;a:: ~ox----- ---- re-tag to red - - B760 403852.00 -  
723820,00 metal box w/handle re-tag to red @

B769a 403835.22 I-72 3850,32 JTWA ID re-tag to red C077b 403827.70 I-72  
3837.20 12-1/2x5xl framing - WL, dbase & DL cite target 888 as source, but UL is

wrong; use I I I 1888UL:4038 27.90 / -723845.31: re-taa to red 1 C091 403826.58  
-723906.48 part of tire Ire-taa to red C092 403827.88 -723910.07 metal ~art

GD5340A wire attached 1

Ire-taci to red

I

C093 403826.58 -723906.48 seat part, tray table piece re-tag to red W5006  
 403826.13 -723643.93 seat 5 (1 2) first class re-tag to red Z2534 403834.34 -  
 723819.49 3 metal structure, 6 X 4 white plastic serving tray tag number  
 incorrectly entered in dbase, should be Z5034; UL ok; I I I I Ichanae taa number to  
 Z5034 in dbase ONLY: re-taa to red ) \$ ! Z2551 1403918.23

.-

I-723825.62 \vent 5x6 diameter Ire-ta~ to red I Z2555 1403812.04 I-72 3732.11  
 Iclothing Ire-tag to red Z3051 ]4038 28,43 I-72 3901.03 Ire-taa to red Z3052  
 403828.68

.

I-72 3859.46 clothing re-tag to red

Z3054 403917.96 ]-72 3835.91 clothing re-tag to red Z3057 403907.56 ;-72  
 3947.89 nylon bag with cord re-tag to red Z3058 403917.96 !-72 3835.91 misc.  
 plastic parts re-taa to red Z3059 403917.96 -723835.91 misc. plastic piece .

Z3505 403852.19 -723801.22 metal box; sneake~ piece of plate re-ta~ to red  
 Z3557 403857.30 -723945.38 white elastic Diece re-tag to red re-taa to red ]Z3558  
 1403801,40

( 1 .,-

I-72 3920.64 Iwhite cdasticDiece

1

Ire-taci to red I

Z3559 403742.80 -723842.00 vety large net entangled with debris re-tag to red  
 Z3571 403822.91 -723846.91 FS 865-880 stringer segment 43L re-tag to red  
 Z3572 403824.01 -723840.06 misc. metal re-tag to red Z3573 403823.77 -  
 723840.56 FS 880-930 stringer segment 35L re-tag to red Z3694 403834.66 -  
 723918.72 misc. metal re-tag to red Z3783 403842.43 -723829.73 empty plastic  
 bag re-tag to red Z5001 403918.03 -723931.78 small piece of metal 1x1O, shirt re-  
 tag to red Z5031 403805.24 -723837,29 personal effects, clothing re-tag to red  
 Z5032 403908.06 -724010.92 14 wiring re-tag to red Z5033 403843.99 -  
 723827.81 green metal structure, number 65665458-4 re-tag to red 25034  
 403834.34 -723819,49 3 metal structure ; 6 x 4 white plastic serving tray re-tag to  
 red 4 1 .----+-- and pen ..... .. c  
 Z5127 403843.85

.. .

i-72 3937.31 metal fragments (yellowish-green) re-tag to red Note: the following  
 tags are just-east of red; the~w~>t~vas-is, and NOT be chanaed to oranae: A271,  
 A267 .

w

Part 5: UL Confirmed; Re-Tag for Yellow Area TAG LAT LONG DESCRIPTION  
 ACTION

AO07 403906.10 -723829.21 TWA AKN7415 cargo container re-tag to yellow  
 A051 403901.66 -723831.62 pln 58607; DME Receiver re-tag to yellow A052  
 403903.76 -723827.88 FS 560-670 incorrect target ref, should be 2981.2S (per  
 target dbase); update target & IatJlong; re-tag to yellow

A053 403903.80 -723828.30 fuselage LHS FS 600-760 re-tag to yellow 4X249  
 403909.49 -723831.92 galley A kitchenlgalley ovens; A6, A5a, A5b, A5c, re-tag  
 to yellow A5d (3 pieces)

A250 403909.49 -723831.92 galley A 4 ovens, coffee maker& drawers re-tag to  
 yellow A409 403904.75 -723825.51 window frame, cushion, honeycomb  
 insulation; re-tag to yellow clothing

A695 403856.80 -723831.50 lavatofy door re-tag to yellow 1A697 403901.90 -723830.00 piece of aircraft interior panel (insulation) re-tag to yellow A699 403859.73 -723829.69 black plastic tray re-tag to yellow C475 403904.00 -723827.00 green bag of mist pieces, airplane debris, wiring re-tag to yellow .. C483 403904.00 -723827.00 green bag mist pieces airplane debris, insulation re-tag to yellow .

Debris field changed per FBI Lot# audit for out-of-area tags.", Approximately 130 times.

L/L changed slightly to reflect target location

Description changed to reflect debris/part data without comments."

"Source tag lat/long was changed to match tgt LLS1 in tgt database"

" Date " , " Time " , " Tag # " , " Target # " , " Source Tag# " , " Latitude " , " Longitude " , " Description (Actual) " , " Log# " , " Hangar Location " , " Aircraft Position " , " Debris Field " , " Aircraft Station " , " Updated " , " FBI# " , " Exempt Debris " , " Modify Tag Color " , " General Admin " , " Comments "

2981.20 , " 2981.2 S " , " 40 39 03.80 " , " -72 38 27.90 " , 4502697.48 , 699439.72 , " S " , " RU " , " , , , , " STA 600-760 " , " 4 " , " fuselage STA 600-760; fwd portion rt cargo door " 972.00 , " GRS972 " , " 40 39 44.91 " , " -72 37 27.02 " , 4504003.82 , 700835.27 , " V " , " GR " , 8 0:00:00 , " V " , " GRS " , 8/22/96 0:00:00 , " 3 " , " Cargo Door latch "

8/25/96 0:00:00 , " C2155 " , " C714 " , " 40 39 46.40 " , " -72 37 27.80 " , " FS 1810 , outer frame aft cargo door panel STR 24R-28R (aft upper main cargo door sill) "

8/2/96 0:00:00 , " B007 " , " , " 40 39 03.00 " , " -72 38 32.00 " , " RF 3 cargo door hinge ,

8/2/96 0:00:00 , " B051 " , " , " 40 39 03.00 " , " -72 38 32.00 " , " motor actuator cargo door " , " , " Electric " , " Yellow " , 12/4/96 9:43:50 , 0,0 , " location from early QA list - JAC 12/04/96 "

8/4/96 0:00:00 , " B153 " , " , " 40 39 04.30 " , " -72 38 27.20 " , " RH side cargo door , FS 640-760 aft STR 28R-43R " , " , " Yellow " , " FS 640-760 " , 9/4/96 16:30:23 , " 8/04/96-65 " , 0,0 ,

8/4/96 0:00:00 , " B155 " , " , " 40 39 04.30 " , " -72 38 27.20 " , " forward cargo door lift " , " L22 " , " Fuselage " , " Yellow " , 9/4/96 16:30:30 , " 8/04/96-65 " , 0,0 ,

8/6/96 0:00:00 , " B2017 " , " 2931.2S " , " , " 40 39 04.30 " , " -72 38 27.20 " , " forward part lower right cargo door , FS 560-670 " , " RF3H " , " L21 " , " Fuselage " , " Yellow " , " FS 560-670 " , 9/13/96 16:53:09 , 0,0 , " POSIT FROM BOAT LABEL , TGT 2931.2S Description changed to reflect debris/part data without comments. " ,

8/5/96 0:00:00 , " B189 " , " , " 40 39 04.30 " , " -72 38 27.20 " , " FS 540-580 STR 24R-30R with top right corner of forward cargo door " , " RF3D " , " L21 " , " Fuselage " , " Yellow " , " FS 540-580 " , 9/23

10:43:14,"8/06/96-2",0,0,,

8/5/96 0:00:00,,"B221",,,,"40 39 04.30", "-72 38 27.20", "small section of upper forward cargo door", "RF3E", "L21", "Fuselage", "Yellow", "9/23/96 10:41:50,"8/07/96-15",0,0,, 8/5/96 0:00:00,,"B223",,,,"40 39 04.30", "-72 38 27.20", "FS 600-720 STR 24R-26R with rear top part of forward cargo door", "RF3C", "L21", "Fuselage", "Yellow", "FS 600-720", "9/23 10:42:19,"8/07/96-15",0,0,,

8/6/96 0:00:00,,"B250",,,,"40 39 04.30", "-72 38 27.20", "FS 600-780 STR 23R-44R with attached cargo door", "RF3A", "L21", "Fuselage", "Yellow", "FS 600-780", "10/12/96 15:33:05,"8/07/96-15",0,0,,

8/7/96 0:00:00,,"B294",,,,"40 39 04.70", "-72 38 26.80", "FS 540-560 STR 34R, cargo door skin, RF FWD", "RF92", "L21", "Fuselage", "Yellow", "FS 540-560", "9/26/96 17:41:35,"8/08/96-31",0,0,,

8/8/96 0:00:00,,"B327",,,,"40 39 04.70", "-72 38 26.80", "aircraft skin/frame, FWD cargo door skin", "RF3I", "RECON", "Cargo", "Yellow", "3/16/97 14:11:03,"8/10/96-9",0,0,,

8/8/96 0:00:00,,"B334",,,,"40 39 04.70", "-72 38 26.80", "forward cargo door segment", "RF3M", "Fuselage", "Yellow", "3/29/97 11:08:43,"8/10/96-9",0,0,,

8/4/96 0:00:00,,"C111",,,,"40 39 46.90", "-72 37 27.90", "aft cargo door cutout (#1860)/seats/fuselage", "Green", "10/12/96 12:55:46",0,0,,

8/5/96 0:00:00,,"C122",,,,"40 39 46.90", "-72 37 27.90", "aft cargo door - lower sill latches and locks", "RF45A", "L16", "Fuselage", "Green", "FS 1880", "10/12/96 12:55:48,"8/05/96-70",0,0,,

8/9/96 0:00:00,,"C268",,,,"40 39 47.00", "-72 37 31.00", "FS 1960-2060 STR 23R-46R, bulk cargo door structure", "RF44B", "Fuselage", "Green", "FS 1960-2080", "10/10/96 8:29:53,"8/10/96-16",0,0,,

8/21/96 0:00:00,,"C644",,,,"40 39 46.89", "-72 37 26.59", "aft cargo door lower aft section", "RF45F", "L15.5", "Fuselage", "Green", "FS 1910", "12/16/96 9:15:04,"8/22/96-5",0,0,,

,,"C2133",,"C673",,"40 39 47.04", "-72 37 26.90", "aft cargo door fragment", "RF45G", "L16", "Fuselage", "Green", "FS 1810", "12/4/96 17:15:05,"8/23/96-15",0,0,"LOT# UPDATED PER 2000 SERIES AUDIT", "location unsupported - JAC 12/04/96"

8/25/96 0:00:00,,"C2155",,"C714",,"40 39 46.40", "-72 37 27.80", "FS 1810, outer frame aft cargo door panel STR 24R-28R (aft upper main cargo door sill)", "RF98", "L16", "Fuselage", "Green", "FS 1810", "10/2/96 17:38:45,"8/26/96-36",0,0,"SOURCE TAG CORRECTED FROM C730 TO C714",

8/4/96 0:00:00,,"C2252",,"C114",,"40 39 46.90", "-72 37 27.90", "FS 1820-1840

STR 23R-27R with aft cargo door hinge", "RF30A", "L16", "Fuselage", "Green", "FS 1820-1840", 4/6/12:35:31, "8/05/96-70", 0,0, "SOURCE TAG CORRECTED FROM C112 TO C114", (NOTE: LOG# RF30A corresponds to TAG# C2252 NOT TAG# C112)"

8/26/96 0:00:00, "B2015",,,,,, "metal strap with internal cargo door switch for forward cargo door; FS 560; WL 164; RBL 96", "L21", "Fuselage", "White", "FS 560", 1/25/97 16:08:02, 0,1, "CHANGED FROM YEL TO WHT PER 2000 SERIES AUDIT DUE TO LACK OF LOT#CHANGED FROM YEL TO WHT PER 2000 SERIES AUDIT DUE TO LACK OF LOT#",

8/5/96 0:00:00, "B2029", "B223", "40 39 04.30", "-72 38 27.20", "forward cargo door segment", "RF3N", "Fuselage", "Yellow", 3/29/97 11:10:52, "8/07/96-15", 0,0, "ORIG SOURCE TAG B206 NOT IN FBI LOG, CORRECTED TO B223",

8/19/96 0:00:00, "C2336", "C932", "40 39 47.36", "-72 37 27.71", "FS 1780-1840 STR 38R-46R forward lower corner of aft cargo door cut-out", "RF54E", "L16", "Fuselage", "Green", "FS 1780-1840", 12/4/6:55:25, "8/20/96-12", 0,0, "LOT# UPDATED PER 2000 SERIES AUDIT, SOURCE TAG CORRECTED FROM C946 TO C932 LOT# UPDATED PER 2000 SERIES AUDIT, SOURCE TAG CORRECTED FROM C946 TO C932",

8/4/96 0:00:00, "C2340", "C112", "40 39 46.90", "-72 37 27.90", "FS 1810-1836 STR 27R-30R, forward right upper corner of aft cargo door", "RF99", "L16", "Fuselage", "Green", "FS 1810-1836", 12/4/6:55:25, "8/05/96-70", 0,0,,

8/5/96 0:00:00, "B2101", "B223", "40 39 04.30", "-72 38 27.20", "aft pressure limiting door forward cargo door", "RF3K", "Fuselage", "Yellow", 3/29/97 11:09:39, "8/07/96-15", 0,0,,

8/5/96 0:00:00, "B2102", "B223", "40 39 04.30", "-72 38 27.20", "forward pressure limiting door forward cargo door", "RF3L", "Fuselage", "Yellow", 3/29/97 11:10:24, "8/07/96-15", 0,0,,

**10. The Poly X wiring was revealed to be faulty in Trans World Airlines Flight 800 and also in United Airlines Flight 811 but was not considered as an initial event for Trans World Airlines Flight 800.**

That defective type wiring was also discovered to have problems in the cargo door area of both aircraft. The NTSB Aging Aircraft Study revealed the poor qualities of Poly X wiring which is present in early model Boeing 747s.

Defective wiring was sought in the fuel tank region for Trans World Airlines Flight 800 as an ignition source for the CWT fire/explosion with no success but not sought as a source of the forward cargo door rupturing open.

BMS13-42A is Poly-X wiring and the forward cargo door location is FS 560-670. Cracked wires were discovered for Trans World Airlines Flight 800 within that zone. Frayed wires in that area have shorted before and caused the forward cargo door to open in flight as stated in NTSB AAR

92/02 for United Airlines Flight 811. Water has been seen pouring out of a forward cargo bay of a Boeing airliner which has a bilge in the cargo compartment to hold that water.

From News reports of the public hearing:

An NTSB aircraft systems investigator told a public hearing into the crash of TWA flight 800 that investigators were actively looking into four possible energy sources that could have triggered the explosion that brought down the Boeing 747.

Bob Swaim said the four areas involve the electrical system that measures the jet fuel in the plane's center wing tank. The NTSB has determined that the plane's center fuel tank exploded but has not yet determined the source of ignition.

Swaim told an NTSB public meeting into the accident 16 months ago that from the beginning numerous possible ignition sources had been studied, but now all but four have been set aside, at least for the present, while more promising ones are pursued.

He said the four are:

- \* - A possible short circuit to the fuel quantity indication system (FQIS) wiring, outside the fuel tank, combined with latent failures not apparent during operation of the plane, or copper sulfide deposits on FQIS components in the fuel tank.
- \* - Energy induced into the FQIS combined with latent failures, foreign materials or copper sulfide deposits in the fuel tank.
- \* - Damage to wiring above the forward cargo compartment. In the flight of a different aircraft, unrelated to the accident, investigation has found that a cargo container may have struck the wiring in this area and created a short circuit. In wreckage recovered from the accident aircraft, a portion of that wiring is missing.
- \* - Possible short circuit in other parts of FQIS wiring, some of which has not been recovered from flight 800. "

NTSB Public Docket Exhibit 9A page 116 for Trans World Airlines Flight 800:  
Systems Group Chairman's  
Factual Report Of Investigation page 116:

"Some wires found in the section of W480 from forward of station 570 and identified as BMS13-42A had numerous cracks in the insulation. Most of the cracks in this bundle were found to expose the core conductor when examined by microscope. Only within five feet of the aft end of the W480 bundle from station 570-900 were insulation cracks found."

NTSB Exhibit 9C, Attachments to the Systems Group Factual Report page 44, 45, 46."A. 1996, burning smell in forward cargo compartment, found damaged wiring shorted to ground, charring found.

B. Oct 12, 1996, Wire bundle arcing and resultant fire at aft bulkhead of forward lower lobe cargo hold on 747-200 freighter.

Public Docket 516A, Exhibit 9A: Systems Group Chairman's Factual report of Investigation, Page 47, "A Boeing telefax of June 25, 1997, stated that: The Poly-X wire was used as general purpose wire on the RA164 (TWA 800) aircraft. Wire



insulation known as Poly-X had three in-service problems:

- Abrasion of the insulation in bundles installed in high vibration areas.

(This problem was corrected by Boeing Service Bulletin No. 747-71-7105, Dated July 19, 1974)

- Random flaking of the topcoat.

- Insulation radial cracks in tight bend radii.

Radial cracking phenomenon of the Poly-X wire was mainly associated with mechanical stress. Bend radius is the largest contributor to mechanical stress in installed wire or cable. Presence of moisture in conjunction with mechanical stress is also a contributor."

The Systems Exhibit 9A continues on same page 47, "Evidence of arcing or short circuiting was found in the fuselage of N93119, (TWA 800) in addition to what was found in the wiring from the raceway below the left cabin floor and near the forward wing spar.

NTSB Exhibit 9C, Attachments to the Systems Group Factual Report, page 44: "Response: There were seven reported wiring fires on the 747 in 1996."

Page 45: "f. 747-200 reported on October 12, 1996

Wire bundle arcing and resultant fire at aft bulkhead of forward lower lobe cargo hold on a 747-200 freighter. This occurred with the airplane on the ground, during post C-check functional test.

Note: Portions of the damaged wire bundles were forwarded to Boeing for evaluation in determining the cause of the damage. The results of the analysis indicated the primary conductor(s) sustained mechanical or thermal damage prior to the application of electrical power."

Page 46, "g. 747-400 reported on November 1, 1997,

There was one reported wire insulation abrasion on the 747 in 1996. There operator reported that a burning smell was noted during cargo loading in the forward cargo compartment. Cargo loading system wiring was found damaged and shorted to ground below the cargo floor at station 650, below the aft right corner of a large ball mat. A wiring loom "p" clip was found broken enabling the wire to chafe against structure. A hole was found burned through the bottom angle of the cargo floor cross member, where the wiring clip attached, and charring was evident in the surrounding insulation blanket. Repairs were made."

Page 57, Letter from Commander Naval Air Systems Command to National Electrical Manufacturers Association, 1 Oct 82, "As you know, the problems with poly-x wire are well known to headquarters and its use had been curtailed."

United Airlines Flight 811 had faulty wiring: From NTSB AAR 92/02:

Wire Damage Found:

Seven wires numbered 101-20, 102-20, 105-20, 107-20, 108-20, 122-20, and 135-20 had visible damage located near a 3.8 inch position as measured from the P3 plug pin tips. This common position on the wire corresponds to a 360-degree loop in the wire bundle, which is located immediately below the junction box. Figures 18 and 19 show typical wire damage. Wire 122-20 had an open insulation area approximately 0.25 inch long. The other four wires had flattened insulation

damage areas.

In the P4 plug connector wire bundle, three wires displayed insulation damage. Wires 113-20, 121-20, and 124-20 had transverse insulation nicks, which exposed bare conductors. All three had insulation nicks 3 inches from the P4 plug pin tips; wires 121-20 and 124-20 had additional insulation nicks 34 inches from the plug pin tips. The two P4 insulation damage locations corresponded to wire bundle clamp positions.

From NTSB AAR 92.02 for United Airlines Flight 811:

10. Short circuit paths in the cargo door circuit were identified that could have led to an uncommanded electrical actuation of the latch actuator; this situation occurred most likely before engine start, although limited possibilities for an uncommanded electrical actuation exist after engine start while an airplane is on the ground with the APU running.

12. Insulation breaches were found on recovered portions of the cargo door wires that could have allowed short circuiting and power to the latch actuator, although no evidence of arcing was noted. All of the wires were not recovered, and tests showed that arcing evidence may not be detectable.

13. An uncommanded movement of cargo door latches that occurred on another UAL B-747 on June 13, 1991, was attributed to insulation damage and a consequent short between wires in the wiring bundle between the fuselage and the moveable door. Because the S2 switch functioned properly on that airplane, movement of the latches would not have occurred after the door was locked.

**11. Mysteries solved:** There are several mysteries left unanswered in the NTSB AAR 00/03 report but explained by the shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup explanation.

The CWT did have a fire/explosion so there was an ignition source. The required ignition source for the CWT fire/explosion was not determined by NTSB after an extensive search.

A. What caused the CWT fire/explosion?

The shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup explanation provides the answer which is engine number three. After the debris is ejected into engine number three after the forward cargo door rupture, the engine threw out turbine blades and caught on fire. After the nose separated and the rest of the aircraft started to disintegrate as it fell, the center fuel tank was twisted apart and caused a fuel vapor cloud to form. Many seconds after the initial event and much lower in altitude, the on fire engine number three ignited the fuel vapor cloud in the CWT creating the large fireball witnessed by ground observers, created the soot on the aft part of the center fuel tank, and caused all the bending and twisting as reported in the AAR. To put it another way, when the cargo door ruptures in flight on a Boeing 747 a huge hole is created in the nose which the 300 knot slipstream tears off. The falling, noseless, structurally compromised aircraft disintegrated into debris of rupturing fuel tanks, fuselage pieces including center tank, and spinning hot on fire jet engine number 3. When falling debris reached about 7500 feet, the fodded on fire engine number three ignited the fuel cloud and center fuel tank into a fireball. Center tank fire/explosion occurred but later and lower than forward cargo door rupture initial event.

B. How could forward cargo door rupture/open when bottom eight latches are latched and locked in TWA reconstruction?

The forward cargo door of Boeing 747s is about nine feet by eight feet square. It has a hinge on the top and eight cam latches on the bottom. On each nine foot side is one midspan latch. The bottom eight cam latches go around eight latching pins. Over each cam latch is a locking sector. The two midspan latches have no locking sectors. The forward cargo door could rupture at the midspan latches and the hinge and bottom eight latches could still be attached to fuselage skin. The top of the door with hinge attached would tear off with the fuselage skin and spin away. The bottom eight latches could stay attached to bottom sill and continue down to the sea with the nose. The middle of the large door can still be ruptured/opened while the lower part stays attached to airframe. Doors can open/rupture with most or all latches latched. TWA 800 reconstruction shows aft midspan latches missing which implies they became unlatched. The door frame sills are smooth and not attached to door which implies door ruptured in those areas. The cargo door sill which is reported to have the bottom eight latches locked may be the aft cargo door sill while the forward sill is still missing and unexamined.

C. Many independent ground and airborne observers reported a 'streak' of various colors and moving in various directions. The 'streak' most certainly existed because of so many independent, unbiased, and verified reports of it.

The NTSB dismissed all those reports. Many explanation were offered by others such as missile, fuel leak on fire, and meteor.

The most probable answer is the one suggested by the shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup explanation: The streak was perceived as such by ground and airborne observers to the west of Trans World Airlines Flight 800 as the pieces of the fuselage forward of the wing on the right side tore off at 300 knots at 13700 feet. The fast moving metal pieces reflected the evening orange sun as a streak to the observers. The true direction relative to the ground was impossible to determine from only one observation point and would give various subjective directions based on the altitude of the objects. For instance, an airliner coming toward an observer on the ground will be perceived as climbing, going up, as it approaches the viewer and descending, going down, as it departs. The actual maneuvering of the aircraft may be level, climbing, or descending.

The streak was evening sunlight reflecting off the departing pieces of fuselage just forward of the wing as perceived by observers on the ground to the west.

D. Red paint smears above the forward cargo door area are unique and found nowhere else along the entire five hundred feet of red painted livery along the fuselage.

This anomaly and important clue to the hull rupture of Trans World Airlines Flight 800 was not addressed in the NTSB AAR.

The probable answer is that when the forward cargo door ruptured open in flight, the top half of the door blew open, outward, up, and slammed into the fuselage skin above it, transferring paint from the door to the fuselage and vice versa. The red paint smears reveal there was some contact from the fuselage skin below to create the disrupted paint scheme.

E. There no burns to the passengers sitting above and near the CWT which is to be expected if the CWT fire/explosion were the initial event.

The most probable explanation for the absence of burns on the passengers is offered by the shorted

wiring/forward cargo door rupture/explosive decompression/inflight breakup cause in which the nose separates before the CWT fire/explosion. After the separation the passengers are thrown clear of their seats and are scattered about as the entire fuselage disintegrates as it falls. When the CWT finally does have its fire/explosion many seconds later and thousands of feet lower, the passengers are not nearby to be burned.

F. Unilateral damage: The starboard side of the fuselage, the starboard engine, and the starboard tailplane are much more severely damaged by inflight events than the port side.

A CWT fire/explosion initial event would create a bilateral damage appearance which is not evident.

The most probable answer to this anomaly is offered by the shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup explanation in which the starboard forward cargo door ruptures open in flight and ejects cargo bay material, passengers and their seats out into the slipstream on the starboard side. The debris gives the shattered appearance to a forty foot by thirty foot rectangle of skin, foreign object damage to engine number three, inflight damage to the right wing leading edge and also to the right horizontal stabilizer.

G. Sudden loud sound: The best and only direct evidence available to understand the cause of the Trans World Airlines Flight 800 destruction is the cockpit voice recorder information.

This information is essentially a very short time of a sudden loud sound. This best evidence does not match the initial event sound of a CWT fire/explosion sound as would be expected.

The sudden loud sound does match most closely that sudden loud sound of United Airlines Flight 811, an event which was caused by the shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup explanation.

The sudden loud sound is the energy of the compressed air molecules rushing out into the lower pressure outside air after the sudden ruptured opening of the pressurized hull on Trans World Airlines Flight 800.

**12. Refusal of authorities to interview author.** For over six years, 1996-2002, this author has attempted to meet with any NTSB and FAA and FBI investigators to discuss the shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup explanation for Trans World Airlines Flight 800. Efforts to meet with the NTSB or FAA or FBI public safety officials have all been rebuffed and to this date no meeting or conversation has ever taken place between the author and any NTSB or FAA safety official.

Efforts have included:

A. Meeting with Congressman Sam Farr asking a meeting with NTSB.

B. Correspondence from Senator John McCain suggesting to NTSB they meet with the author to discuss the concerns.

C. Email and letter correspondence with NTSB and FAA safety officials consisting of hundred of separate dispatches consisting of thousands of pages to dozens of officials. The responses by NTSB and FAA to this author were under a dozen and less than a few pages. Most responses from officials were to requests by others such as media or politicians requesting information and then forwarded to the author by the media or politician. Neither the NTSB nor the FAA nor the FBI have ever asked one question about the shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup discovery for Trans World Airlines Flight 800 and other similar

Boeing 747 inflight breakups. The FBI has never even responded to the warnings of a repeat of the cause of the accident.

D. The return correspondence from NTSB and FAA has always been to deny the plausibility of the explanation, to denigrate the author, to give reasons which were clearly incorrect, to evade giving answers, to state facts which were in error, and generally to express displeasure at the continued correspondence from the author.

E The NTSB eventually refused to reply to any correspondence from the author and stated such to any other person inquiring about the shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup.

F. The public hearing in Baltimore in December 1997 offered no opportunity to the NTSB to hear from the public and in particular this author.

G. In general, after six years and thousands of pages of documented evidence offered in support of the shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup explanation to justify a meeting with NTSB, FAA, or FBI officials to discuss the cause of a fatal civilian airliner, there were no meetings nor telephone calls from the officials to this author.

A typical response from NTSB to a media person is below:

"Your proposed article is incorrect. First of all, Senator McCain did not request that the NTSB meet with Mr. Smith. The Senator asked that the Board respond to Mr. Smith's concerns, which we have done numerous times and in great detail... Secondly, Mr. Smith is simply wrong. There is absolutely no physical evidence to support his personal theory that the forward cargo door came unlatched. Although Mr. Smith does display some knowledge of the Boeing 747, he has a basic misunderstanding of the facts. For example, Mr. Smith claims that there are 10 latches on the cargo door and that the Board only discusses eight in the above mentioned report. While a superficial description of the door might imply that there are 10 latches, Mr. Smith is, in fact, incorrect in implying that they all hold the door onto the fuselage. The eight at the bottom of the door, which were discussed in the report actually hold the door closed - the other two, one on each side of the door are merely "alignment latches" and do not hold the door closed."

**13. Typical response from NTSB to an inquiry and author's reply.** Below are excerpts from a letter to NTSB from the author responding to a letter from NTSB regarding the shorted wiring/forward cargo door rupture/explosive decompression/inflight breakup explanation for Trans World Airlines Flight 800: It is rare to include a letter from a citizen to a safety board in an AAR but the exchange gives the character of the discourse between a public safety agency, the media, and a private citizen. Note the veiled threat from the Chairman of NTSB to the media person who made the inquiry that "it would not be productive to correspond with Mr. Smith further..."



Office of the Chairman

**National Transportation Safety Board**

Washington, D.C. 20594

DEC 14 2000

Dear [REDACTED]

Thank you for your October 2, 2000, letter regarding Mr. John Barry Smith's assertion that the TWA flight 800 accident was caused by a wiring/switch fault in the accident airplane's electrical system, which led to the rupture of the midspan latches of the forward cargo door in flight. He asserts that this rupture precipitated the sequence of events that led to the explosion of the fuel/air vapor in the center wing fuel tank (CWT).

As you know, on August 23, 2000, the National Transportation Safety Board concluded that the probable cause of the TWA flight 800 accident was an explosion of the CWT resulting from ignition of the flammable fuel/air mixture in the tank. The source of ignition energy for the explosion could not be determined with certainty, but the Board concluded that, of the sources evaluated by the investigation, the most likely was a short circuit outside of the CWT that allowed excessive voltage to enter the CWT through electrical wiring associated with the fuel quantity indication system. The Board also concluded that contributing factors to the accident were (1) the design and certification concept that fuel tank explosions could be prevented solely by precluding all ignition sources and (2) the design and certification of the Boeing 747 with heat sources located beneath the CWT with no means to reduce the heat transferred into the CWT or to render the fuel vapors in the tank nonflammable.

The Safety Board did consider the possibility that the TWA flight 800 accident might have been initiated by the in-flight separation of the forward cargo door. All eight of the latching cams along the bottom of the door were found in the latched position and, along with some pieces of the cargo door itself, remained attached to the pins along the lower door sill. There were no indications of preimpact failure of the hinge at the top of the door. Investigators verified that these cams, pins, and sill pieces were from the forward cargo door by matching the fractures to the attaching pieces of structure. This evidence indicates that the door was closed and locked at impact. Further, deformation and fracture patterns on the door matched damage to the adjacent fuselage structure, confirming that the door was in the closed position at the time of impact. Docket materials supporting the Board's findings, including detailed information about the condition of the cargo door, are available on the Board's Web site at <<http://www.nts.gov>>.



You indicate that Mr. Smith claims that "only eight [of 20 door latches from TWA flight 800] have been recovered, and they are all from one sill found in the aft debris field" and that "[t]he only cargo doorsill found in the aft fuselage debris field belongs to the rear cargo door, and is not the forward cargo doorsill." The forward cargo door was found in the "yellow" wreckage recovery zone, which contained the nose portion of the airplane and pieces of the fuselage forward of about station 840. The aft portion of the airplane, including wreckage from the rear cargo door, was found in the "green" wreckage recovery zone, which contained most of the airplane wreckage, including pieces of the fuselage aft of about station 1000. Therefore, Mr. Smith is incorrect in asserting that the only recovered cargo door pieces were those from the rear cargo door.

You also state that Mr. Smith asserts that "all ten locking latches, the manual locking handle, the viewing ports, and two 'overpressure relief doors' have not been fully accounted for in the investigation and are not in the wreckage database." The Safety Board recovered and accounted for all of the closing hardware for the forward cargo door. All ten of the closing cams and pins are in the recovered structure database and are physically located on the reconstructed portion of the airplane. (A metallurgical report on the forward cargo door discusses only the eight latching cams and pins on the bottom of the door and does not discuss the two alignment pins and cams on the sides of the door.)

In your letter, you also indicate that Mr. Smith asserts that "[b]lades on the Number 3 engine were found damaged, in a manner consistent with explosive decompression of the adjacent forward cargo door." However, physical evidence indicated that damage to the number 3 engine's fan blade airfoils was due to the blade mid span shrouds shingling (overlapping) and tearing out part of the airfoils when the engine impacted the water. Further, the damage noted on the number 3 engine's low- and high-pressure compressor airfoils was similar to that observed on the other three engines' compressor airfoils. None of the four engines installed on TWA flight 800 had any damage that could have been caused by the ingestion of a foreign object. Therefore, this damage does not support Mr. Smith's contention that the forward cargo door separated in flight.

Finally, you state that Mr. Smith asserts that "[t]he FDR [flight data recorder] plots of TWA [flight] 800, Pan Am [flight] 103, and UAL [United Airlines flight] 811 are consistent with the explosive decompression of the right forward cargo door" and that "[b]ad wiring...caused the forward cargo doors to open in flight on high time B747's [including these airplanes and Air India flight 182]...and that [t]he photographic, CVR [cockpit voice recorder], FDR, FOD [foreign object damage], and other evidence points to a common scenario of cargo door failure." You also state that Mr. Smith believes "the outward peeled ruptures in metal shown in photographs...are clear evidence of cargo door failure, not of a [CWT] explosion."

Mr. Smith is correct that the United Airlines flight 811 accident was caused by the in-flight separation of the forward cargo door. However, the investigation of the Pan Am flight 103 accident (in which the Safety Board participated extensively) revealed overwhelming evidence that the accident was precipitated by the explosion of a bomb in the forward cargo

compartment, not by inadvertent opening of the forward cargo door. Further, regarding Smith's contention that the "outward peeled ruptures" from the TWA flight 800 airplane indicative of an in-flight cargo door failure, the investigation's Sequencing Group (which included participants from all of the parties to the investigation) reached a different conclusion. The Sequencing Group determined that the damage to the airplane was consistent with overpressure in the CWT as the initiating event, not a failure of the cargo door.

Mr. Smith's assertion that the CVR evidence for the four accidents mentioned in the letter indicate a common scenario is also incorrect. The CVR termination sound signature for Pan Am flight 103, Air India flight 182 (both of which were brought down by bombs exploded in flight), and TWA flight 800 were all characterized by a rapid increase in amplitude with evidence of prior anomalies. In contrast, the CVR from the United Airlines flight 811 accident involving the in-flight separation of the cargo door revealed a longer-term sound signature with a slower onset. Additionally, the loud terminating sound on the United Airlines flight 811 CVR was preceded by several precursor lower-order events, some of which were noticed and commented on by the flight crew.

In sum, Mr. Smith's position is simply not supported by the facts. Our correspondence database indicates that Mr. Smith has written the Safety Board many letters regarding his theories about the cause of the TWA flight 800 accident. The Board has responded to Mr. Smith numerous times, indicating that Board investigators have considered his theories and that there is no evidence exists to support his conclusions. In March 1998, I informed Mr. Smith that my correspondence had exhausted this issue and that he should expect no further response from the Board on this subject. I am pleased to have had this opportunity to provide you with details about the Board's position on this issue. However, I continue to believe that it would not be productive to correspond with Mr. Smith further about his theories regarding the cause of the TWA flight 800 accident.

Sincerely,



Jim Hall  
Acting Chairman

Dear Mister Jim Hall, Bernard Loeb, Ron Schleede (Ret), Al Dickinson, Jim Wildey, Bob Swaim of NTSB, and Misters McSweeny Mr. Ron Wojnar Mr. Dimtroff, Mr. Schalekamp, Mr. Breneman, Mr. Lyle Streeter of FAA, 15 Jan 01

This is John Barry Smith responding with a rebuttal to Chairman Jim Hall of NTSB who states in a 14 December 2000 letter that the wiring/cargo door explanation for

TWA 800 has been considered and ruled out. The NTSB, as represented by the Chairman, Jim Hall, and Bernard Loeb, Ron Schleede (Ret), Al Dickinson, Jim Wildey, Bob Swaim states that the NTSB has considered the wiring/cargo door explanation for TWA 800 and ruled it out based upon evidence and has corresponded with me numerous times. That evidence is incomplete and NTSB has not corresponded with me numerous times. NTSB has written me a few times with short statements of opinion telling me they are right and I am wrong. In addition, the NTSB has failed to respond to the specific absolute refuting evidence to the center tank as the initial event and have consistently refused for over four years to discuss the wiring/cargo door explanation or even meet with me to allow me to present a decade of research and analysis which has led me to conclude that the same probable cause of faulty wiring leading to a ruptured/open cargo door in flight has caused four Boeing 747 accidents, including UAL 811 and TWA 800. The actual refuting evidence to the center tank explanation and the actual confirming evidence of the wiring/cargo door explanation is listed below in response to NTSB assertions.

“NTSB: “Thank you for your October 2, 2000, letter regarding Mr. John Barry Smith's assertion that the TWA flight 800 accident was caused by a wiring/switch fault in the accident airplane's electrical system, which led to the rupture of the midspan latches of the forward cargo door in flight. He asserts that this rupture precipitated the sequence of events that led to the explosion of the fuel/air vapor in the center wing tank (CWT).”

JBS: Yes, that is my assertion with the clarification that it was wiring based upon new evidence of the faults of Poly X wiring in all aircraft, and in particular, early model Boeing 747s such as TWA 800, which shorted on the door unlatch motor.

NTSB: “As you know, on August 23, 2000, the National Transportation Safety Board concluded that the probable cause of the TWA flight 800 accident was an explosion of the CWT resulting from ignition of the flammable fuel/air mixture in the tank. The source of ignition energy for the explosion could not be determined with certainty, but the Board concluded that, of the sources evaluated by the investigation, the most likely was a short circuit outside of the CWT that allowed excessive voltage to enter the CWT through electrical wiring associated with the fuel quantity indication system.

JBS: The NTSB does not have an ignition source for the center tank explosion which is conclusive evidence that the probable cause of initial event as center tank explosion is not confirmed and that all other reasonable alternative explanations are plausible until ruled out by proper and thorough evaluation. A reasonable alternative mechanical explanation that has precedent and supported by official documents should be thoroughly investigated. The wiring/cargo door explanation is mechanical, plausible, supported by Public Docket evidence, has precedent in a similar type aircraft and has not been thoroughly investigated to the standard set by the precedent, UAL 811 in NTSB AAR 92/02. To say an explosion happened and not have the ignition source positively identified after years of searching and tests is to say the current explanation is incomplete and very possible not the initial event. There are three essential factors for a fuel explosion; air, fuel, ignition source; to not have all three is to admit the current explanation may be wrong. In fact, the wiring/cargo door explanation does have an ignition source for the CWT explosion;

a FODDed, on fire engine number three which ignited the center tank as the disintegrating wreckage fell after the explosive decompression caused by the ruptured/opened cargo door in flight allowed the nose to be torn off. This scenario is supported by wreckage debris locations, CVR and FDR data, and the precedent of UAL 811's FODDed and on fire engine number three. The actual refuting evidence of the center tank as the initial event is the absence of any sooted material on the passengers or the fuselage forward of the wing indicating the nose came off first in a generally straight tear line followed by the explosion of the tank which sooted those parts of the fuselage aft of the leading edge of the wing. In addition, the sudden loud sound on the CVR does not match the sound of a center tank explosion as compared with a known center tank explosion CVR sound in a NTSB chart. Also, the port side just forward of the wing is smooth while the starboard side is shattered which indicates a unilateral event and not the bilateral damage that a center tank event would show. The NTSB explanation as a center tank explosion is partly right because the center tank did explode, but the NTSB has the timing wrong, it was not the cause but a symptom.

NTSB: "...the most likely was a short circuit outside of the CWT that allowed excessive voltage to enter the CWT through electrical wiring associated with the fuel quantity indication system."

JBS: So very vague as to be meaningless. A short circuit outside the CWT includes 98% of the aircraft. The wiring/cargo door explanation has precedent of bare wires in the cargo door area of the confirmed cargo door accident, UAL 811. TWA 800 wreckage has bare wires in that cargo door area:

The Systems Exhibit 9A, page 116:

"Some wires found in the section of W480 from forward of station 570 and identified as BMS13-42A had numerous cracks in the insulation. Most of the cracks in this bundle were found to expose the core conductor when examined by microscope. Only within five feet of the aft end of the W480 bundle from station 570-900 were insulation cracks found."

(Note that BMS13-42A is Poly-X wiring. Cargo door location is FS 560-670 and cracked wires discovered are within that zone. Frayed wires in that area have shorted before and caused the forward cargo door to open in flight, NTSB AAR 92/02 UAL 811. Water has been seen pouring out of a forward cargo bay of a Boeing airliner. Water and leaking electricity make a powerful conductor. Both are known to exist in Boeing cargo compartments.)

NTSB: "The Safety Board did consider the possibility that the TWA flight 800 accident might have been initiated by the in-flight separation of the forward cargo door. All eight of the latching cams along the bottom of the door were found in the latched position and, along with some pieces of the cargo door itself, remained attached to the pins along the lower door sill. There were no indications of preimpact failure of the hinge at the top of the door. Investigators verified that these cams, pins, and sill pieces were from the forward cargo door by matching the fractures to the attaching pieces of structure. This evidence indicates that the door was closed and locked at impact. Further, deformation and fracture patterns on the door matched damage to the adjacent fuselage structure, confirming that the door was in the closed position at the time of impact.

NTSB: "The Safety Board did consider the possibility that the TWA flight 800 accident might have been initiated by the in-flight separation of the forward cargo door."

JBS: Considered but not investigated nor evaluated to the standard set for confirmed ruptured/open cargo door in flight, UAL 811. The UAL 811 AAR 92/02 has a complete metallurgical examination of the entire door, latches, cams, pins, overpressure relief doors, manual locking handle, hinge, and torque tubes. The TWA 800 'consideration' of the forward cargo door consists of one sentence, Docket Number SA-516, Exhibit No. 15C, Report Number 97-82, Section 41/42 Joint, Forward Cargo Door, "Examination of the lower lobe forward cargo door showed that all eight of the door latching cams remain attached (along with pieces of the door itself) to the pins along the lower door sill." A one sentence dismissal of a plausible mechanical explanation with precedent in a similar accident by an incomplete examination of eight of ten latches is not up to the aircraft accident investigation standards set by the NTSB in previous reports.

NTSB: "All eight of the latching cams along the bottom of the door were found in the latched position and, along with some pieces of the cargo door itself, remained attached to the pins along the lower door sill."

JBS: Misleading statement from NTSB of the word "all"; there are ten latches per cargo door for a total of twenty latches. Only eight have been recovered and were attached to a cargo door sill which was found in the aft debris field. The only two references to a 'sill' in the TAGS database refer to the aft sill, none for the forward:

8/5/96 0:00:00,,"C122",,"40 39 46.90", "-72 37 27.90", "aft cargo door - lower sill latches and locks", "RF45A", "L16", "Fuselage", "Green", "FS 1880", 10/12/96 12:55:48, "8/05/96-70", 0,0,

8/25/96 0:00:00,,"C2155",,"C714", "40 39 46.40", "-72 37 27.80", "FS 1810, outer frame aft cargo door panel STR 24R-28R (aft upper main cargo door sill)", "RF98", "16L", "Fuselage", "Green", "FS 1810"

There are no references to any aft or forward cargo door parts in the addendum to the TAGS database, Exhibit 21F Appendix 5: "Updated Wreckage Not Included in Tags Table."

Eight is not ten. Ten is complete for forward cargo door; eight is incomplete. The two missing latches are the midspan latches, the location of which is exactly where the outward peeled ruptures occur in the forward cargo door as confirmed by photographs of the actual shattered forward cargo door wreckage of TWA 800.



“X” marks the spot of the outward peeled rupture of the aft midspan latch of the forward cargo door of TWA 800. Note hinge and red paint smears on fuselage skin above shattered door.





The large gaping hole to the left of the yellow tag marks the spot of the outward peeled rupture of the missing forward midspan latch of the forward cargo door of TWA 800. Also note red paint smears above hinge, inward pillowing of skin lower down on door pieces, and absence of most of recovered door pieces.

NTSB: “There were no indications of preimpact failure of the hinge at the top of the door.”

JBS: There were indications of failure at the top of the door with red paint smears that would only occur when the door ruptured/opened in flight. These paint smears match the style of paint smears of the UAL 811 cargo door area when the door ruptured/opened out and upward and slammed into the fuselage skin above leaving door paint on the fuselage.

NTSB: "Investigators verified that these cams, pins, and sill pieces were from the forward cargo door by matching the fractures to the attaching pieces of structure."

JBS: The items only refer to the eight pieces recovered and do not refer to the two missing midspan latches. Metallurgical examination and report of those "cams, pins, and sill pieces" is absent, unlike the two AAR of UAL 811.

NTSB: "This evidence indicates that the door was closed and locked at impact."

JBS: Absolutely false logic and refuted by the incomplete recovery of evidence and absolutely refuted by photographic evidence of the actual wreckage of the few recovered door pieces which show outward petal shaped ruptures, paint smears, and the location of wreckage debris in the ocean that indicated clearly the forward cargo door ruptured in flight as the initial event and separated in pieces which created the entire shattered area around the forward cargo door on the starboard side. The port side opposite the cargo door is smooth and unshattered which refutes the center tank explosion as the initial event since a 'center' event would cause equal bilateral damage, not the severe unilateral damage on starboard side, the cargo door side. A latched cargo door sill in which the rest of the door is shattered and tossed to the wind is not a door which is closed and locked at impact. The actual confirming evidence that the forward cargo door opened in flight is the photographs showing the outward peeled ruptures at the two midspan latches, the engine blade in the right horizontal stabilizer, and the sudden loud sound on the CVR which matches a previous ruptured cargo door in flight on a similar type aircraft.

NTSB: "Further, deformation and fracture patterns on the door matched damage to the adjacent fuselage structure, confirming that the door was in the closed position at the time of impact."

JBS: Absolutely incorrect and proven by photographic evidence. There is no "door"; there are dozens of pieces of the door with most of it still missing and unrecovered as shown by photographs and the recovered wreckage database. To say a 'door' is "in the closed position" when the manual locking handle has not been recovered and examined to determine if it in the proper position and stowed is to give a worthless opinion about the status of a door. A latched cargo door sill in which the rest of the door is shattered and tossed to the wind is not a door which is in the closed position at the time of impact. The few pieces of the forward cargo door which were recovered were found many hundreds of yards apart from each other according to wreckage plot and indicate the door did not shatter upon impact but before impact. The TAGS database lists all the pieces of the forward cargo door which were recovered and constitute less than 50% of the door and confirmed by the wreckage reconstruction: (Note 'white' tag which means it was later changed and contradicts the Chairman's statement below.)

8/4/96 0:00:00,, "B155",,, "40 39 04.30", "-72 38 27.20", "forward cargo door lift", "L22", "Fuselage", "Yellow",

8/5/96 0:00:00,, "B189",,, "40 39 04.30", "-72 38 27.20", "FS 540-580 STR 24R-30R with top right corner of forward cargo door", "RF3D", "L21", "Fuselage", "Yellow", "FS 540-580",

8/5/96 0:00:00,, "B221",,, "40 39 04.30", "-72 38 27.20", "small section of upper forward cargo door", "RF3E", "L21", "Fuselage", "Yellow",

8/5/96 0:00:00,, "B223",,, "40 39 04.30", "-72 38 27.20", "FS 600-720 STR 24R-

26R with rear top part of forward cargo door", "RF3C", "L21", "Fuselage", "Yellow", "FS 600-720",  
 8/8/96 0:00:00, "B334", "40 39 04.70", "-72 38 26.80", "forward cargo door segment", "RF3M", "Fuselage", "Yellow",  
 8/26/96 0:00:00, "B2015", "metal strap with internal cargo door switch for forward cargo door; FS 560; WL 164; RBL 96", "L21", "Fuselage", "White", "FS 560",  
 8/5/96 0:00:00, "B2029", "B223", "40 39 04.30", "-72 38 27.20", "forward cargo door segment", "RF3N", "Fuselage", "Yellow",  
 8/5/96 0:00:00, "B2101", "B223", "40 39 04.30", "-72 38 27.20", "aft pressure limiting door forward cargo door", "RF3K", "Fuselage", "Yellow",  
 8/5/96 0:00:00, "B2102", "B223", "40 39 04.30", "-72 38 27.20", "forward pressure limiting door forward cargo door", "RF3L", "Fuselage", "Yellow",

There are no references to any aft or forward cargo door parts in the addendum to the TAGS database, Exhibit 21F Appendix 5: Updated Wreckage Not Included in Tags Table.

NTSB: "You indicate that Mr. Smith claims that "only eight [of 20 door latches from TWA flight 800] have been recovered, and they are all from one sill found in the aft debris field" and that "[t]he only cargo door sill found in the aft fuselage debris field belongs to the rear cargo door, and is not the forward cargo door sill." The forward cargo door was found in the "yellow" wreckage recovery zone, which contained the nose portion of the airplane and pieces of the fuselage forward of about station 840. The aft portion of the airplane, including wreckage from the rear cargo door, was found in the "green" wreckage recovery zone, which contained most of the airplane wreckage, including pieces of the fuselage aft of about station 1000. Therefore, Mr. Smith is incorrect in asserting that the only recovered cargo door pieces were those from the rear cargo door."

NTSB: "The forward cargo door was found in the "yellow" wreckage recovery zone, which contained the nose portion of the airplane and pieces of the fuselage forward of about station 840."

JBS: The 'forward cargo door' was not found anywhere. It was shattered into many pieces (one found in 'white' zone) as shown by the reconstruction photographs and less than 50% of the total door was recovered as shown by the TAGS wreckage database. The important pieces to determine if the cargo door was properly latched/did not rupture in flight are missing to include the manual locking handle, and the two midspan latches. None of the recovered pieces of the forward door were sooted which refutes the center tank as initial event since the forward door is very near the center tank. There was only one cargo door sill recovered and it was found in the aft debris field.

In addition, the color of a tag was changed even though the piece landed in a different color zone which depicts the actual landing location of the debris.

"DOCKET NO. SA-516

EXHIBIT NO. 211

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C.

Appendix 8: Tag Renumbering Procedure

(5 pages)  
TWA 800 Tags System Procedure  
Tag Re-Numbering  
OTECH CAJ 9/25/96

Applicability:

When a tag number needs to be changed. Primarily reason: when the tag alpha designator (A B C or X Y Z) or color code (RED, YELLOW, GREEN) is found to be at odds with the debris field in which the

object was actually found. Such tags are referred to as "out-of-area" tags.

Re-tagging may also be necessary for debris field locations which cannot be verified. If database

validation processes indicate that existing tag location information is not verifiable, then re-tagging to

WHITE will be accomplished using this procedure and associated documentation.

For those situations where documentation indicates that re-tagging would revise the debris field

location (i.e., the tag color should be changed), back-up documentation will be maintained to support the

re-tag action."

JBS: At odds with the debris field? The debris field is reality. Pieces landed where they landed for a physical reason. Sophisticated location techniques were used and latitude and longitude locations were logged as the pieces were retrieved. Where the pieces landed is of paramount importance and to administratively change the landing location is very misleading and non excusable. The pieces were found to be at odds with the debris field only using the center tank as the initial event. The original location of the debris field pieces make sense when using the wiring/cargo door explanation to explain why fuselage pieces forward of the wing landed where they did. (The overall debris appraisal was made by Docket Number SA-516, Exhibit No. 22A, Trajectory Study, page 3: "The wreckage distribution shows that parts were initially shed from the area just forward of the wing.") The center tank is not 'just forward of the wing' while the forward cargo door is. The center tank is aft of the leading edge of the wing and thus parts were not initially shed from that area which means it was not the initial event.

NTSB: "Therefore, Mr. Smith is incorrect in asserting that the only recovered cargo door pieces were those from the rear cargo door."

JBS: A completely wrong and ignorant statement by Chairman Hall of NTSB. I never said and do not assert now that "the only recovered cargo door pieces were those from the rear cargo door." In fact, I refer over and over to the forward cargo door pieces; they are conclusive proof that the forward door ruptured in flight. To say I assert "... the only recovered cargo door pieces were those from the rear cargo door," is to show conclusively that the NTSB does not understand the wiring/cargo door explanation, has not seriously considered the explanation, has not discussed the explanation with me, and is content with confused thinking about it.

The wiring/cargo door explanation does refer to the recovered pieces of the aft cargo door (also to many other parts of TWA 800) and asserts that the only cargo door sill of two which were on TWA 800 when it took off was found in the aft

debris field and is most likely that of the aft cargo door, a door which is identical in size, function, and parts to the forward cargo door. All pieces of the aft cargo door recovered are listed below; (Note that there are more pieces recovered for the aft door than for the forward door and no 'white' changed tags.)

8/4/96 0:00:00,,"C111" ,,, "40 39 46.90", "-72 37 27.90", "aft cargo door cutout (#1860)/seats/fuselage" ,,,, "Green" ,,,  
 8/5/96 0:00:00,,"C122" ,,, "40 39 46.90", "-72 37 27.90", "aft cargo door - lower sill latches and locks", "RF45A", "L16", "Fuselage", "Green", "FS 1880",  
 8/21/96 0:00:00,,"C644" ,,, "40 39 46.89", "-72 37 26.59", "aft cargo door lower aft section", "RF45F", "L15.5", "Fuselage", "Green", "FS 1910",  
 8/25/96 0:00:00,,"C2155", "C714", "40 39 46.40", "-72 37 27.80", "FS 1810, outer frame aft cargo door panel STR 24R-28R (aft upper main cargo door sill)", "RF98", "16L", "Fuselage", "Green", "FS 1810"  
 8/9/96-37" ,,"C2133", "C673", "40 39 47.04", "-72 37 26.90", "aft cargo door fragment", "RF45G", "L16", "Fuselage", "Green", "FS 1810",  
 8/25/96 0:00:00,,"C1080" ,,, "40 39 46.40", "-72 37 27.80", "FS 1900-1940 aft cargo door surround, STR 41R-44R", "RF45E", "L 15.8", "Fuselage", "Green", "FS 1900-1940",  
 8/4/96 0:00:00,,"C2252", "C114", "40 39 46.90", "-72 37 27.90", "FS 1820-1840 STR 23R - 27R with aft cargo door hinge", "RF30A", "L16", "Fuselage", "Green", "FS 1820-1840"  
 8/19/96 0:00:00,,"C2336", "C932", "40 39 47.36", "-72 37 27.71", "FS 1780-1840 STR 38R-46R forward lower corner of aft cargo door cutout", "RF54E", "L16", "Fuselage", "Green", "FS 1780-1840",  
 8/4/96 0:00:00,,"C2340", "C112", "40 39 46.90", "-72 37 27.90", "FS 1810-1836 STR 27R-30R, forward right upper corner of aft cargo door", "RF99", "L16", "Fuselage", "Green", "FS 1810-1836",  
 8/4/96 0:00:00,,"C111" ,,, "40 39 46.90", "-72 37 27.90", "aft cargo door cutout (#1860)/seats/fuselage" ,,,, "Green" ,,,  
 8/21/96 0:00:00,,"C644" ,,, "40 39 46.89", "-72 37 26.59", "aft cargo door lower aft section", "RF45F", "L15.5", "Fuselage", "Green", "FS 1910",

There are no references to any aft or forward cargo door parts in the addendum to the TAGS database, Exhibit 21F Appendix 5: Updated Wreckage Not Included in Tags Table.

NTSB: "You also state that Mr. Smith asserts that "all ten locking latches, the manual locking handle, the viewing ports, and two 'overpressure relief doors' have not been fully accounted for in the investigation and are not in the wreckage database." The Safety Board recovered and accounted for all of the closing hardware for the forward cargo door. All ten of the closing cams and pins are in the recovered structure database and are physically located on the reconstructed portion of the airplane. (A metallurgical report on the forward cargo door discusses only the eight latching cams and pins on the bottom of the door and does not discuss the two alignment pins and cams on the sides of the door.)

NTSB: "The Safety Board recovered and accounted for all of the closing hardware for the forward cargo door."

JBS: Absolutely not true: 'all the closing hardware' is missing from all of the

wreckage pieces databases, from the public docket, from examination and evaluation in Exhibits, and the actual wreckage reconstruction. In fact, all of the forward cargo door has not been recovered, accounted for, or evaluated, with less than 50% recovered and those few consist of 'segments' 'pieces' and 'parts.' The closing hardware is extensive and included, torque tubes, bellcranks, manual locking handle, ten cams, pins, latches, and overpressure relief doors within the door. To claim that all closing hardware for the forward cargo door was recovered and accounted for is a falsehood.

NTSB: "All ten of the closing cams and pins are in the recovered structure database and are physically located on the reconstructed portion of the airplane.

JBS: There is no documentation that of the twenty identical closing cams and pins, the alleged ten belong to the forward cargo door and not the aft. There is no documentation of the missing two midspan latches from the forward cargo door being found. There is no evaluation of the condition of any of the cams and pins of either door. In the entire wreckage databases there is no report of any 'cams' nor 'pins' in the recovered structure database. The two midspan latches of the forward door are not physically located on the reconstructed portion of the airplane as proven by photographs.

NTSB: "A metallurgical report on the forward cargo door discusses only the eight latching cams and pins on the bottom of the door and does not discuss the two alignment pins and cams on the sides of the door."

JBS: Misleading statement by NTSB and metallurgist Jim Wildey, as the two midspan latches are not trivial 'alignment pins and cams', but identical cams, pins, and latches to the lower eight. The top of the door is held by a lengthwise hinge and the lower sill of the door is held by eight latches. The two sides, each eight feet tall, are held in by one latch per side, the midspan latch. The lower eight latches have locking sectors which press against the cams to prevent inadvertent opening in flight. The two midspan latches have no locking sectors. This absence of two sectors per door is the fatal design error of the door in addition to being outward opening and nonplug. An Airworthiness Directive issued after the forward cargo door of UAL 811 ruptured/opened in flight to strengthen the locking sectors had no effect on the two midspan latches because they have no locking sectors to strengthen. Those two locations is where the ruptures occurred in TWA 800, at the midspan latches where no locking sectors existed, as confirmed by photographs. To "not discuss the two alignment pins and cams on the sides of the door" as NTSB admits is to admit to an incomplete examination and evaluation of the forward cargo door, a door initially considered to be the initial event of TWA 800.

NTSB: "In your letter, you also indicate that Mr. Smith asserts that "[b]lades on the Number 3 engine were found damaged, in a manner consistent with explosive decompression of the adjacent forward cargo door." However, physical evidence indicated that damage to the number 3 engine's fan blade airfoils was due to the blade mid span shrouds shingling (overlapping) and tearing out part of the airfoils when the engine impacted the water. Further, the damage noted on the number 3 engine's low- and high-pressure compressor airfoils was similar to that observed on the other three engines' compressor airfoils. None of the four engines installed on TWA flight 800 had any damage that could have been caused by the ingestion of



a foreign object. Therefore, this damage does not support Mr. Smith's contention that the forward cargo door separated in flight.

NTSB: "None of the four engines installed on TWA flight 800 had any damage that could have been caused by the ingestion of a foreign object. "

JBS: Absolutely incorrect statement as shown by actual examination of engine number three as reported in the TWA 800 Public Docket:

Exhibit 8A, Page 11, paragraph 3, discussing results of engine 3 disassembly, "Of the 46 fan blades in the fan rotor, 21 blades with complete or partial airfoils and 6 root sections were recovered. All of the fan blades had sooting on the convex airfoil surfaces. Most of the full length airfoils were bent rearward and the tips outboard of the outer midspan shroud were bent forward slightly. About half of the fan blades had impact damage to the leading and trailing edges. Almost all of the impact damage to the airfoils could be matched to contact with the midspan shroud on an adjacent blade. One full length blade had four soft body impacts along the leading edge and a partial airfoil had a soft body impact, which had some streaking extending rearward."

NTSB: "Therefore, this damage does not support Mr. Smith's contention that the forward cargo door separated in flight."

JBS: The damage to engine number three conclusively supports the wiring/cargo door explanation that the forward cargo door separated in flight by showing that foreign objects and door skin ejected after explosive decompression were ingested into the adjacent engine number three which led to uncontainment and the spitting out of a blade into the right horizontal stabilizer immediately behind the engine. Docket No. SA-516, Exhibit No. 7A, Structures Group Report, page 33: "5.1 Horizontal Stabilizer, "Some of the items found in the horizontal stabilizer are sections of seat track, a stator blade from turbine section, and glitter." On 5.1.1 Right Horizontal Stabilizer, page 34, "An engine stator blade from turbine section penetrated the upper honeycomb surface near the outboard trailing edge

JBS: Only 58% of the fan blades were recovered which means 42% were missing. It is very likely the 'stator blade' found in right horizontal stabilizer was from engine number three which sits directly in front of it. "Almost all' of the 'impact damage,' was explained which implies some wasn't explained. All blades in engine three had soot. Soot means fire. FOD usually means fire. Only engine number three had any sooting inside engine. One full blade and one partial blade had 'soft body impacts'. There is nothing normally soft inside a jet engine. Soft body impact means foreign object damage which could mean the soft bodies of passengers ejected from the open fuselage, as happened with UAL 811. Streaking could be blood streaks. Missing blades in engine three and one blade found directly aft in right horizontal stabilizer recovered far away from main engine means uncontainment in flight. Uncontainment means engine number three was not intact at water impact but implies destruction and fire inflight. The FODded, uncontained, spewing blades, on fire engine number three is very likely the plausible ignition source for the nearby center tank which was disintegrating into fuel vapor as it fell.

NTSB: "Finally, you state that Mr. Smith asserts that "[t]he FDR [flight data

recorder] plots of TWA [flight] 800, Pan Am [flight] 103, and UAL [United Airlines flight] 811 are consistent with the explosive decompression of the right forward cargo door" and that "[b]ad wiring ... caused the forward cargo doors to open in flight on high time B747's [including these airplanes and Air India flight 182] ... and that [t]he photographic, CVR [cockpit voice recorder], FDR, FOD [foreign object damage], and other evidence points to a common scenario of cargo door failure." You also state that Mr. Smith believes "the outward peeled ruptures in metal shown in photographs ... are clear evidence of cargo door failure, not of a [CWT] explosion. Mr. Smith is correct that the United Airlines flight 811 accident was caused by the in-flight separation of the forward cargo door. However, the investigation of the Pan Am flight 103 accident (in which the Safety Board participated extensively) revealed overwhelming evidence that the accident was precipitated by the explosion of a bomb in the forward cargo compartment, not by inadvertent opening of the forward cargo door. Further, regarding Mr. Smith's contention that the "outward peeled ruptures" from the TWA flight 800 airplane are indicative of an in-flight cargo door failure, the investigation's Sequencing Group (which included participants from all of the parties to the investigation) reached a different conclusion. The Sequencing Group determined that the damage to the airplane was consistent with an overpressure in the CWT as the initiating event, not a failure of the cargo door.

NTSB: "Mr. Smith is correct that the United Airlines flight 811 accident was caused by the in-flight separation of the forward cargo door."

JBS: I asset the above because of NTSB AAR 90/01 and 92/02 regarding UAL 811: NTSB conducted an incomplete investigation of the forward cargo door of UAL 811 and came to an incorrect probable cause in AAR 90/01 for its opening in flight leading to nine fatalities: Improper latching. Upon further investigation the door was found to be properly latched and the cause to be electrical. A new AAR was published which was AAR 92/02, giving the new probable cause. The NTSB TWA 800 investigation in AAR 00-03 is also incomplete leading to the wrong probable cause as the center tank exploding as the initial event. A precedent has been set of NTSB conducting an incomplete investigation leading to an incorrect probable cause in an AAR leading to the event occurring again (UAL preflight uncommanded opening of cargo door) and thus having to write another AAR with the new probable cause. This sequence will happen again unless further investigation of the wiring/cargo door explanation is conducted for TWA 800. A precedent has been set for NTSB to further investigate an accident even though a final AAR has been published. A precedent has been set for NTSB to discover and admit an error of opinion and correct it.

From  
NTSB AAR 92/02:  
NTSB/AAR-92/02  
(SUPERSEDES NTSB/AAR-90/01)

The wrong probable cause in AAR 90/01 for UAL 811: "The National Transportation Safety Board determines that the Probable Cause(s) of this Accident was: The sudden opening of the improperly latched forward lobe cargo door in flight and the subsequent explosive decompression."

The new probable cause in AAR 92/02 for UAL 811: “Before the recovery of the cargo door, the Safety Board believed that the door locking mechanisms had sustained damage in service prior to the accident flight to the extent that the door could have been closed and appeared to have been locked, when in fact the door was not fully latched. This belief was expressed in the report and was supported by the evidence available at the time. However, upon examination of the door, the damage to the locking mechanism did not support this hypothesis. Rather, the evidence indicated that the latch cams had been backdriven from the closed position into a nearly open position after the door had been closed and locked. The latch cams had been driven into the lock sectors that deformed so that they failed to prevent the back-driving.

Thus, as a result of the recovery and examination of the cargo door, the Safety Board's original analysis and probable cause have been modified. This report incorporates these changes and supersedes NTSB/AAR-90/01.

The issues in this investigation centered around the design and certification of the B-747 cargo doors, the operation and maintenance to assure the continuing airworthiness of the doors, cabin safety, and emergency response.

The National Transportation Safety Board determines that the probable cause of this accident was the sudden opening of the forward lower lobe cargo door in flight and the subsequent explosive decompression. The door opening was attributed to a faulty switch or wiring in the door control system which permitted electrical actuation of the door latches toward the unlatched position after initial door closure and before takeoff.”

NTSB: “However, the investigation of the Pan Am flight 103 accident (in which the Safety Board participated extensively) revealed overwhelming evidence that the accident was precipitated by the explosion of a bomb in the forward cargo compartment, not by inadvertent opening of the forward cargo door.”

JBS: There is not “overwhelming evidence that the accident was precipitated by the explosion of a bomb in the forward cargo compartment, not by inadvertent opening of the forward cargo door.” That NTSB statement is unsupported opinion and shows that NTSB also influenced incorrectly the PA 103 probable cause as reported in AAIB AAR 2/90. Pan Am 103 is another similar event of TWA 800. It has many similarities that match TWA 800 which are supported by facts, data, and evidence. The wiring/cargo door explanation concludes PA 103 was an ruptured/open cargo door inflight, as was Air India Flight 182.

PA 103, AI 182, and TWA 800 are the only Boeing 747 accidents to have the following unusual and rare similarities:

- non Section 41 retrofit
- early model
- Boeing 747
- experienced hull rupture forward of the wing in cargo bay.
- nose came off
- damaged number three engine
- sudden sound on CVR
- loud sound on the CVR

short duration sound on the CVR  
abrupt power cut to FDR  
outward peeled skin in cargo door area  
longitudinal break in forward cargo door,  
more severe inflight damage on starboard side  
at least nine never recovered bodies  
vertical fuselage tear lines forward of the wing and aft of cargo door  
torn off skin in forward cargo door area on starboard side,  
outward peeled skin in cargo door area  
downward bent floor beams in cargo door area,  
destruction initially thought to be have been caused by a bomb.

NTSB: "Further, regarding Mr. Smith's contention that the "outward peeled ruptures" from the TWA flight 800 airplane are indicative of an in-flight cargo door failure, the investigation's Sequencing Group (which included participants from all of the parties to the investigation) reached a different conclusion. The Sequencing Group determined that the damage to the airplane was consistent with an overpressure in the CWT as the initiating event, not a failure of the cargo door.

JBS: Again, that conclusion is unsupported opinion which is contradicted by facts, data, and evidence elsewhere in the Public Docket such as NTSB's own Trajectory Study. The Sequencing Group is James F. Wildey II, National Resource Specialist-Metallurgy. He is not an aircraft accident investigator. The TWA 800 Public Docket SA-516, Exhibit 18A is the Metallurgy/Structural Group Chairman Factual Report Sequencing Study, signed by only Mr. Wildey. Contrary to the NTSB statement above, the Sequencing Group did not determine that the failure of the cargo door was not the initiating event as the words, "Cargo Door" are not to be found in any of the 57 page exhibit. There is nothing in the "Study" about the forward cargo door, which is a serious omission as the ruptured/opened door was initially considered by NTSB to be the initial event and the forward cargo door lies very close to the center tank. This is further evidence that the wiring/cargo door explanation has not been properly evaluated by NTSB.

NTSB: "Mr. Smith's assertion that the CVR evidence for the four accidents mentioned in your letter indicate a common scenario is also incorrect. The CVR termination sound signatures for Pan Am flight 103, Air India flight 182 (both of which were brought down by bombs exploding in flight), and TWA flight 800 were all characterized by a rapid increase in amplitude with no evidence of prior anomalies. In contrast, the CVR from the United Airlines flight 811 accident involving the in-flight separation of the cargo door revealed a longer-term sound signature with a slower onset. Additionally, the loud terminating sound on the United Airlines flight 811 CVR is preceded by several precursor lower-order events, some of which were noticed and commented on by the flight crew.

NTSB: "The CVR termination sound signatures for Pan Am flight 103, Air India flight 182 (both of which were brought down by bombs exploding in flight), and TWA flight 800 were all characterized by a rapid increase in amplitude with no evidence of prior anomalies."

JBS: The CVR examinations for all four accidents have ruled out a bomb sound and match each other and UAL 811. To state a bomb went off in an aircraft and yet have

the CVR not have a bomb sound is to logically rule out the bomb as the cause of the sudden loud sound and thus the accident. An alternative must be found and it is in the explosive decompression sound. UAL 811 had that explosive decompression sound and it matches AI 182, TWA 800, and PA 103.

NTSB: “In contrast, the CVR from the United Airlines flight 811 accident involving the in-flight separation of the cargo door revealed a longer-term sound signature with a slower onset. Additionally, the loud terminating sound on the United Airlines flight 811 CVR is preceded by several precursor lower-order events, some of which were noticed and commented on by the flight crew.”

JBS: NTSB Chart 12 below which compares all CVR sound of the four accidents. They match in the very rare occurrences of a sudden loud sound, not a bomb sound, which is then almost immediately followed by an abrupt power cut to the FDR. UAL 811 did not have any ‘lower-order events’ picked up by the CVR as the time in the chart is in milliseconds. In spite of much effort to make the sudden loud sound a bomb sound, the sounds lack the low frequencies which exist in bomb sounds and the rise time is too slow for the explosion of a bomb. All of the four sounds match the known sound of the explosive decompression of UAL 811 forward cargo door rupturing/opening in flight. The NTSB CVR study omits any detailed analysis of this important sudden loud sound.

NTSB: “In sum, Mr. Smith's position is simply not supported by the facts. Our correspondence database indicates that Mr. Smith has written the Safety Board many letters regarding his theories about the cause of the TWA flight 800 accident. The Board has responded to Mr. Smith numerous times, indicating that Board investigators have considered his theories and that no evidence exists to support his conclusions. In March 1998, I informed Mr. Smith that our correspondence had exhausted this issue and that he should expect no further response from the Board on this subject. I am pleased to have had this opportunity to provide you with details about the Board's position on this issue. However, I continue to believe that it would not be productive to correspond with Mr. Smith further about his theories regarding the cause of the TWA flight 800 accident.

NTSB: “In sum, Mr. Smith's position is simply not supported by the facts.”

JBS: My position is supported by ample facts from four similar accidents, from the Public Docket, from government AARs, from photographs, and other official documents.

NTSB: “Our correspondence database indicates that Mr. Smith has written the Safety Board many letters regarding his theories about the cause of the TWA flight 800 accident. The Board has responded to Mr. Smith numerous times,...

JBS: I have written the NTSB many times but they have not responded numerous times to me. Senator John McCain wrote suggesting a meeting with me but NTSB declined. Congressman Sam Farr has asked for a meeting with me but NTSB, Mr. Drake, refused and reiterated that, in fact, they will not correspond, discuss, meet with me ever. (Note the effort to make the messenger the point of argument instead of the message of wiring/cargo door explanation. I am trivial; the message of wiring/cargo door safety item is paramount.)

NTSB: “However, I continue to believe that it would not be productive to correspond with Mr. Smith further about his theories regarding the cause of the TWA flight 800 accident.”

JBS: Not productive? The NTSB and the FAA have never tried for a productive exchange of ideas with me. NTSB has selected random statements and attempted to contradict them while ignoring the irrefutable facts that rule out center tank explosion as initial event and support the wiring/cargo door explanation. Those facts among many which will never go away are:

Sudden loud sound on the CVR.

Stator blade in right horizontal stabilizer.

Photograph of forward cargo door showing paint smears, missing midspan latches, outward petal shaped rupture holes at midspan, pillowing inward force on other parts of door.

Three other similar events with similar evidence with one event, UAL 811, being a confirmed electrical/cargo door caused accident:

Completed 25 July 2002  
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