Exhibit 12 - Analysis of Flight Data Recorder (FDR) 12-Second Line

By Captain Howard T. Mann

 # TWA Flt. 800, B747-131, Takeoff to End of Data
Tabular Data No. 1, Created: January 09, 1997, National Tranportation Safety Board

LOCAL TIME (ref. CVR)	MSL Alt. (FEET)	IAS (KNOTS)	Pitch Angle (degrees)	Elevator Position Right (degrees)	Mag. Heading (degrees)	Roll Angle (degrees)	Rudder Position (upper) (degrees)	Angle of Attack (degrees)	EPR Engine 1 (ratio)	EPR Engine 2 (ratio)	EPR Engine 3 (ratio)	EPR Engine 4 (ratio)	Long. Accel (g)	Vert. Accel. (g)	VHF	Pitch Trim Stab Pos (degrees)
20:31:10	13747.00	290	3.6	0.1	82	0	0.63	3	1.31	1.29	1.29	1.3	0.10	0.9	Off	3
	13757.00		3.6	0.4	82	0	0.72	3					0.10	0.9		3
							0.72	3					0.10	0.9		
													0.10	0.9		
20:31:11	13772.00	288	3.6	0.1	82	0	0.72	3	1.3	1.29	1.3	1.3	0.10	0.9	Off	3
		298					0.72	3	1.3	1.29	1.29	1.29	0.10	0.9	Off	
							0.72	3					0.10	0.9		
													0.10	0.9		
													0.10	0.9		
20:31:12	10127.00	100	8.3	11.2	163	144	77.76	106	1.14	2.46	2.36	2.44	0.18	-089	Key	4
			2.2	-0.2	276	0	-36.54	30					0.18	-089		
							0.72	3					0.05	1.02		
20:31:13																

TWA Flight 800 Flight Data Recorder Word Location

	Data Word	20:31:10 Second Block	20:31:11 Second Block	20:31:12 Second Block
Leading Edge Flaps Lt. / VHF	39	33	55	
Leading Edge Flaps Rt.	40	34	56	
Thrust Reversed (1,2,3&4)	41	35	57	
Vertical Acceleration	42	36	58	
Longitudinal Acceleration	43	37	59	
Time	1	38	60	
(2 to 10 reserved for	2	39	61	
	3	40	62	
	4	41	63	
	5	42	64	
	6	43		1
	7	44		2
	8	45		3
	9	46		4
Synchronization)	10	47		5
Vertical Acceleration	11	48		6*
Longitudinal Acceleration	12	49		7*
Rudder Position – Upper	13	50		8*
Rudder Position – Lower	14	51		9
Angle of Attack	15	52		10*
Pressure Altitude Os.	16	53		11
Pressure Altitude Fine	17	54		12*
Magnetic heading	18	55		13*
Pitch Attitude	19	56		14*
Roll Attitude	20	57		15*
Elevator Position Rt.	21	58		16*
Elevator Position Lt.	22	59		17
Flap Position – Rt. Inbd.	23	60		18
Flap Position – Lt. Inbd.	24	61		19
Flap Position – Rt. Outbd.	25	62		20
Flap Position – Lt. Outbd.	26	63		21
Pitch Trim Stabilizer	27	64		22*

There are 43 data words recorded by the Flight Data Recorder and 64 words are recorded in sequence, each second.

The chart above presents recorded data from the Flight 800 Flight Data Recorder (FDR) as it was originally published by the NTSB. The vertical line of data for Time 20:31:12 (the line immediately to the left) contains the information that is in dispute, and because it disputes NTSB findings, it was eliminated from the record. For several reasons, which I will elaborate, that line proves the fallacy of the NTSB center fuel tank explosion being the initiating event in the downing of FL800. In order that we might establish a sequence of events, the chart to the left will be used to establish synchronization between that data word sequence and the data that was recorded and then deleted by the NTSB (shown above).

The process was simple trial and error until a match was obtained. The 10 and 11 second lines are shown here simply to confirm that a match was established. For example, look at item 64 of the 20:31:10 second line. For a match, it was necessary that the line include the Stabilizer Trim parameter because it appears twice in the 10-second line recorded above. By the same reasoning, item 64 in the 12-second line cannot include another Stabilizer Trim parameter because only one was recorded on the 12-second line. The stabilizer trim may become very important in analyzing this accident and for that reason, establishing its proper position in the order is primary. I will touch on that aspect later when we cover the Stabilizer Trim parameter.

Had TWA Flight 800 landed in Paris uneventfully, anyone seeing the 20:31:12 data would probably just consider the figures recorded were due to some kind of a computer malfunction and dismiss the data out of hand. For an Accident Investigator charged with finding the cause of this accident to disregard that information, particularly so close to the time a loud unidentified sound was recorded on the Cockpit Voice Recorder, within a second of the moment in question, bears on incompetence. I personally know from past experience, the personnel at the NTSB are extremely competent, which leads one to ask why this investigation has gotten so far off track.

Aileron Position Rt. Inbd.	28		1	23
Vertical Acceleration	29		2	24*
Longitudinal Acceleration	30		3	25*
Rudder Position – Upper	31		4	26*
Rudder Position – Lower	32		5	27
Angle of Attack	33		6	28*
EPR #1 Engine	34		7	29*
EPR #2 Engine	35		8	30*
EPR #3 Engine	36		9	31*
EPR #4 Engine	37		10	32*
Airspeed	38		11	33*
Leading Edge Flaps Lt. / VHF	39		12	34*
Leading Edge Flaps Rt.	40		13	35
Thrust Reverse (all)	41		14	36*
Vertical Acceleration	42		15	37*
Longitudinal Acceleration	43		16	38*
Time	1		17	39*
(2 to 10 reserved for	2		18	40
	3		19	41
	4		20	42
	5		21	43
	6		22	44
	7	1	23	45
	8	2	24	46
	9	3	25	47
synchronization)	10	4	26	48
Vertical Acceleration	11	5	27	49 #
Longitudinal Acceleration	12	6	28	50 #
Rudder Position – Upper	13	7	29	51 #
Rudder Position – Lower	14	8	30	52
Angle of Attack	15	9	31	53 #
Pressure Altitude Os.	16	10	32	54
Pressure Altitude Fine	17	11	33	55 #
Magnetic heading	18	12	34	56 #
Pitch Attitude	19	13	35	57 #
Roll Attitude	20	14	36	58 #
Elevator Position Rt.	21	15	37	59 #
Elevator Position Lt.	22	16	38	60
Flap Position – Rt. Inbd.	23	17	39	61
Flap Position – Lt. Inbd.	24	18	40	62
Flap Position – Rt. Outbd.	25	19	41	63
Flap Position – Lt. Outbd.	26	20	42	64
Pitch Trim Stabilizer	27	21	43	
Aileron Position Rt. Inbd.	28	22	44	
Vertical Acceleration	29	23	45	
Longitudinal Acceleration	30	24	46	
Rudder Position – Upper	31	25	47	
Rudder Position – Lower	32	26	48	
Angle of Attack	33	27	49	
EPR #1 Engine	34	28	50	
EPR #2 Engine	35	29	51	
EPR #3 Engine	36	30	52	
EPR #4 Engine	37	31	53	
Airspeed	38	32	54	

Red = Flight 800
Blue = Flight 803
Black = NTSB withheld

Some would have you believe that when the power is removed from the Flight Data Recorder it always fouls the last data. To begin with, the data you see in the 12-second line is not the last data. The last data is trapped in the RAM buffer and is lost when power is removed. Put another way, as the FDR operates, it constantly erases the tape ahead of the new recording. In the NTSB haste to denigrate the 12-second line on the FDR, they have announced it is possible for old data to bleed through an erasure and appear as though it is data from TWA Flight 800. An examination of the 20:31:12-second line seems to indicate that is indeed what occurred. The chance of this happening seems remote until we examine exactly what takes place in the FDR. Anytime power is removed, the tape contains good data followed by an erasure followed by data recorded on a flight 25 hours before. If we subsequently record over an erasure, the process eliminates the possibility of a bleed through.

On Flight 800, we did not record over the erasure and the NTSB cannot dispute this fact because they are the ones who suggested it and they have already displayed it on their website. Research has indicated the data being erased at the time of the accident was from TWA Flight 803, which departed Paris for New York, July 16, 1996. The fact that the flight was westbound helps to interpret the latter entries on the FDR 12-second line and the analog data that appears after the power was lost. The NTSB has reported there was no power after the 12-second line. We believe we have evidence to the contrary, but there is no evidence that power was available until 20:31:20 as is indicated in the analog graphic provided by the NTSB.

In the opinion of this author, all data up to and including item 48 of the 12-second line, was recorded on the accident flight and all data marked with # bled through from previous flight erasure. Consider the following:

Items 49, 50, 51, 53, 56, 57, 58 and 59 are non-FL800 data and agree precisely with the analog data from the previous flight (803-16 Paris to New York).

Item 55 (Pressure Altitude-Fine) did not record for a reason. Normally the altitude parameter utilized both a FINE and COARSE function, with the COARSE function data indicating which 5,000 foot bracket the aircraft is in and the FINE function determining just what the altitude in the 5,000 foot bracket was. TWA #119, the aircraft utilized on FL800, had an inoperative FDR COARSE altitude function. This presented no problem to the NTSB technicians because they had tracked the aircraft through the 5 and 10 thousand-foot levels and were able to determine what 5,000-foot bracket FL800 occupied. Had it been an important item, no doubt the NTSB would have made an effort to extract altitude data from the aircraft's descent into New York. You will note item 56 (Magnetic Heading) is recorded in FDR digital data as 276 corresponding to the previous Westbound Flight 803-16, 25 hours earlier. If you check on the analog chart, you will see there is no place to record the 276 Magnetic Heading, because it is out of the scale range

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* = Recorded on Flight 800 20:31:12-second line.
# = Recorded on Flight 803, 16 July 1996, Paris to New York

EXHIBIT 12A - FLIGHT DATA WORD LOCATION

By Captain Howard T. Mann

Longitudinal and Vertical Acceleration - LONGACC

Longitudinal and Vertical Acceleration are sensed by an accelerometer in the right wing wheel well on the keel beam at fuselage station 1310. FL800's center of gravity was 18.4% of the Mean Aerodynamic Chord which computes to approximately station 1290.6. Both acceleration parameters are sensed by a single unit that is capable of switching from the vertical to longitudinal measurements by use of a simple motor driven cam arrangement that changes the plane being sensed (vertical vs. longitudinal). The actual measurements are obtained by measuring how much one electrical sine wave moves in regard to another.

With the aircraft at rest, the vertical parameter will indicate near – 90 (1"G") and the longitudinal parameter will indicate near "0". (No acceleration). The Longitudinal and the vertical were indicating .10 and .90 respectively prior to the 12-second line. During the 12-second data line it appeared the aircraft was falling and accelerating at the same time. We know the aircraft pitched up and at 300 knots that should have produced a positive climb, but it did not. I believe the reason it did not was due to the disruption of airflow over the wing, which disturbed the angle of attack. With lift on the wing decreasing (-.89G) there is less drag and the airspeed tends to increase, thus .10 becomes .18 momentarily.

This is the last data recovered from FL800 and signifies the end of a recorded frame of 43 items. When electrical power failed on FL800, we lost the data that was in the Random Access Memory. The next item to follow would be the time 20:31:13 and the synch buffer (2-10) which we never see in the data. Somewhere (2-10) in the synch buffer the data from FL800 ceases and we start to see data that was recorded on FL803-16. This data would have started sometime in the FL803 Synch buffer (2-10) and then produce the data I have specified as coming from FL803. We do not see the break point between FL800 and FL803 when in fact they could have been out of synch by as much as 18 words and we would not see it in the data we have been allowed to see. For further confirmation you will note the FL803 first parameters to record are those that immediately follow the synch buffer as shown below.

Flight 800 last three items	Airspeed	100
	Vertical Accel	-.89
	Long. Accel.	.18
Break		
	Vertical Accel.	1.02
	Long. Accel.	0.05
	Rudder Position	.72
	Angle of attack	3.0
	Magnetic Hdg.	276
	Pitch	2.2
	Roll	0.0
	Elevator	-0.2

Note the items recorded for FL803 are modest compared to FL800 erratic data.

Rudder

The Upper Rudder parameter was fairly consistent at .72 and when it indicated .72 after the excursions some people interpreted this as indicating the analog data was a continuance of FL800 after the excursions on the 12-second line.

It is not generally known that on July 4, several days prior to the accident (7-17-96) it was necessary to remove one of the large "canoe" fairings from the trailing edge of the left wing on account of a broken support bracket. The purpose of the fairing is to reduce aerodynamic drag around the wing flap track assembly. The aircraft may be operated with one of these fairings removed if certain restrictions are observed. Removing the fairing on the left wing increased drag on the left side of the aircraft to the extent that the aircraft required right rudder trim of .72. This same condition existed on the 25 hour previous FL803-16 and hence the identical rudder trim would be required at 300 knots. Consequently the indication of .72 for 803-16. This trim condition was so noticeable to one Flight Engineer he had reported it to his supervisor that the fairing replacement should be expedited because its absence was causing an increase in fuel consumption.

Position transmitters in the vertical stabilizer provide the rudder position indications for the FDR. It is apparent that a pressure wave, from an explosion outside the aircraft on the left side, caused the aircraft to yaw to the right as the FDR shows. There can be no doubt about this because both compass systems display a heading moving to the right. In addition to the heading changes, both of the Inertial Navigation Systems (INS) indicate a drift to the right caused by a force from the left. The pressure wave traveled back along the aircraft at approximately 1.74 feet/millisecond (1.1+.635) where 1.1 equals shock wave speed and .635 equals the aircraft forward speed. The pressure waave struck the rudder causing the 77.76 that we see in the FDR data and which represents approximately three times the normal maximum travel of the rudder and may have caused damage to the rudder power units and/or their anchor points.

The combination of yaw damper action and pressure decrease that follows the pressure wave draws the rudder to the left and registers on the FDR as a –36.54. This would equate to left rudder to stop the turn. The 36.54 also exceeds the rudder maximum travel. This represents the last rudder position for TWA FL800 and the next rudder indication of .72 is from the previous flight 803-16 July 1996. In the wreckage the upper rudder had the control arm for the position transmitter attached but without the position transmitter. It is the opinion of the author that after the FDR registered 77.76, the rudder was no longer in the original manufactured configuration and was uncontrollable.

Note: In the "Roll" parameter an excessive roll to the right accompanied by hard right rudder may have been an attempt to avoid something approaching from the left as has been reported.

Note: When a swept wing aircraft makes a rapid turn to the right or left as the case may be, it enters a realm where "Dutch roll" may result. For example, let us consider the FL800 case where the aircraft turned and banked to the right. In this instance the right wing tucks behind the aircraft nose which blocks some of the oncoming air, which in turn, reduces lift on the right wing. In addition, yawing right effectively reduces the wing span on the right wing and its relative airspeed reduction compared to the left wing also contributes to an unhealthy condition tending to drop the wing even more. As the aircraft recovers from this right wing down condition, it tends to over correct and the result is a left wing down condition. That is what is known as a "Dutch Roll". I believe this aircraft rolled over with the first steep bank and never recovered. While the aircraft was in the steep bank all four engines were subjected to a direct or slightly aft crosswind at the speed of sound. Under these circumstances the engines would surely have stalled and may have flamed out.

Roll

Roll Angle represents the angle between the lateral axis of the aircraft and an artificial horizon as supplied from gyro information. Before the excursions of the 20:31:12 line the indication on the FDR was steady at "0". The roll angle suddenly indicates a steep right-bank to 144 degrees. 180 degrees would represent inverted flight.

We believe the steep bank angle is due to a yaw to the right caused by an explosion outside, low and to the left of the forward fuselage. The shock wave beneath the left wing pitched the nose of the aircraft up and to the right. As the left wing passed over the epicenter of this blast pressure beneath the left wing coupled with engine(s) stalling due to the sonic wave across the face of the engines, aggravated the already steep bank angle.

This aircraft was truly upset and when the FDR less than one second later is indicating "0" roll, common sense dictates this is not the same flight. The "0" roll flight was recorded 25 flight hours earlier as TWA FL803-16 July 1996 Westbound over the Atlantic Ocean enroute from Paris to JFK, cruising at 33,000 feet indicating M.84 and its Engine Pressure Ratio power setting of 1.44 was keeping the aircraft exactly on the Power Chart airspeed of 300 knots.

Further substantiation of the steep bank angle is presented elsewhere in this document in Exhibit 1 regarding Fuel Quantity indications found in the wreckage. It should be noted that the steep bank angle indication may have been induced by the pilots attempting to avoid something out the left side window, that same something witnesses were not allowed to report on at the Baltimore hearing.

Pitch Angle represents the angle between the longitudinal axis of the aircraft and an artificial horizon as supplied form gyro information. Direction of the elevator movement seems to be puzzling to some, so it bears further analysis.

At 20:18:27 local time TWA 800 is cleared for takeoff on runway 22R by the JFK tower. At 20:19:35 the aircraft is rolling down the runway and "Rotate" is recorded on the CVR. As the pilot pulls back on the control yoke the elevator moves up (+ on the FDR), the tail moves down and the nose moves up (+17). As the nose moves up the angle of attack moves from +3 to +11.

During taxi, Longitudinal Acceleration hovers around 0.00 and changes to a maximum of 0.21 during take off. This computes to an acceleration of 6.7 feet per second. The Vertical Acceleration indicates .97/.98 until the aircraft leaves the runway when it changes to 1.10. .97/.98 is as close as the accelerometer gets to 1 "G".

Before the 12-second line, the Pitch Angle was indicating +3.6 on the FDR. During the large excursions at 20:31:12, the pitch changed to 8.3. To the lay person that does not seem like a lot, but at 300 knots that would put everyone back in their seats. That much pitch change should produce a positive rate of climb and it would except for the disruption in the angle of attack caused by the shock wave.

In the analog data the elevator is recorded at –0.2 after the excursions. Since FL800's takeoff from JFK the Elevator displays a minus reading only once and that was for less than one second. Here again, the recorded data is from 803-16 at 33,000 feet Paris to New York.

Engine Pressure Ratio - EPR

Before we attempt to discuss Engine Pressure Ratio (EPR) we should cover a few basics that can be confusing. Engine Pressure Ratio (EPR) is the primary thrust setting instrument for the Boeing 747. EPR is obtained by dividing the pressure in the tailpipe of a jet engine by the pressure on the face of the engine except on the 747, the face pressure is taken with a Pt2 probe mounted on the left side of the engine pylon and tailpipe pressure (Pt7) is measured, not in the tailpipe but, between the last two turbine stages. Hereafter referred to as Pt2 in front of the engine and Pt7 in the rear.

The following numbers have nothing to do with reality. I am using them here to illustrate a point. With 10psi on the face (Pt2) of a jet engine it would require 20psi in the tailpipe (Pt7) to obtain an EPR of 2.00. In this instance, the engine driving all its rotating mass, including the fan, which requires many thousands of horsepower, and in raising the pressure across the engine by 10psi is consuming fuel at a tremendous rate. Now suppose air pressure at sea level is 14psi. It isn't it is actually 14.7. It would be ½ of 14 or 7psi at 18,000'. At 36,000' the pressure would half again and be ½ of 7 or 3 ½ psi. In very simple terms, that is why jet engines burn less fuel at high altitude. They simply are not producing as much thrust and that is why we cannot compare EPR at takeoff with EPR at altitude.

On TWA FL800 the EPRs had been indicating 1.3, 1.29, 1.29 and 1.29. During the excursion of the 20:31:12 line the EPR indications changed to 1.14, 2.46, 2.36 and 2.44. These are erratic indications and I believe they signal erratic conditions. This is valid data. It shows the aircraft in extreme conditions. Remember, this aircraft was lost and the FDR is trying to tell us what happened as it was designed to do, if we have the common sense to listen.

The blast we have alluded to was a powerful one and it occurred close to the engines on the left side of the aircraft. #1 Engine EPR seems to indicate the high pressure on the face of the engine causing the EPR to compute to a lower number. The erratic EPR on engines 2,3 and 4 indicate power beyond the manufacturers fondest dreams, and that something erratic was happening to these engines. From this and other indications, I believe these 3 engines were in the process of stalling and if so, their EPR indications would be useless. Engine stalling requires more explanation.

Consider a jet engine with 15 stages of compression. As fresh air is drawn in the front of the engine and it goes through the 15 stages and comes out as hot high pressure air which is directed into burner cans where the fuel is injected and ignited. Turbine inlet guide vanes direct the resultant hot gases toward turbines that extract energy to drive the large fan for propulsion the 15 stage compressor, engine accessories and raise the pressure across the engine.

When a jet engine is running at a given speed, we call this steady-state and each stage of the engine's 15 stage compressor is doing its part compressing the incoming air in order to create the power required to drive the engine and produce the required EPR. If the airflow into the engines is disturbed they have a tendency to stall. This does not happen often but then we do not often encounter a shock wave moving at the speed of sound.

If the blast that hit the aircraft originated where we think it must have, considering the aircraft's forward speed, we could expect a 90 degree crosswind at the speed of sound on the face of engines #2, #3 and #4 and this would provide the impetus for engine stall. In order for a jet engine to be efficient it is designed to run with a very low stall margin. Equate jet engine stall with your car backfiring out through the carburetor and at the same time blowing the muffler off the exhaust. Because jet engines normally operate very close to stall, it does not take much airflow change to induce a violent jet engine stall. When this happens there is a momentary loss of thrust and possibly flameout. I am not positive about the flameout, but there can be no doubt about the stall. The 1.44 EPR shown in the analog after 20:31:12 is from FL803 which was cruising Westbound at 33,000' indicating Mach .84 with an air speed of 300 knots.

<u>Altitude and Airspeed - T/A/S</u>

We must study <u>Altitude and Airspeed</u> together because the two are physically interconnected. Atmospheric pressure (STATIC) is introduced into a hermetically sealed instrument case. This pressure is picked up from Pitot-Static heads on either side of the aircraft with the resultant being an average pressure except that in the case of a shock wave, the near side port serves as a low-pass filter and would cause the static pressure inside the sealed case to be lower than actual. There are two sealed diaphragms within the instrument case. The altitude diaphragm expands and contracts as the pressure in the case changes with altitude and converts the pressure changes to altitude indication with more pressure indicating lower altitude.

When the explosive blast occurred outside the aircraft, the increase in pressure caused the altimeter function of the FDR to indicate a reduction in altitude of 3,645 feet. This is a false indication of altitude and it is coming from FL800. The second diaphragm in the case is used to compute airspeed in the FDR. As static pressure outside the aircraft changes this diaphragm tends to expand and contract in the same manner as the altitude diaphragm except Pitot pressure is introduced into the interior of the airspeed diaphragm and the resultant movement is computed as airspeed. Generally speaking, Pitot pressure is derived from an open tube facing into the airstream.

On FL800 the indicated airspeed dropped from 298 to 100 knots due to the higher pressure in the instrument case. On TWA 747s the Pitot pressure for this function is taken from the right hand side of the aircraft and consequently the Pitot head was shielded by the fuselage from the pressure wave on the left side of the aircraft. This fact is important in trying to compute a viable airspeed reading. Some Boeing literature has the FDR Pitot pressure coming from the left side of the aircraft. The TWA Flight Crew operating manual is very specific about this point and on TWA aircraft the Pitot pressure for the FDR comes from the right hand side. On Flight 800 these two parameters support one another because they both use and record independently the increased pressure in the hermetically sealed instrument case.

Elsewhere in the document, I have indicated that he data after the excursions in the 20:31:12 second line come from TWA FL803, July 16, 1996. I have indicated that the aircraft was cruising at 33,000 feet (FL330). There are several clues to support this position as follows:

1. A close examination of the analog data displays an apparent roughness in the recording at FL800s low altitude that could be attributed to a very very light turbulence at the lower altitude, while the data at the higher altitude is smooth as glass as is to be expected.

2. A second clue comes from the last heading shown on the 12-second line. The heading indicates 276 and this equates to a flight Westbound. TWA FL800 was Eastbound.

3. The third clue is the 1.44 Engine Pressure Ratio indications in the analog data after the large excursions of the 12-second line.

4. The fourth clue is found in the 300-knot airspeed indicated in the analog data. TWA utilized Mach .84 (84% of the speed of sound) Power Charts. As you can see Mach .84 airspeed varies with altitude (Std.Temp.) and the speeds are as follows, (31,000 – 314) (33,000 – 300) (35,000 – 287) (37,00 – 274) and (39,000 – 262). Reference to the numbers above makes it simple to find FL803s altitude. The 1.44 EPR in the analog data is the power required to maintain M.84 (300 airspeed) at 33,000 feet.

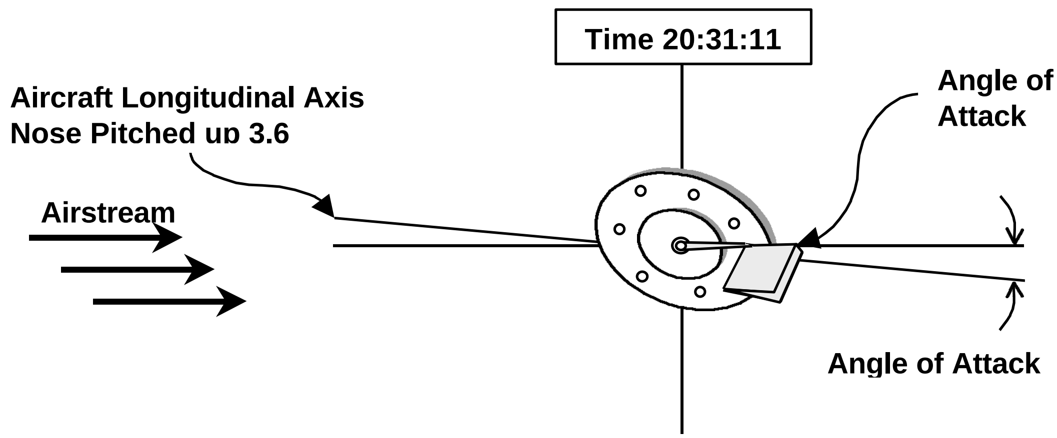
We have all the figures we need except the altitude and it is not recorded because of the inoperative Coarse Altitude function. I have reason to believe technicians at the NTSB are under the impression that FL803s altitude was 37,000’ instead of the 33,000’ I have indicated. With that in mind, I anticipate they may make such an announcement. The tape prior to the 25-hour point has already been erased, and they are unable to track the flight climb through the various 5,000’ brackets during descent into JFK. IF FL803 had climbed up to 37,000’ after the indications we see for 33, 000’ that would explain our difference of opinion. The airspeed is the best clue in this case. 300 Knots at 37,000 feet is the equivalent of M.91 and that just did not happen. Normal airspeed at Mach .84 for 37,000’ cruise is 274. True Airspeed = 274+2%/thousand feet = 485.

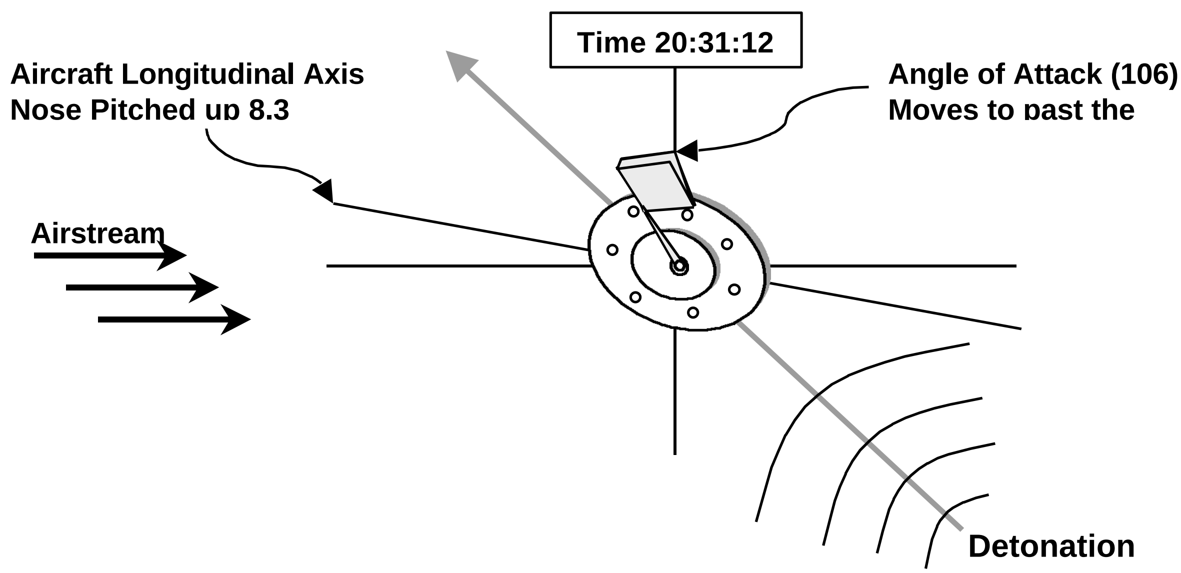
Heading

Magnetic Heading senses heading information from small fluxgate type transmitters in either wing tip and applies it to directional gyros in the compass couplers in the lower electronics compartment. The NTSB has announced that both outer wing panels failed due to high "G" loads and when the outer wing left, so did the transmitters. It is not important in this case because, according to the NTSB, in less than a second electrical power to the FDR was lost. The pilot has the option to choose which compass system to display in his primary heading instrument and the FDR goes along with the choice. Prior to the 20:31:12 second line the heading had been recorded as 82 degrees on the 20:31:11 second line. At the time of the excursion of the 12-second line, the heading moved to the right and displayed an heading of 163 degrees. There were other similar indications from both compass systems that the aircraft was turning to the right. Note as shown at 276 in the following digital data but it is not recorded in the Analog data for good reason. The analog chart has no place to record a 276 heading. The analog data is still in the eastbound bracket and unable to register westbound headings. It is our contention that the 276 heading is from FL803-16 which was recorded 25 flight hours earlier Westbound (276 degrees) from Paris to New York. At the time the flight was cruising at 33,000 feet indicating M.84 and 300 knots airspeed. TWA M.84 Power Charts indicate that an Engine Pressure Ratio of 1.44 is required to maintain chart airspeed of 300 knots at 33,000 feet. All of the figures fit except we do not have the altitude recorded, it is a fact that we can estimate the altitude from the airspeed of 300 knots. M.84 airspeed at 31,000 feet is 314 knots, at 33,000 feet it is 300 knots and at 35,000 feet it is 287 knots.

Angle of Attack

The Angle of Attack represents the angle the airstream is striking the leading edge of the wing. It is sensed by a weather vane device on the left side of the forward fuselage. It is intended to give the pilot advance warning of an imminent stall. Navy jet pilots use Angle of Attack to fly precise landings aboard aircraft carriers. When an aircraft stalls there is buffeting over the wing and a certain amount of shaking. The Stall Warning System augments this warning by shaking the control column. A small electric motor mounted on the forward side of the column incorporates an out of balance flywheel which shakes the control column before the wing actually stalls. Initiation of the warning varies with the amount of wing flaps in use. At Time 20:31:11 the flight data Recorder indicates a normal Angle of Attack of 3 degrees. At the time of the excursions we see on the 20:31:12 second line the FDR indicates and Angle of Attack of 106 degrees, followed by 30 degrees. The 30 degrees is the final Angle of Attack reading from TWA Fl800. There is, however, one more Angle of Attack reading on the FDR. That reading of 3 degrees did not come from FL800 but rather from TWA FL803 data that was recorded 25 hours earlier and not yet erased.





Elevator

Elevator position is sensed by a position transmitter in the horizontal stabilizer. Elevator movement (+ or -) in the FDR record has been puzzling for some investigators. With that in mind, I will try to explain Elevator movement that we see and also give a brief description of the flight. At time 20:17:18 FL800 is cautioned about wake turbulence from a departing aircraft and is cleared into position and to hold runway 22R. Pilot not flying responds in 6 seconds. Stopped on the runway in position for takeoff the following FDR reading register: Airspeed 83 (from departing aircraft blast), Elevator is faired at 0,0, Roll angle is –1 (slight cross wind from the right lifts right wing slightly), Angle of Attack is .25, Engines at idle with EPR of 1.01, the Longitudinal Acceleration registers 0.00 and the Vertical Acceleration is .97 (one"G").

At 20:18:21 FL800 is cleared for takeoff. Pilot responds in 6 seconds. The crew completed the before takeoff checklist and at 20:18:49 the engines spin up and Longitudinal Acceleration gradually increased from .01 to .21 over the next 14 seconds. (.21 x 32.2 = 6.67 feet per second). On takeoff, the pilot not flying the aircraft calls 80 knots at 20:19:14 and holds forward pressure on the control column to hold the nose wheels on the runway. At this time the FDR Elevator Parameter is registering between –4.0 and –8.0, the aircraft is pitched down at the nose, -0.7. At 20:19:23 the pilot not flying calls out V one. V one is the theoretical point at which the aircraft could and would continue the takeoff with an engine failure. When the pilot not flying calls out "Rotate" at time 20:19:35, the airspeed is 113 knots and as the control column is gradually moved back, the elevator trailing edge movers up to approximately 8.0 degrees, and the aircraft starts to pitch up from 0 to 17 degrees over the next 15 seconds. At the same time, Angle of Attack changes from 0 to 11 and the Vertical Acceleration registers the first evidence of the aircraft leaving the runway and showing a positive rate of climb.

At 20:19:41 two clicks can be heard on the CVR. Up until this time the landing gear control handle has been locked in "Gear Down" position. The two clicks signify the aircraft weight is off the landing gear and the control handle is unlocked and free to move to "Gear Up" position. This is a safety system to prevent inadvertent gear retraction on the ground. At time 20:19:43, "Gear Up" is recorded. At 44 seconds (1 second later) pilot not flying repeats "Gear Up". As the airspeed builds with the gear retracted, the Elevator indication decreases from 8 to 1.02. At 20:20:00 the JFK tower changes FL800 to Departure Control. FL800 responds in 5 seconds with "Kennedy Departure, TWA 800 leaving 900 for 5,000. Departure Control comes back with radar contact climb and maintain 11,000. FL800 responds in 5 seconds. At 20:20:44 Departure directs FL800 "Left heading 150". TWA 800 acknowledges in 4 seconds and starts a left bank (-20) to the new heading. At 20:22:01 Departure Control advises "Left Heading 070" FL800 responds in 6 seconds. At 2):22:29 Departure Control advises "Left heading 050". FL800 responds in 6 seconds. At 20:22:44 FL800 is given traffic and obviously the crew is looking for it as it takes FL800 10 seconds to respond. At 20:23:19 FL800 is cleared direct Betty intersection to resume your own navigation. FL800 responded in 3 seconds. At 2)23:37 Departure advises: TWA 800 contact Boston 132.3 (frequency). In 5 seconds FL800 responds with "Say again the frequency". Departure Control advises 132.3. TWA acknowledges in 2 seconds. At 20:24:01 the CVR transcript indicates (sound of noise of damaged recording tape). At 20:24:30 a comment about climbing like a homesick angle. The aircraft had ascended about 2,000 feet in the last minute. At 20:24:41.7 (note we are now using tenths of seconds on the tape) TWA FL800 calls "New York Center TWA's lifeguard 800 heavy 8,200 climbing 11 thousand." It had been 56 seconds since told to change frequencies and FL800 addressed the wrong ATC Center. That does not sound like the Captain Steve Snyder I knew. The tape should be thoroughly examined.

Before the 20:31:12 line, the Elevator had been indicating between .1 and .3. At the time of the 20:31:12 reading, the Elevator changed to 11.2. This was more elevator that was used during the takeoff rotation. That is a lot of elevator to apply at 300 knots. That much Elevator at that speed normally applied by the pilot would have over-stressed the aircraft in positive gravity (G) overload. Because it was applied in less than a second, it is probably the product of shockwave displacement of the pilot and/or the control column.

Pitch Trim Stabilizer - Added 8/12/98

The Pitch Trim Stabilizer parameter of the Flight Data Recorder could not be included in time for printing of the rest of this report because certain 747 Flight Simulator Tests had not been accomplished and the results tabulated.

The normal pitch up or down of the 747 aircraft is accomplished in two ways. Adjustment of the horizontal stabilizer and manipulation of the elevators by the pilot, with dominance by the stabilizer function, which provides the coarse element of the longitudinal trim while the elevator provides the fine adjustment. This interrelation is being stressed here in order that the uniformed may realize the gravity of the situation if the pilot is unable to control the stabilizer trim setting. Examination of NTSB reports regarding the stabilizer indicate that just such a situation may have developed during the excursions of the 20:31:12 second line.

At 20:31:11 the stabilizer trim was recorded by the FDR as 3 Units Nose Up. During the excursions of the 12-second line, which we believe were caused by a detonation outside the aircraft, the stabilizer trim indication of the FDR changed to 4 Units Nose Up. This change, coming as it did during the 12-second excursions may have been a harbinger of things to follow. To understand the significance of this we must take a look at the manufactured configuration and the method utilized to adjust stabilizer trim. The Stabilizer is the largest controlled flight surface on the aircraft (over 1400 sq. ft.). It is pivoted near its rear spar and adjusted by a jackscrew and ballnut arrangement attached to the front spar. The jackscrew is normally driven by two hydraulic motors pressurized from two separate hydraulic systems. Either system operating alone can facilitate the trim adjustment but it takes a little longer with only one system operating. The system incorporates two hydraulic brakes to maintain the selected adjustment.

The jackscrew is hollow and is reinforced by a large through bolt approximately 4 feet long. The bolt and the jackscrew were both found broken in the wreckage. It has not been determined if this damage was caused by water impact or by force of an external detonation. The fact that the FDR indicates a trim of 4 and the mechanism was fractured at a 3.3 suggests the stabilizer may have been free to float to any position. The pilot could not control the position and the brakes provided the system would not be effective since they only control rotation of the jackshaft which is now broken. The FDR position transmitter for the stabilizer is located near the rear spar and has nothing to do with the cable controlled indicators in the cockpit.

During Flight Simulator tests it was found that normal stabilizer movement would require 7 seconds to change the trim from 3 to 4 units. The reason for the low rate of change is to prevent overload of the stabilizer and elevator systems. At the same time, an aircraft loaded and trimmed as TWA 800 would have its rate of climb increased from a stable 2000 feet per minute to 6000 feet per minute over the 7 seconds. Imagine the loading that would occur if the change was accomplished instantly, as would be the case if the jackshaft was broken. We saw it change from 3 to 4 units. It may have changed to 15 units. There was no restriction except structure which allows at least 15 units nose up. For those who may be wondering about using a Flight Simulator to check out airplane performance, it is a procedure that has been in use for years. Had Boeing been asked to supply the numbers, I expect they would have recommended such a procedure.