NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

March 21, 2003

SYSTEMS GROUP CHAIRMAN'S FACTUAL REPORT

A. ACCIDENT: DCA03MA022

Location: Charlotte-Douglas International Airport, North Carolina
Date: January 8, 2003
Time: 0848 Eastern Standard Time
Aircraft: Raytheon Model 1900D, N233YV, operated by Air Midwest Airlines, d.b.a. US-Airways Express flight 5481

B. SYSTEMS GROUP

Members – Charlotte, North Carolina Activities: (January 8-12, 2003)

Group Chairman:	Robert L. Swaim National Transportation Safety Board Washington, DC
Assistant Group: Chairman	Michael Hauf National Transportation Safety Board Washington, DC
Member:	Paul DeVore Federal Aviation Administration (FAA) Wichita, Kansas
Member:	Willard Crowe Raytheon Aircraft Company Wichita, Kansas
Member:	Rod Voth Raytheon Aircraft Company Wichita, Kansas
Member:	Rudy Quevedo International Association of Machinists New York, New York

Member: John Oxley
Air Midwest Airlines
Huntington, West Virginia

Member: Jamison Murphy
Airline Pilots Association (ALPA)
Fort Mill, South Carolina

Members – Wichita, Kansas Activities: (January 21-22, 2003)

Group Chairman: Michael Hauf
National Transportation Safety Board
Washington, DC

Member: Paul DeVore
Federal Aviation Administration (FAA)
Wichita, Kansas

Member: Willard Crowe
Raytheon Aircraft Company
Wichita, Kansas

Member: Rod Voth
Raytheon Aircraft Company
Wichita, Kansas

Member: Rudy Quevedo
International Association of Machinists
New York, New York

Member: John Oxley
Air Midwest Airlines
Huntington, West Virginia

Member: Jamison Murphy
Airline Pilots Association (ALPA)
Fort Mill, South Carolina

C. SUMMARY

On January 8, 2003, at about 0848 Eastern Standard Time, Air Midwest flight 5481 (d.b.a. US Airways Express), a Beech 1900, N233YV, crashed shortly after takeoff from Charlotte-Douglas International Airport (CLT), Charlotte, North Carolina after a distress call was made by the Captain. The flight was a scheduled passenger flight to Greenville-Spartanburg, South Carolina. The 2 crewmembers and 19 passengers onboard were killed and one person on the ground received minor injuries. The airplane was destroyed due to impact forces and a post crash fire.

The Systems group convened at Charlotte, North Carolina, during the period of January 8th - 12th, 2003, to document the airplane systems at the scene of the accident. The group recovered and documented parts and components related to the control systems of the aircraft.[1]

As part of the investigation, the systems group convened in Wichita Kansas, at the Raytheon Aircraft Services Hangar during the period of January 21-22nd, 2003, to make pitch control system measurements. The purpose of the activity was to document the relationship between the column, cable, elevator and tab positions at specific test conditions. The serial number of the aircraft used for this evaluation was UE-116, (registered as N116YV).

This factual report describes the Raytheon, Beech, 1900D aircraft control systems as found at the accident site. The report also summarizes the testing conducted at Wichita and examinations accomplished at the NTSB Materials Laboratory.

D. DETAILS OF THE INVESTIGATION:

Brief system descriptions are taken from cited pages of the 1900D Airliner Maintenance Manual, (AMM)[2]. The group at Charlotte, North Carolina on January 12, 2003, developed the un-cited descriptions of the primary pitch and pitch trim system that were not quoted from the AMM.

1.0 FLIGHT CONTROLS – GENERAL DESCRIPTION

(With reference to AMM section 27-00-00, Page 001)

All primary flight control surfaces are manually controlled through cable-pulley-bellcrank systems. Dual controls are provided for operation by either the pilot or the copilot. The ailerons and elevators are operated by conventional control wheels interconnected by a "T" shaped control column.

Adjustable trim tabs are installed on the left aileron, the rudder, and on each elevator. The tabs are manually controlled by the pilot through drum-cable systems using jackscrew actuators. The tab position indicators are provided on the pedestal tab controls.

The ailerons, elevators, and rudder may be secured with control locks installed in the crew compartment when the airplane is on the ground and out of service. The physical gust

[1] Attachment 1 contains the documentation of the cockpit.

[2] Raytheon Electronic Publication System (REPS), (UE-1 and after), revision 6, dated August 2002.

locks are a set of removable pins that are inserted through sets of holes to lock the positions of the movable portions of the flight controls with respect to fixed structural features.

The accident airplane did not have an autopilot installed.

1.1 PITCH CONTROL SYSTEM

1.11 System description:

The Raytheon Aircraft Beech 1900D Airliner Maintenance Manual (AMM, 27-30-02, page 205) shows that the primary pitch control stops contact each elevator control horn, at the root of each elevator. The deflection settings shown are:

20 [degrees] +1 –0 UP DEFLECTION FROM THE NEUTRAL POSITION[3]
14 [degrees] +1 –0 DOWN DEFLECTION FROM THE NEUTRAL POSITION

The Model 1900D involved in the accident was equipped with a mechanically operated pitch control system, (Reference Figure 1 and Attachment 2). The horizontal tail surfaces are mounted at the top of the vertical stabilizer. Each side of the horizontal tail has an elevator and the inboard trailing edge of each elevator has a cut-out for a single partial-span trim tab. The forward outboard corner of each elevator has a balance weight that is rounded and is located behind the horizontal stabilizer when the elevator is near neutral.

The elevators are each connected by separate rods to a single aft elevator bellcrank. The aft elevator bellcrank is located within the junction of the vertical and horizontal stabilizers and has two springs connected to the aircraft structure. The spring tension is toward the nose-down direction. Control cables lead down the vertical tail from the aft bellcrank to a set of turnbuckles in the base of the tail. The 3/16-inch diameter cables are routed to beneath the rear cargo compartment, through pulleys and the aft pressure bulkhead seals. The control cable paths then route through additional pulleys to the forward control cable bellcrank, located beneath the pedestal and First Officer's floor. The forward bellcrank is connected to the bottom of the "T" control-column by an adjustable-length push-pull rod (Ref. Figure 5). The control-column pivots fore-aft on bearings that are attached to the control column support arm. These bearings are located about seven inches above the location where the push-pull rod connects to the column. A universal joint connects each end of the top of the control column to tubes carrying the Captain and First Officer control yokes. Each control yoke tube slides fore-aft on sets of three rollers.

[3] The elevator neutral position is defined as the point where the position of the trailing edge of the elevator is aligned with the wing chord plane of the stabilizer. The AMM describes the measurement procedure using a travel board, (protractor), positioned at station 50 on the stabilizer. An inclinometer was used by the group as an additional form of measurement. The positive symbol denotes a elevator trailing edge up (TEU) position.

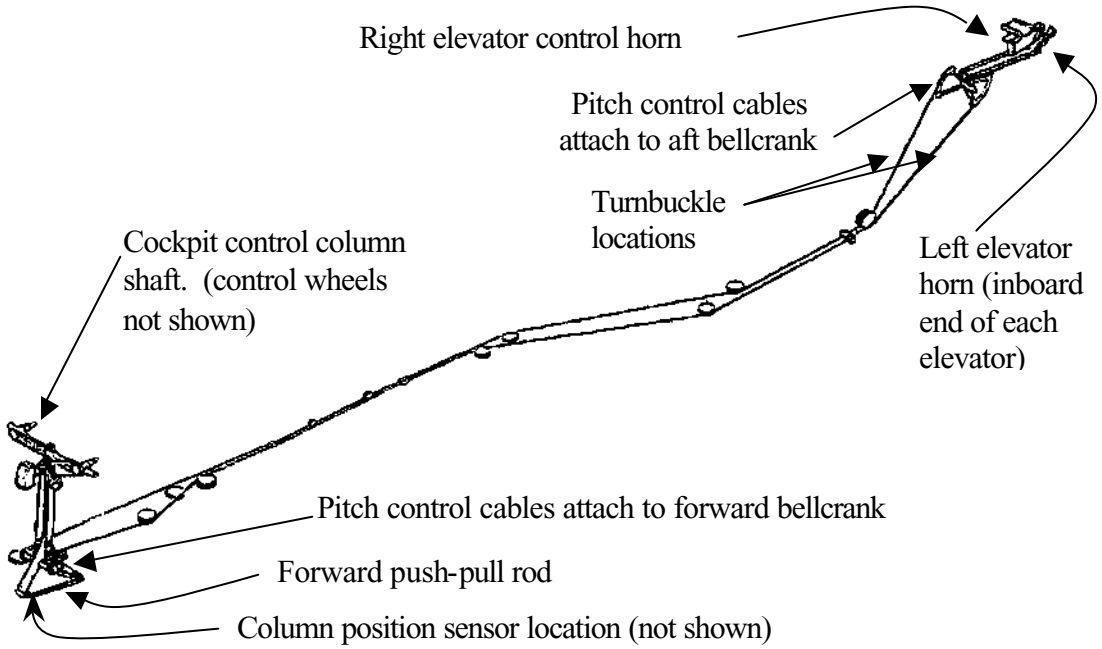


Figure 1. Primary Pitch Control System

1.12 Pitch control system components identified at the accident scene.

(1) Elevator Control Horn & Primary Stop Bolts:

The elevator control horn is located at the root of each elevator; it is connected to the elevator assembly by a shaft. (Ref. Figure 2) At the accident site, the rivets connecting the elevator control horn to the elevator shaft were inspected for security. The rivets were found to be tight and the horns were solidly fixed to the left and right elevator shafts , reference Photograph 1. The horns moved freely in their respective bearings.

The primary stop bolts for the pitch control system are located on the left and right elevator control horn supports. They are accessible by removing the aft stabilizer fairing. At the accident site, the four primary stops bolts were found attached to the control horn support and safety-wired. The length of each stop bolt was measured from the top of the bolt to the structure at the base of the stop nut. The results of the measurements are shown in Table 1.

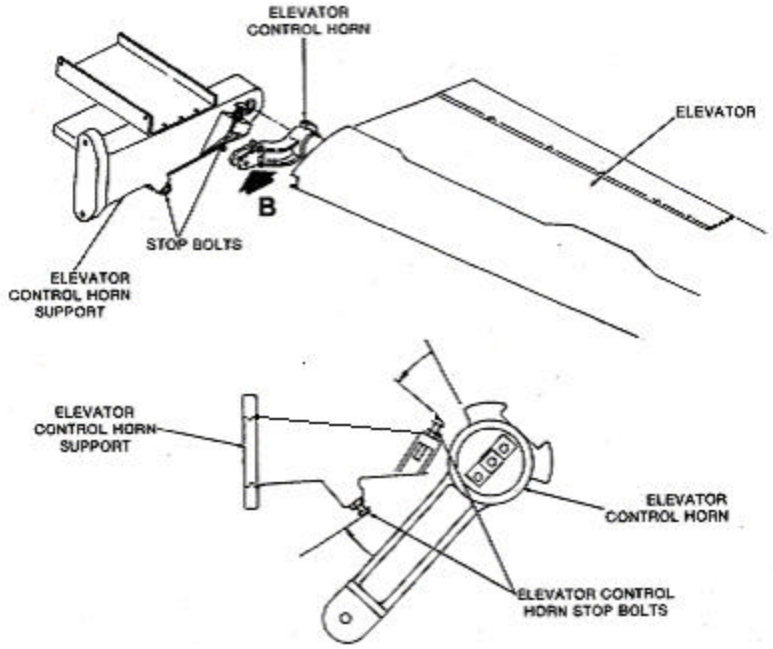
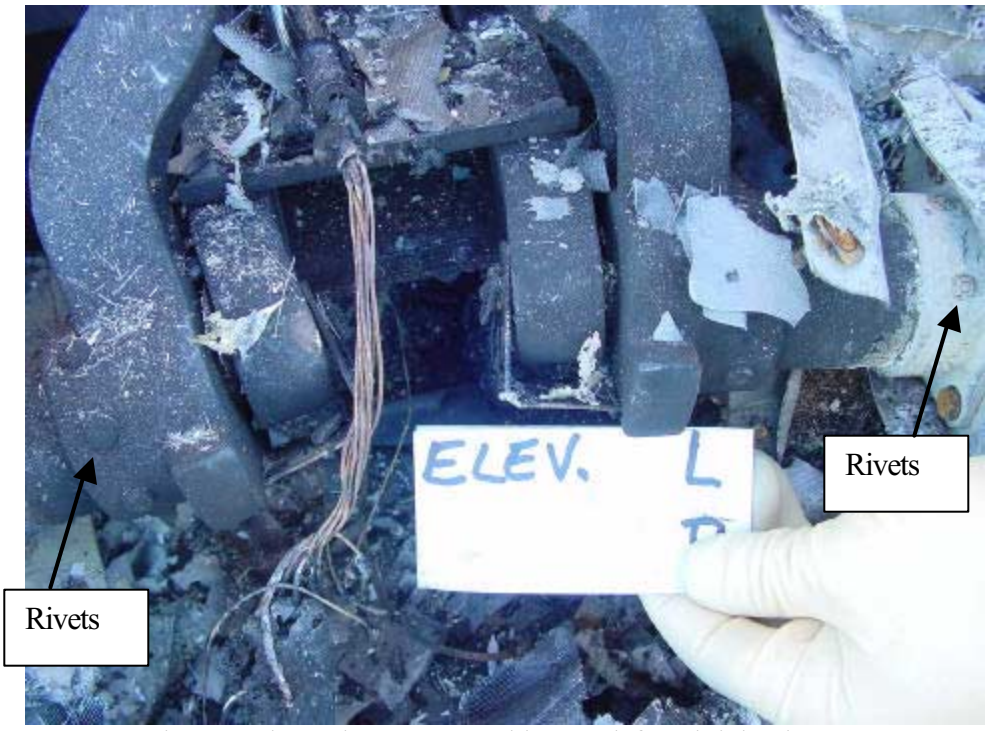


Figure 2 – elevator control horn and control horn stop bolts



Photograph 1. Elevator control horns- left and right elevator

Table 1. Primary pitch control stop bolt extensions:

	Left Elevator	Right Elevator
Upper bolt	0.65”	0.64”
Lower bolt	0.94”	0.83”

(2) Elevator Weights:

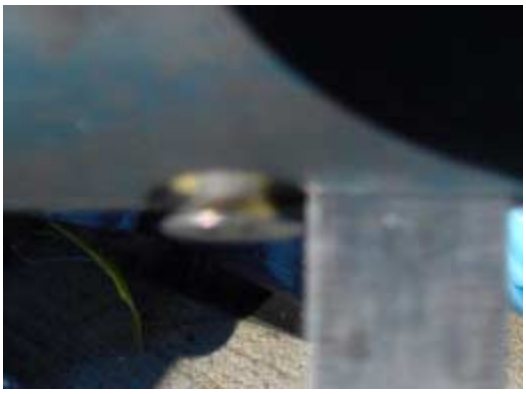
Balance for each elevator is accomplished by means of a weight in the leading edge contour at the outboard end of each elevator. A group of smaller weights are attached to the aft side of the contoured weight by two screws. Also attached to the contoured weight is a stack of elevator balance adjustment weights, mounted at the inboard face of the contoured weight. The stack is composed of a number of lead washers and a cover plate; the number varies according to the required elevator balance adjustment. The stack is retained with two screws or with two safety-wired bolts if Airworthiness Directive (AD) 2002-23-11, effective 01/10/2003 has been complied with. The AD states that the safety wire was intended to prevent the balance weight attachment screws from loosening.

Each blackened elevator weight was found unattached and in an area that had burned; the adjacent aluminum elevator material was missing (Ref. Photograph 2) and splatters of aluminum were found beneath the remains of the tail structure. Each weight had a set of two bolts at one end and each set of bolts was connected by safety wire (Ref. Photograph 3). This arrangement was similar to the configuration described in AD 2002-23-11.

The fire-damaged weight from the right elevator had an internal weight that was loose enough to rattle and the heads of the countersunk mounting screws were found to vary from flush to about 1/8-inch of visible extension from the forward edge of the weight. (Ref. Photograph 4) Examination of the rear side of the threaded ends of the fasteners revealed steel nut-plates that were blackened, and having the edges bent up. The left weight was inspected. Similar nut-plates on the left weight were mounted to aluminum structure. Examination showed that the structural build-up that the countersunk fastener goes through is: weight, aluminum structure, and then into the nut-plate. The aluminum structure that attaches to the right weight was missing. Without the thickness of the aluminum structure, the fasteners were able to move in the screw holes.

Photograph 2. Counter weight - right

Photograph 3. Safety wire between bolt heads

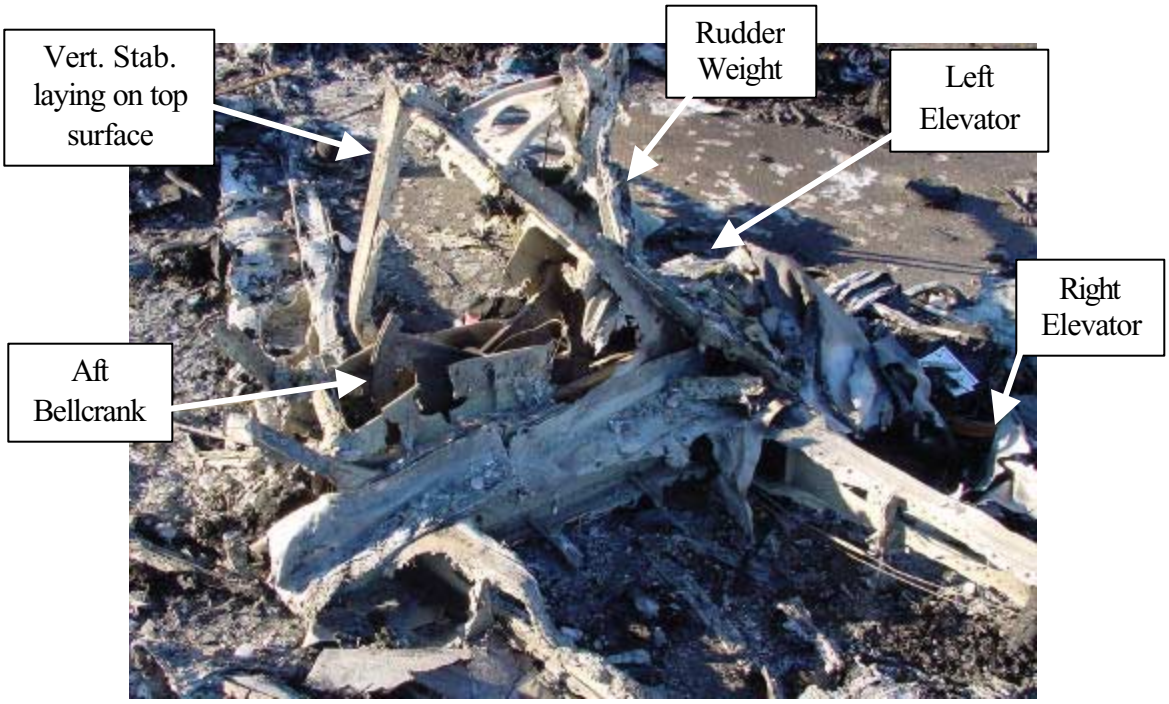


Photograph 4. Maximum projection of the countersunk mounting screw. Aluminum structure was missing from beneath the plate-nut at the opposite end of this screw and aluminum splatters were on the concrete beneath this weight.

(4) Elevator Aft Bellcrank and Surrounding Area:

Structure that had contained the aft rig pin[4] holes for the aft bellcrank was missing and fire damaged; the surrounding area was also fire-damaged (Ref. Photograph 5). Both the bellcrank and pushrod were removed from the aircraft structure (Ref. Photograph 6). Under finger pressure, the bellcrank did not rotate freely and was further examined by the NTSB Materials Laboratory.

[4] Rig pins are maintenance tools that may be inserted into the control system to immobilize movable components at a reference position. The use of rig pins during maintenance on the ground is described in the AMM.



Photograph 5. Inverted tail section, with the lower portion of the remaining vertical stabilizer toward the top of the photo. The leading edges are to the left edge of the photo. The right horizontal stabilizer is closest to the viewer. The aft bellcrank is visible at the intersection of the vertical and horizontal stabilizers.

Photograph 6. Aft bellcrank after removal, laying inverted, with right side visible.

The NTSB Materials Laboratory examined the aft bellcrank and the small pieces of structure remaining attached. The remaining structure appeared to have been melted away during exposure to fire. The structural pieces rotated easily (one with little or no resistance and one with small resistance), but it was noted that the attaching bolt and nut did not rotate with the structure. Removal of the nut from the bolt and partial

disassembly of the bolt showed that the inner races of the bearings were very difficult to move relative to the outer races. What appeared to be the remains of polytetrafluoroethylene (PTFE) bearing seals were partially melted and deformed around the internal balls.

The bearing and bearing boss on the nut end of the attachment bolt were cut from the remainder of the bellcrank. The metal retention ring was disassembled from the face of the bearing, allowing removal of the PTFE seal. The PTFE seal had been deformed around the protruding portion of the inner race and into the space between the ends of the retention ring. Visual examination of the balls of the bearing revealed the presence of what appeared to be gritty dried grease. The bearing (without the PTFE seal and retention ring) was ultrasonically cleaned in toluene for several minutes. After this cleaning, the inner race rotated easily within the outer race under hand pressure.

(5) Elevator Aft Bellcrank Tension Springs:

Both left and right down tension springs were located in the area of the aft bellcrank. The right tension spring was found with its upper end not attached to its respective link; its lower end was attached to structure. The structure that forms the lower attach point was fire damaged. The left tension spring was found with its upper end attached to its respective link in the most forward of four holes; its lower end was attached to structure. A visual examination of the spring showed that the spring was not totally relaxed. (Ref. Figure 3 and Photographs 7 and 8).

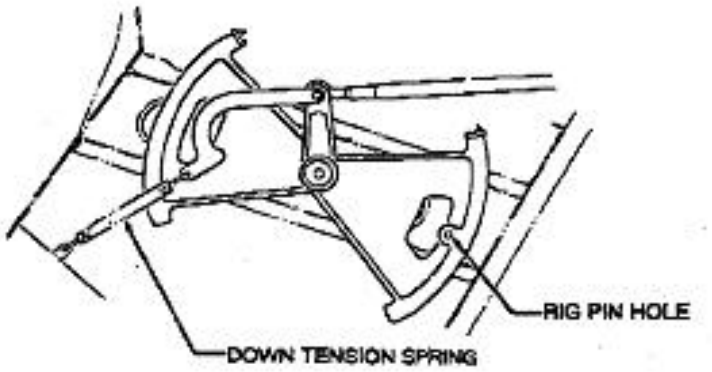


Figure 3. Aft Bellcrank and Down Tension Spring, (two total). (Left edge of figure is toward nose of airplane.)

Photograph 7. Left and right springs shown, right spring is not attached to link. (Right edge of photo is toward nose of airplane.)

Photograph 8. Left spring as found attached to link. (Left edge of photo is toward nose of airplane.)

Examination of the tension springs at the NTSB Materials Laboratory revealed partial surface melting of the bellcrank, adjacent to the right spring attachment link (upper end of the spring). A globule of re-solidified metal was noted adjacent to the lower end of the spring. Magnified visual examination of the disconnected end of the right spring and the right linkage showed no evidence of unusual wear patterns, scratching, or other damage related to the separation of the spring from the link.

(6) Aft control rods:

The model 1900D aircraft has two aft control rods; each rod connects one elevator control horn to the aft elevator bellcrank.

Both elevator aft control rods were found within the wreckage. The aft end of each control rod was found connected to its respective elevator control horn; the forward end

of each the control rod was found connected to its respective aft bellcrank link. The length of each control rod was measured. This measurement was taken between the centerlines of the bolt holes in the rod ends at each end of the respective control rod. The length of the left control rod was 20.53 inches; the right control rod was 20.44 inches.

(7) Primary Pitch Control Cables:

NOTE: Descriptions of the pitch control system are provided in terms of airplane nose up (ANU) and airplane nose down (AND).

The primary pitch control cables were followed completely from the tail to the nose of the airplane and were found to have one turnbuckle, each. The turnbuckles were located in wreckage from the area of the vertical tail base, about eight feet from the aft bellcrank. The extensions of the turnbuckles were found to be different, with the AND turnbuckle longer than the ANU turnbuckle. (Ref. Table 2) The AND turnbuckle was near full extension, with one thread visible. The ANU turnbuckle extension was found almost fully compressed. (Ref. Photographs 9 and 10)

Table 2. Primary pitch control cable turnbuckle dimensions

Item measured:	**ANU Cable Turnbuckle (inches):**	**AND Cable Turnbuckle (inches):**
Turnbuckle lengths between the centers of the holes in the swaged terminals.	5.54 inches	7.30 inches, with one thread showing.

Photograph 9. Elevator "AND" cable turnbuckle. Note: this turnbuckle was pinched in structure and the safety clip that is visible beneath the "DN" lettering was pulled off during extrication. To mark the rotational position, a stripe of gloss black paint was applied.

Photograph 10. Elevator "ANU" cable turnbuckle

All primary and trim control cables had damage, with numerous bends, kinks, and breaks. At about the location where the fuselage was folded toward the remains of the right wing, the AND pitch control cable was found to have two braided strands (of 7 total) broken and one of the woven strands appeared to have pinch damage and was flattened. The broken strands were spirally unwound and were found in the area between the rear wing spar and the forward edge of the rear cargo compartment. The length from the forward end of the AND cable to the breakage point in strands was 16 feet, 8 inches. The majority of spiral unwrapping was toward the forward end of the cable and was approximately 38 inches long. Forward of the unwound area, the cable remained routed through a pulley/pulley bracket assembly that was sharply gouged on the aft end of the bracket; further inspection found no wear on the bracket. (Ref. Photograph 11.

The portion of the pitch control cable with a spirally unwound section was examined at the NTSB Materials Laboratory. The examination found that the cable was composed of seven strands. Two of the strands were completely severed and a third was partially severed. All of the broken wire ends were located within less than approximately one inch of each other. On one side of the break location, the separated strands had been pushed back from the fracture location, resulting in the unwound spirals. Magnified visual examination of the broken wire ends disclosed that most of the wires were flattened by mechanical damage adjacent to the fracture, and that many of the wires were bent adjacent to the fracture. Bent, flattened, and damaged wires were also noted on the partially separated strand. No evidence of fatigue cracking or preexisting wear was noted in the damaged portion of the cable.

Photograph 11. Elevator down (AND) cable showing spiraled strands.

The length of each of the 3/16" diameter pitch control cables was measured at the accident site and then at the NTSB Materials Laboratory and the results are shown in Table 3. The "Accident Site" cable measurements for Table 3 were made with a 100 foot Lufkin steel tape measure while each cable was stretched between two people.[5] The NTSB Lab Measurements shown were the result of four measurements that were averaged from four tape measures, after noting an inch of difference between the scales. The air temperature at the accident site was in the mid forties (Fahrenheit) and in the upper sixties at the NTSB Materials Laboratory.

NOTE: The dimensions noted in the "Reference Measurement" column are based on the dimensioning shown on the respective engineering drawings. Those drawings specify that the dimension is from the distal end of the swaged, threaded terminal to the proximal end of the ball portion of the swaged ball terminal.

Table 3. Primary pitch control system cable measurements

Elevator Cable Part Number	Reference Measurement: Beech Aircraft Corporation "Drawings"	NTSB Lab Measurements: NOTE.	Accident Site Measurements: Made from different measurements than the other columns
Up Cable:			
P/N 129-524085-29	514.12 inches Note A	513.1 inches Note C	514.1 inches Note E
P/N 114-526031-1	106.25 inches Note B	106.2 inches Note D	107.6 inches Note F
Down Cable:			
P/N 129-524085-25	495.38 inches Note A	495.1 inches Note C	497.1 inches Note E
P/N 114-526031-3	107.12 inches Note B	107.3 inches Note D	109.5 inches Note F

NOTES:

A Beech Aircraft Corporation, "Cable Assembly –Primary Flight Control, Fuselage", Elevator Aft 129-524085, sheet 1 of 1, Rev A, dated 1-22, 1991.

[5] Each installed cable was assembled from the two shorter lengths, connected by the turnbuckles for adjustment of overall cable length.

B Beech Aircraft Corporation, "Cable Assy, Elevator Aft" 114-526031, sheet 1 of 1, Rev A, dated 3-29, 1982.

C Cable length from the inside end of the ball swaged terminal MS20664C6 at the forward bellcrank to the end of swaged terminal MS21260L6LH for the left terminal and MS21260L6RH for the right terminal.

D Cable length from the inside end of the ball swaged terminal MS20664C6 at the aft bellcrank to the end of swaged terminal MS21260L6LH for the left terminal and MS21260L6RH for the right terminal.

E Cable length from end of the forward bellcrank to center of turnbuckle. Note, the forward end of this measurement was taken from the edge of the bellcrank, not from the end of the cable.

F Cable length from end of the rear bellcrank cable to center of turnbuckle.

(8) Forward Bellcrank and Secondary Stops:

The forward pitch control bellcrank was seen in the intact airplane, in Wichita, located beneath the cockpit floor and the bellcrank contained the secondary stop bolts (Ref. Figure 4). In the cockpit wreckage, the bellcrank was located in an area of fire and impact damage; the bellcrank was found fractured into two pieces. The fracture surfaces of the bellcrank did not exhibit the black soot covering seen on the side surfaces of the bellcrank and surrounding materials. The secondary control stop that was nearest to the body of the bellcrank was found bent, with a sharp burr on the head of the bolt. The extension was 0.93 inches from the top of the bolt to the base of the exposed threads at the stop-nut. The stop at the end of the bellcrank arm was straight and the extension was 0.65 inches. The primary pitch AND and ANU cables were found attached to the bellcrank as shown in Figure 1.

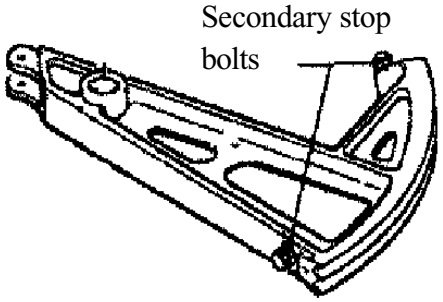


Figure 4. Forward bellcrank showing secondary stops

(9) Control Column and Wheel Assembly:

Description:

At the top of the control column assembly are two control wheels (also known as control yokes) for the Captain and First Officer. Each control wheel is mounted on a plate located on the aft end of a tube assembly that is installed through the instrument sub-panel control column supports. Each control column support contains a set of three rollers that support the respective tube assembly. The forward end of each control wheel tube assembly is connected to a universal joint at each outboard end of the "T" column. In the mid-portion of the Captain's tube is a hole for a (ground) gust lock and corresponding hole are located on the support for the tube. (Ref. Photograph 12) A sprocket and chain mechanism mounted at the forward end of each tube connects the rotational movement of the wheels and is routed downward to the aileron control cables. The control column pivots at the lower section of the column and the forward pitch quadrant push-pull tube connects to the control column 7 inches below the pivot point. (Ref. Figure 5)

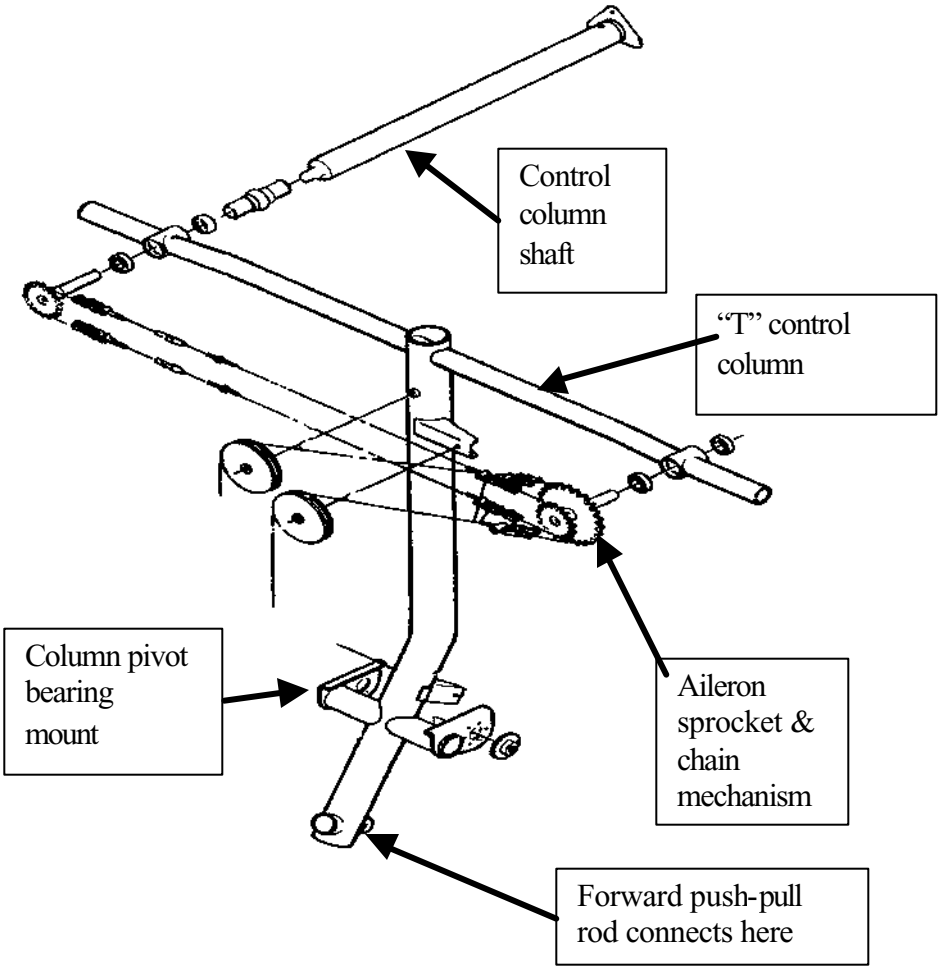
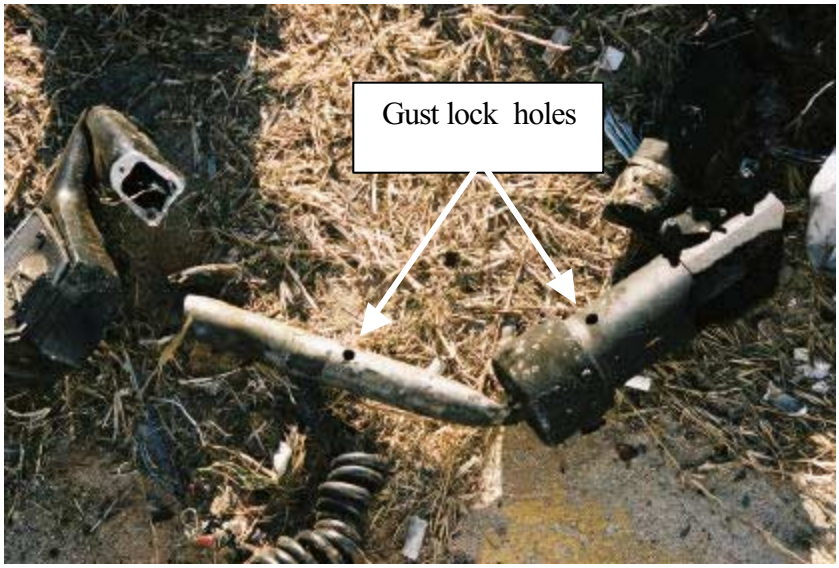


Figure 5. Control column assembly

Photograph 12. View of a gust lock installed to immobilize pitch controls in a Model 1900D. (The accident airplane is not shown in this photograph.)

The Captain's control wheel was found approximately 20 feet forward of the cockpit and separate from the tube assembly. The Captain's tube was bent and found mostly extended out of the support assembly. The forward end of the tube was not found connected to the "T" control column; it had separated at the universal joint. (Ref. Photograph 13)



Photograph 13. Captain's control wheel and column assembly. The Captain's control wheel is to the left, the end plate is mounted at the left end of the tube assembly, the gust lock holes in the moveable tube (smaller diameter tube in center-left of photograph) and fixed support assembly (larger diameter tube at right) are visible.

The First Officer's control wheel was found within the cockpit and separated from the control column. The tube and support assembly were found connected to the control column via the universal joint.

The "T" shaped portion of the control column was found in the forward area of the flight compartment; it was dented and slightly crushed, but was intact. The left and right pivot bearing mounts, for the pitch control column, were found separated from structure, with the mounting rivets broken in tension. Both pivot bearings were found, however, their installation orientation was not determined.

The Captain's tube and support assembly was examined at the NTSB Materials Laboratory in Washington D.C. on February 5, 2003. The tube assembly was measured to be 5.34 inches from the center of the gust lock hole to the outside of the end plate. The thickness of the end plate was measured to be 0.1 inch; when subtracted, the distance from the center of the gust lock hole to the forward side of the end plate is (5.34-0.1) = 5.24 inches. Per Beech Aircraft Corporation Drawing 101-524487, "Tube Assembly - Control Wheel", the distance from the center of the gust lock hole to the forward side of the plate is 5.24 inches.

(10) Forward Push-Pull Control Rod:

Description: The push-pull tube assembly is located below the cockpit connecting the lower "T" control column to the forward bellcrank. The tube assembly is accessible from a panel beneath the fuselage.

The Maintenance Manual, Elevator Control Rigging – Maintenance Practices, AMM 27-30-02-201, revision 7, dated December 2002, describes the adjustment requirement for this push-pull tube assembly. Step f. on page 5 states to adjust the center-to-center length of the push-pull tube assembly between the control column and the forward elevator bellcrank to a dimension of 15.12 +/- 0.06 inch.

The push-pull control rod was found beneath the control pedestal in the cockpit and the aft end of the tube assembly was attached to a portion of the forward bellcrank. The adjustable rod end at the forward end of the tube assembly had six threads exposed and was bent. At the accident site, the length of the tube assembly could not be accurately measured due to a bend in the tube and a more severe bend in the rod-end.

The push-pull rod was re-measured at the NTSB Materials Laboratory in Washington D.C. on January 31, 2003. Three measurements were taken: from the center of the hole in the fixed rod end to the end of the tube, the thickness of the nut, and the length from the top of the nut to the center of the hole in the adjustable rod end. Raytheon calculated the length of the push-pull control rod by using the drawing, 50-524433, for the control rod, and the specification drawings for the nut and the rod end. The results of the measurement are shown below in Table 4.

Table 4. Results of push-pull control rod measurements:

	Drawing 50-524433	Measurements at NTSB Lab
Dimension "B"	14.03 inch (50-524433)	13.99 inch
Nut P/N MS21083N6	(0.251 to 0.282) 0.2665" nom	0.270 inch
Rod End P/N MS21151-8	6 threads = 1.0035 " (calculated from drawings)	1.07 Inches
Total Tube assembly length:	15.30 inches (calculated from drawings)	15.33 Inches:

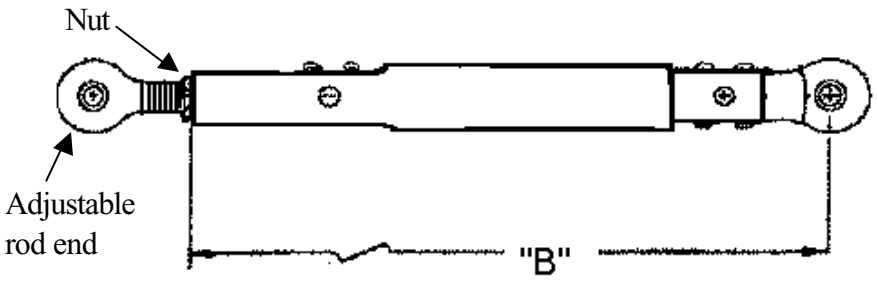


Figure 6. Sketch of forward push-pull rod

(11) Column Bob-Weight (ballast and control stop):

The bob weight is located on the First Officer's side of the cockpit; it is attached to the vertical section of the "T" column through a interconnect link. The control column bob weight contributes to control "feel" and flight control stability.

The Maintenance Manual, Elevator Control Rigging – Maintenance Practices AMM 27-30-02-201 revision 7, dated December 2002, shows that the gap between the head of the stop bolt and the bob-weight is 0.5 +/- 0.06 inches. There is no requirement for the length of the stop bolt.

The bob-weight was located in the forward area of the cockpit; it was displaced, from its normally rigged position. The gap between the head of the stop bolt and the bob-weight could not be measured. However, the bob-weight stop bolt length was found set to 1.62 inches; it was measured from the top of the bolt-head to the exposed surface of the lock-nut. The lock nut was found loose enough to rotate the nut with finger pressure.

During the ground testing in Wichita it was found that the bob-weight stop bolt is accessible without removing the seat or floorboards.

(12) Column Roller Slider Assemblies:

The roller slider assemblies (also known as control column supports) were found separated from the majority of the sub-panel structure. The set of three rollers from each end of each control column each had one eccentric that could be adjusted to set roller clearance. The First Officer's rollers had about 1/16-inch clearance on the shaft. The roller on the eccentric screw rotated freely. The eccentric adjustment screw could be turned to loosen or tighten the roller with a screwdriver, but the adjustment did not change freely. The Captain's assembly was found burned, with the shaft displaced away from the center of the rollers and unable to rotate. Binding of the column rollers was the subject of FAA safety recommendation 01.270, titled Binding Jammed Control Column. The safety recommendation resulted in Raytheon adding the roller check to the third (of six inspections) 200-hour interval detailed inspections, and revising their AMM, (section 27-30-02, page 8), to include a procedure for checking the rollers. The FAA considers Raytheon's action to be sufficient to address the safety recommendation and have recommended that it be closed.[6]

(13) Column Position Sensor:

The pitch control column position sensor was found contained within its bracket assembly. (Ref. Photograph 14) Two wires were found attached and extending out of the sensor. The wires were severed about 6 inches away from the sensor. The sensor was firmly attached within the bracket and did not move or rotate. The linkages from the control column to the position sensor appeared to be intact, during an initial examination. After the removal of several other cockpit components, the linkage from the control column to the position sensor was found broken at the control column clamp. The sensor and linkage were removed from the aircraft and the input lever to the sensor was found free to move from the original position. The clamp connecting the linkage to the control column was found attached to the column; however, it was slightly loose due to the rubber contained within the clamp being heat damaged. The sensor rotated freely 360 degrees. A measurement of the broken sensor rod end linkage yielded a center-to-center length of approximately 3.31 inches.

Access to the column position sensor was examined during the ground testing in Wichita. To gain access to the elevator column position sensor, 14 screws must be removed to open a small panel on the lower fuselage, slightly aft of the nose gear. The sensor attached to structure adjacent to the left of the base of the control column. The sensor is connected to the elevator system by a linkage from the sensor to the base of the control column.

[6] FAA Memorandum of February 28, 2002, from the Associate ACO Manager Airframe Services Wichita Aircaft Certification Office, ACE-118W, to Manager, Program Management Branch, ANM-114.

Photograph 14. Column, position sensor, clamp, and linkage.

(14) Examination of similar Model 1900D airplane at Charlotte:

In Charlotte, the Systems Group examined an operational airplane (N174YV) on January 11, 2003. A panel was removed from the area of the first officer's feet by unlatching two quarter-turn fasteners. To measure pitch control cable displacement, a six-inch steel scale was placed near the pitch cable. The column yoke was moved until a mark on the cable moved 0.9 inches. The equivalent yoke travel was about 0.85 inches. Three measurements were taken at the control column Ref. Table 5. The group agreed that the measurements were approximate and could be more precisely determined through additional testing, which was subsequently accomplished at Wichita, Kansas.

Table 5. Measurements between control yoke and roller cover at instrument sub-panel.

From aft face of the roller cover to forward surface of the yoke at full forward position.	2.75 inches
Measurement taken at approximate point where elevator was visually near neutral when seen from the ground.	4.18 inches
Measurement taken at full aft yoke position.	9.25 inches

1.2 Pitch Trim Control System:

1.21 System Description:

The pitch trim system provides each elevator with a single moveable tab and pitch trim actuator. Each pitch trim actuator is a dual output-shaft design, with input from a control cable wrapped around a drum, translating the motion into extension of a set of parallel output shafts. The two shafts for each actuator are connected by flat plates, known as 'dog-bones,' and each output shaft terminates at a rod-end bearing. Each actuator output shaft rod-end bearing is bolted to a rod that is connected at the aft end to the trim tab horn; providing two connection paths between each actuator and the respective trim tab.

The two pitch trim actuator drums are connected by a 1/16-inch diameter pitch trim control cable that is also connected to a drum beneath the cockpit control pedestal. The drum beneath the pedestal is connected by a link-chain to a rotating wheel, located on the left side of the pedestal. Trim inputs are manually made in this system design and no electric trim was installed in this airplane.

1.22 Pitch Trim Control System Components Identified at the Accident Scene

The trim cables were found broken near the rear rudder bellcrank and in other locations, such as aft of the rear wing spar.

The pitch trim control wheel was found intact and still connected to the control shaft rod and quadrant assembly. The index-marked facial plate from the top of the pedestal was missing. The line located on the movable portion of the trim indicator aft of the "DN" was traced onto paper and held against the trim indications in another airplane (N174YV). With the operational airplane controls adjusted to match the card, the pitch trim indication was near the full down position.

The trim system was inspected for compliance with AD 95-02-17, titled Elevator Trim Tab Control Cable. All cables were in the correct orientation and within the keeper pins. Features of the pitch trim control system were measured for future reference (Ref. Table 6).

Table 6. Pitch trim control path measurements.

Item measured: (Described from tail forward)	**Left measurement (inches):**	**Right measurement (inches):**
Trim tab connecting rod between tab horn and actuator shaft control rod ends (two per side).	10.25	10.25
Actuator body aft surface to actuator shaft bearings that the tab connecting rods attach to.	3.115	3.02
Actuator body aft surface to actuator shaft connecting plates, known as "dog-bones."	1.86	1.85
Cable groove on drum in which the trim cables attach.	Middle	Middle
Length from the center of the drum to the center of the turnbuckle. (This cable is normally the lower cable.)	15.62	15.75
Length from the center of the drum to the center of the turnbuckle. (This cable is normally the upper cable.)	12.25	12.50

1.3 WICHITA GROUND TESTING:

Ground tests were conducted on the primary pitch and pitch trim control systems of an exemplar Raytheon, Beech, 1900D aircraft in Wichita. The purpose of the testing was to document the relationship between the column, cable, elevator and elevator tab positions for various test conditions. Prior to any testing, the primary pitch and pitch trim control systems were rigged according to chapter 27-30-02 of the AMM.

The first test condition obtained baseline values for maximum fore and aft control column positions, cable displacements, and maximum elevator up and down positions. A test was also accomplished to determine the elevator trailing edge position with the gust lock pin installed through the movable control yoke tube and fixed gust lock hole. After baseline values were determined, additional group activity:

- Checked the compliance, or stretch, in the primary pitch control system, and
- Performed a control sweep of the pitch control system.
- Varied the pitch control cable tension from the initial rig cable tension to determine the effects of column to elevator position.

The second test condition consisted of adjusting the pitch system components on the test aircraft to match the dimensions of the pitch system components from the accident aircraft. This test condition required the following changes: the primary pitch control cable turnbuckles were adjusted to the length of the turnbuckles of the accident aircraft,

the aft pushrod and forward push-pull control rod were adjusted, and the secondary stops on the forward bellcrank were adjusted.

The last test condition consisted of rigging the pitch controls to the location of the gust lock pin, instead of the forward rig pin. The gust lock pin was installed into the control yoke tube and then the pitch system components were adjusted until the elevator trailing edge was faired with the stabilizer. This test was accomplished twice: once with the aircrafts pitch system components matching the accident aircrafts pitch system components, and once with the aircraft in a properly rigged condition.

NOTE: For all tests, the column position was measured from the forward surface of control wheel casting to the aft surface of the control column support roller cover; the elevator deflections were measured both with a digital inclinometer and a rigging board.

1.31 Pitch System Evaluation – Control System Rigged Per AMM:

(a) Primary Pitch System Baseline Positions:

The group examined how adjustments to the pitch control system affect elevator or column positions. To accomplish this, the pitch control system was rigged to the AMM and the positions of the column and elevator were measured at their minimum and maximum displacements. The Captain's control column was moved forward until the elevator control horn contacted the primary down stop; it was then moved aft until the elevator control horn contacted the primary up stop. To obtain baseline values for the elevator neutral position, a rig pin was installed into the aft elevator bellcrank. The column neutral position was obtained by installing a rig pin in the forward bell crank.

For each of the baseline conditions, four measurements were recorded: column displacement, Flight Data Recorder (FDR),[7] pitch control cable displacement and left/right elevator position. Table 7 provides the results of this test.

(b) Primary Pitch Control System Compliance:

The compliance, or stretch, of the primary pitch control system was measured by moving the control column to its forward and aft extreme movement capabilities. The controls were moved until the primary stops were contacted at the elevator horns and a force was then applied to the control column through a force gage at the control wheel, until the secondary stops at the bob-weight or forward bellcrank were contacted. The force required to reach the stops typically required a 33 pound push and a 100 pound pull. This technique quantified the compliance in the system by applying the force after the elevator horn contacted its primary stop at the horizontal stabilizer until the point where the secondary stops at the bob-weight/forward bellcrank were contacted. (Ref. Table 8)

[7] FDR information was provided to the FDR Group.

(c) Elevator Deflection with Gust Lock Pin Installed in Control Yoke Tube:

The gust lock pin was installed into the Captain's control yoke tube; this restricted movement of the elevator control system. The same four measurements were recorded: column displacement, Flight Data Recorder (FDR),[8] pitch control cable displacement and left/right elevator position. (Ref. Table 9, and Figure 8.).

(d) Primary Pitch Control System – Full range of travel:

Inputs at the Captain's control column moved the primary pitch control system throughout the full (34 degree) range of travel. The control column was initially positioned to full forward and was then moved aft until the elevator control horn contacted the up stop. Measurements of the control column, cable and left/right elevator were recorded for every two degrees of elevator displacement, starting at the elevator positioned full down. The results are show in Charts 1-3.

NOTE: The cable displacement was measured by how far a reference mark on the cable would move forward or how far aft of the station 482.75 frame. Both elevators and tabs were rigged to the faired position, per instructions contained in the AMM (also known as "zeroed out").

NOTE: Descriptions of the elevator are provided in degrees of Trailing Edge Down (TED) and Trailing Edge Down (TEU). The elevator position was measured using a Travel Board (TB) and a digital inclinometer (INC)

Table 7: Positions of control column, cable displacement and elevator position, as rigged per AMM

Test Condition	Control Column (Inches)	Cable Displacement (Inches)	Left Elevator Position (Degrees)	Right Elevator Position (Degrees)
Column Full Forward	2.09	6.19 Aftward	TB 14.75 TED INC14.70 TED	TB Not Used INC 14.80 TED
Pin in Aft Bellcrank (Column Neutral - Trailing edge of elevator faired to stabilizer wing chord plane)	4.12-4.16	3.81 Aftward	TB 0.0 INC 0.0	TB Not Used INC 0.0
Pin in FWD bellcrank (aft bellcrank not pinned)	4.25	[No measuremt]	INC 0.0	[No measurement]
Column Full Aft	8.9	0.5 inch forward	TB 20.4 TEU INC 20.4 TEU	TB Not Used INC 20.0 TEU

[8] FDR information was provided to the FDR Group.

Table 8: Primary pitch system compliance – as rigged per AMM

Test Condition	Control Column (Inches)	Cable Displacement (Inches)	Elevator Position (Degrees)	Right Elevator Position (Degrees)
Column Full FWD + 33lbs (bob-weight stop contacted)	1.81	6.19 Aftward	TB14.75 TED INC 14.8 TED	TB Not used INC 14.8 TED
Column Full Aft + 100 lbs	9.34	0.63 Forward	TB 20.0 TEU	TB = 20. TEU

Table 9. Column and elevator positions with gust lock pin installed in control yoke tube:

Test Condition	Control Column (Inches)	Cable Displacement (Inches)	Left Elevator Position (Degrees)	Right Elevator Position (Degrees)
Gust lock Pin installed in Control Yoke Tube	2.81-2.84	5.62 Aftward	TB 10.5 TED INC 10.7 TED	TB Not Used INC 10.7 TED

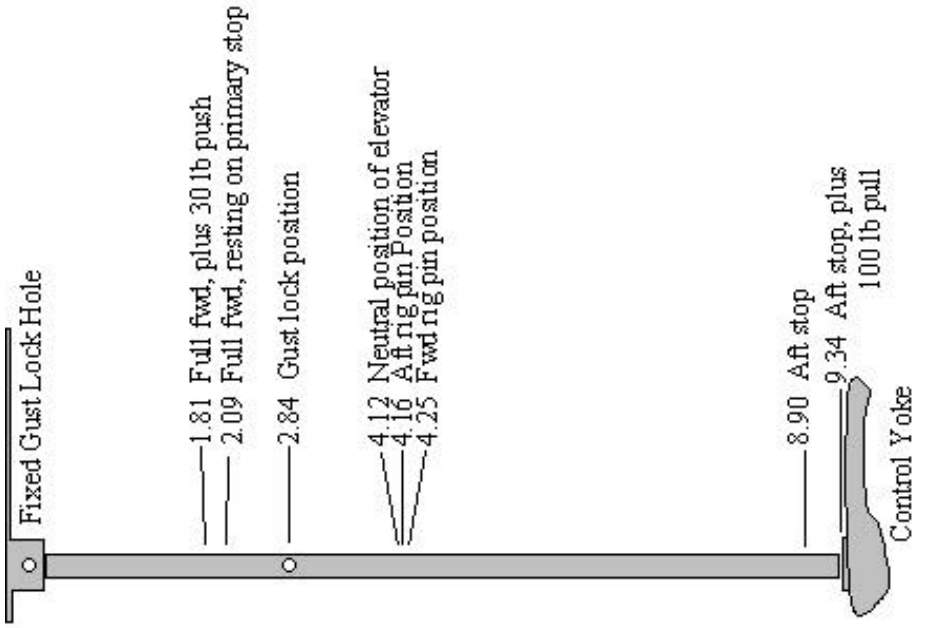


Figure 7. Control yoke positions, as rigged to AMM.
Illustration is to approximately ½ scale.

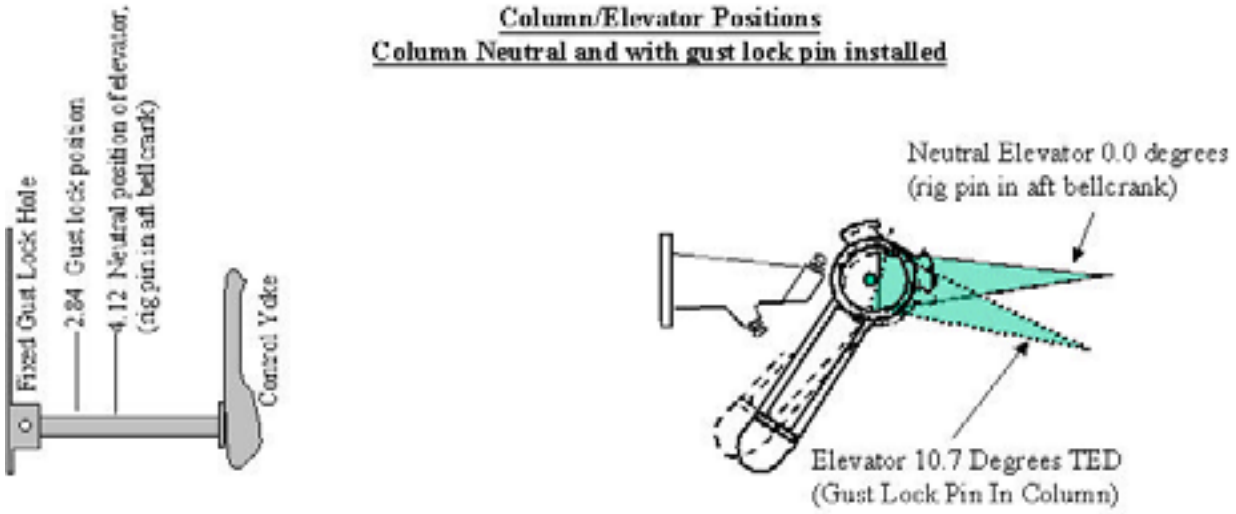


Figure 8, Control yoke and elevator positions at neutral and with the gust lock pin installed in the column

Chart 1. Column position vs. elevator cable displacement

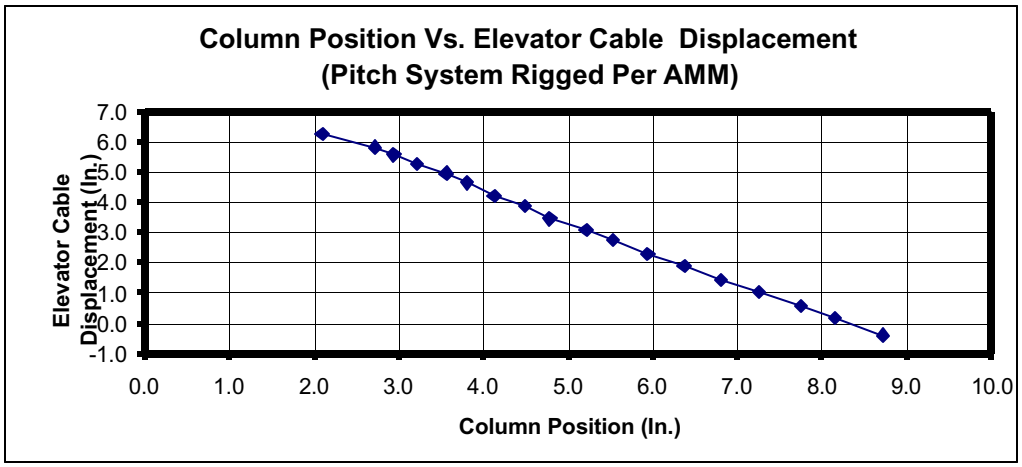


Chart 2. Column position vs. elevator position

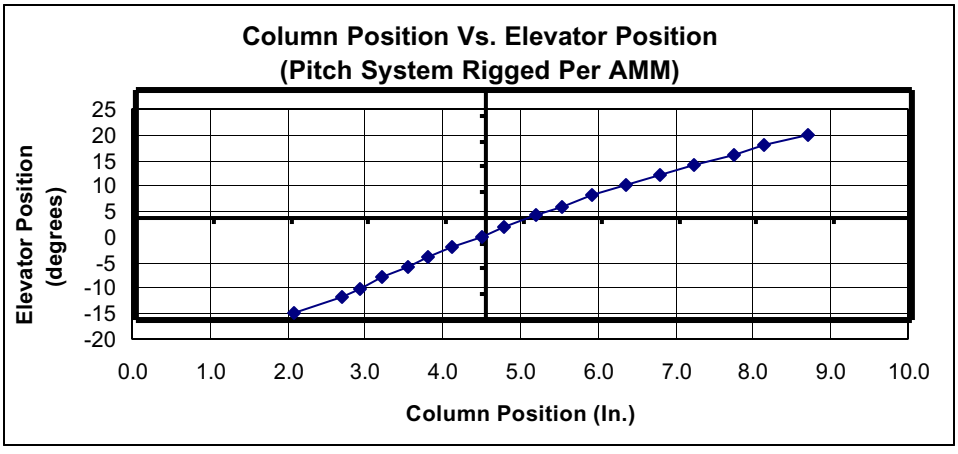
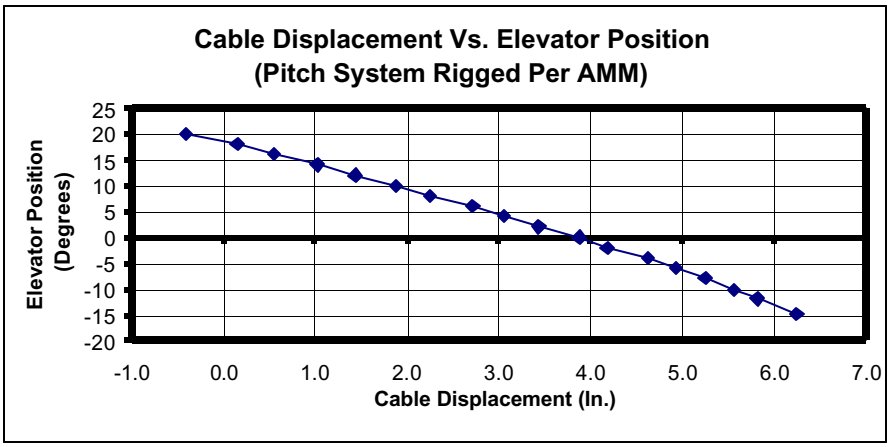


Chart 3. Elevator Cable Displacement Vs. Elevator Position



(e) Cable Tension Variation (Primary Pitch Control System)

The group examined the results of varying the pitch control cable tension from the initial AMM-specified cable tension to determine the effect on the relation between the control column and the elevator. A first set of tests were conducted to document the effects of increasing the cable tension from AMM-specified tolerances. A second set of tests documented the effects of decreasing the cable tension from AMM-specified tolerances. For each test, the column was moved from its full forward position to its full aft position and measurements were taken at several points along the travel. The measurements at each point in the travel were of column position, cable displacement, and elevator position.

The first test increased the primary pitch cable tension to 33 pounds over the initial AMM-rigged cable tension. The control column was moved while measuring the control column and elevator positions. The cables were then re-tensioned to their original values.

The second test decreased the primary pitch cable tension to 25 pounds less than the initial AMM-rigged cable tension. The control column was moved while measuring the control column and elevator positions. The cables were then re-tensioned to their original value.

In each test and with the column positioned to full aft, the elevator position measurement was 19.9 degrees TEU. With the column positioned to full forward, the elevator was 14.8 degrees TED with an increased cable tension, and 14.5 degrees TED with decreased cable tension.

1.32 Pitch Control System Adjusted to Match Accident Aircraft Pitch Control System:

NOTE: Prior to adjustment, the Elevator nose Up cable turnbuckle length[7] was 6.50 inches. The Elevator nose Down cable turnbuckle length[7] was 6.25 inches.

The primary pitch control cable turnbuckles on the test aircraft were adjusted to the length[9] of the primary pitch control cable turnbuckles found at the wreckage site (Ref. Table 2). The cable tensions were then set to the tensions shown on a maintenance record dated January 6, 2003[10]. The cable tension and temperature values are:

1. Elevator "UP" cable tension 57 lbs.
2. Elevator "DOWN" cable tension 62 lbs.
3. Temperature when cable tension was recorded: 55 degrees F.[11]

The control column and left elevator position measurements were measured and recorded after these adjustments (Ref. Table 10).

NOTE: After each adjustment to the pitch control system, the aft rig pin was installed through the aft quadrant and the control column position was measured and recorded. The forward rig pin was then installed through the forward quadrant and the elevator position was measured and recorded.

NOTE: The cable displacement and the right elevator position were not measured for this test. The elevator position was measured using the digital inclinometer only.

Table 10. Pitch control system positions after changing turnbuckle length:

Test Condition	Control Column (Inches)	Left Elevator Position (Degrees)
Pin in Aft Bellcrank	3.22	0.0
Pin in FWD bellcrank (aft bellcrank not pinned)	4.22	5.4 TEU
Gust lock Pin in Control Yoke Tube	2.84	4.4 TED
No pin installed Let Elevator full down (bob-weight stop contacted)	1.94	10.2 TED
Column full aft, Primary stops contacted	7.75	20.2 TEU

The aft pushrods of the test aircraft were adjusted to the lengths of the aft pushrods found at the wreckage site and the pitch control system measurements were once again taken. (Ref. Table 11)

[9] The length was measured between the centers of the manufactured holes through each of the two swaged terminals.
[10] See Maintenance Records Factual report, dated March 12, 2003, Appendix 23.
[11] The temperature for the rigging in Wichita was 72 degrees Fahrenheit, as measured with a calibrated digital thermometer placed next to the control cable turnbuckles. The airplane had been in the hangar for more than 24 hours prior to rigging. The average cable tensions were set to 80.5 pounds.

Table 11. Pitch control system positions after changing turnbuckle length & aft rod end:

Test Condition	Control Column (Inches)	Left Elevator Position (Degrees)
Pin in Aft Bellcrank	3.25	0.5 TEU
Pin in FWD bellcrank (aft bellcrank not pinned)	4.25	5.8 TEU
Gust lock Pin in Control Yoke Tube	2.84	4.1 TED
No rig pins installed Left Elevator full down (bob-weight stop contacted)	1.91	9.7 TED
Column full aft, Primary stops contacted	7.66	INC 19.0 TEU

The adjustable rod-end of the forward push-pull tube on the test aircraft was adjusted to match the visible extension of what was found in the accident airplane. The test airplane was received with one visible thread and was adjusted so that six threads were visible. The forward bell crank forward stop bolt length was also adjusted to 0.93 inches (referencing a similar length from the accident airplane) and the results of these adjustments were measured at the control column and elevator (Ref. Table 12)

Table 12. Relative pitch control system positions, following adjustments to the turnbuckle length, aft rod end, fwd push-pull tube, and forward bellcrank stop bolts:

Test Condition	Control Column (Inches)	Left Elevator Position (Degrees)
Pin in Aft Bellcrank:	3.88	0.8 TEU
Pin in FWD bellcrank: (aft bellcrank not pinned)	4.84	6.1 TEU
Gust lock Pin in Control Yoke Tube	2.84	8.1 TED
No rig pins installed Let Elevator full down (bob-weight stop contacted)	2.37	8.4 TED
Column full aft, Primary: stops contacted	8.25	20.3 TEU

1.33 Pilot Evaluation of the Pitch Control System:

Three Model 1900D type-rated pilots each conducted control sweeps[12], with the primary pitch control system rigged to the AMM. All three pilots were male of average height and build. The sweeps were accomplished so the pilots could get a feel of the system rigged to the AMM. The aircraft's pitch control system components were then adjusted to that of the accident aircraft. The following components were adjusted: Turnbuckles, forward push-pull tube, aft push rod, and forward bellcrank stop bolts. The same three pilots then repeated the control sweeps with no noticeable change in the feel or position of the control wheel.

1.34 Pitch System Evaluation with Gust Lock Pin Installed in Control Yoke Tube:

The positions of the pitch control system components were documented with the gust lock pin installed in the control yoke tube. The gust lock evaluation consisted of two tests.[13]

Test 1. Documentation of pitch control component positions with (1) gust lock pin installed, (2) at rigging found in wreckage, and (3) based upon positioning the elevator trailing edge to fair with the horizontal stabilizer:

NOTE: The primary pitch control system of the test aircraft was previously configured to match the pitch system configuration of the accident airplane. The following primary pitch system components were already adjusted: Turnbuckles, aft push rod, forward push-pull rod, and the forward bellcrank stops.

The gust lock pin was installed into the control yoke tube. The primary pitch control system cable turnbuckles and the left aft pushrod were adjusted until the trailing edge of the left elevator was faired to the stabilizer. The adjustments required:

1. The "DOWN" cable turnbuckle was adjusted so that approximately. 0.3 inch of threads were showing on each terminal.

2. The "UP" cable turnbuckle was shortened such that the terminals touched each other, which was the shortest length possible (5.0 inches).

3. The left elevator aft pushrod length was increased by rotating the rod end 11 turns.

The adjustments resulted in the trailing edge of the elevator faired to the stabilizer. The gust lock pin was removed and the control column was positioned full forward and full aft and the positions along the control path were measured.

[12] A control sweep consists of fully deflecting the flight controls by moving the control column and wheel aft and clockwise and then forward and counterclockwise; this is referred to as a box-shaped pattern.

[13] Note that baseline measurements are contained in Table 9.

(Ref. Table 13) In the full aft position, the left elevator horn contacted its primary up stop.

Table 13. Pitch control system positions with gust lock pin installed:

Column Position	Left Elevator Position (Degrees)	Right Elevator Position (Degrees)
Full Forward	0.5 TED	Data not taken
Gust lock Pin in Control Yoke Tube	Faired to Stabilizer	Data not taken
Full Aft	19.5 TEU	Data not taken

Test 2. Documentation of pitch control component positions with (1) gust lock pin installed, (2) at rigging initially to AMM, and (3) based upon positioning the elevator trailing edge to fair with the horizontal stabilizer:

Prior to accomplishing this test, the forward push-pull rod was adjusted back to its original length, so that one thread was exposed, and the left aft pushrod was shortened back to its original length by rotating the rod end by 11 turns. The resulting aft rod length was 20.68 inch total length. The primary pitch control system cable turnbuckles remained at the following positions:

1. The "DOWN" turnbuckle had approximately. 0.3 inches of threads showing on each terminal.

2. The "UP" cable turnbuckle had the terminals touching each other, which was the shortest length possible (5.0 inches).

The gust lock pin was installed into the control yoke tube, resulting in a 1.0 degree elevator trailing edge down deflection. The aft push/pull rod end was adjusted, by extending the rod end out, by two turns to fair the trailing edge of the elevator to the stabilizer. The gust lock pin was removed and the control column was positioned full forward and full aft to obtain the maximum elevator UP and DOWN deflections available. (Ref. Table 14)

Table 14. Maximum elevator deflections:

Control Column Position	Left Elevator Position (Degrees)	Right Elevator Position (Degrees)
Full forward	4.5 TED	Data not taken
Gust lock Pin in Control Yoke Tube	Faired to Stabilizer	Data not taken
Full aft	19.5 TEU	Data not taken

NOTE: With the control column positioned forward, the bob-weight contacted the stop bolt.

1.35 Cable Routing Evaluation:

In Wichita, the primary pitch control system cables and surrounding areas were examined for potential jam locations. The cables were accessible for examination in three areas: forward bellcrank location, aft cargo bay and in the area of the turnbuckles.

(a) Forward bellcrank:

The elevator cables were found attached to the forward bellcrank; one cable routed aft, and the other cable routed forward, around a pulley, and then aft. The cables moved freely through their full range of travel without interference with structure.

(b) Aft cargo bay;

In this area, no jams or restrictions were found in the travel of the elevator UP or DOWN cable. All the holes through structure in the aft cargo area had plastic grommets. The cables also moved freely through their full ranges of travel without interference with structure.

(c) Turnbuckle Area:

The cables and the area surrounding the turnbuckles had no locations identified in which the cables could interfere with structure throughout the full ranges of travel.

1.36 Elevator Down Spring Removal Evaluation:

This test determined the affects of a disconnected elevator down tension spring on the forces felt at the control column. The control column force was measured and recorded before one of the two springs was disconnected. A force gauge[14] was connected to the First Officer's control wheel. Using the force gauge, the force to pull the control wheel aft was measured; and the force to return the wheel to its forward position was measured. The average of these two forces was calculated and shown in Table 15.

[14] Chatillion model 80D push-pull scale with a 0 to 80 lb scale

Table 15. Column force with both down tension springs attached

Condition	Force Gauge Measurement
Column Pulled Aft	41 lbs
Column Moved Fwd	31 lbs
Average	36 lbs

One of the two elevator down tension springs was removed from the aft bell crank. The spring that remained attached is in the bottom forward hole of the down spring adjustment link (least spring tension). The spring that was removed was also in its bottom hole. The force to move the control column was again measured; the results are shown in Table 16.

Table 16. Column force with one down tension springs removed

Condition	Force Gauge Measurement
Column Pulled Aft	37 lbs
Column Moved Fwd	24 lbs
Average	30.5 lbs

1.4 AILERONS AND AILERON TRIM SYSTEM

The aileron cables were still attached to the sprocket on the forward top ends of the respective control column shafts.

The left aileron including the trim tab was found attached to the wing rear spar. The outboard three feet of this aileron was missing; it was in an area of extensive fire damage. There were splatters of aluminum on the concrete beneath the missing portion of the aileron. The actuator bellcrank was found at the inboard end of the aileron; it rotated freely. The aileron actuator stop bolts were found intact and straight.

The aileron trim mechanism was found with the trim cable on the sixth of the 12 grooves. The distance from the trim actuator body to the flat plate that connects the two actuator shafts (known as the dog bone) was 0.78 inches. The distance from the trim actuator body to the centerline of the actuator rod bearings was 1.980 inches.

The right aileron was fire damaged and almost entirely missing. In the area of the missing aileron structure were splatters of aluminum on the concrete. The actuator bellcrank was found separate from the inboard end of the aileron; it rotated freely. The aileron actuator stop bolts were found intact and straight.

The aileron cable quadrant, located in the center section of the airplane, was found. The bellcrank within the cable quadrant rotated freely. The cables found attached to the bellcrank were the aft cable to the left wing, the forward cable to the right wing, and the aft cable to the right wing. The cables not found attached were the forward cable to the left wing and the two cables that route forward to the cockpit.

1.5 WING FLAP CONTROL SYSTEM:

1.51 Flap System Description:
(With reference to AMM section 27-50-00, Page 001)

The Model 1900D has two flaps on each wing, and the system is driven by an electric motor through a gearbox mounted on the rear spar. The gearbox drives four flexible drive shafts connected to jackscrews at each flap. In the cockpit, the flaps are operated by a sliding lever on the pedestal, located below the condition levers. The flap control selections are UP, 17, and 35 degrees. Flap position is indicated on a flap position indicator located in the center panel.

1.52 Flap System Components Identified at the Accident Scene

(1) Flap Handle:

The flap handle was located within the main wreckage in the forward area of the flight compartment. The handle was intact and extended out of the flap control section of the center panel. After extrication, the flap handle was found at about the FLAPS 35 degree selection.

(2) Flap Position Indicator:

The majority of the flap position indicator was found, separated from the main instrument panel. The majority of the pointer needle was missing and not contained within the indicator. The stub of what appeared to have been the flap indicator needle was oriented to near the full-down position.

(3) Flap Actuators:

The model 1900D aircraft has a total of four flap actuators, one for each flap. All four inboard and outboard flap actuators were found within the main wreckage. Each flap actuator extension[15] was measured at the accident site.. In a letter, 982-03-03-L31/UE-233, dated, March 17, 2003, Raytheon supplied the corresponding "degree of extension" for each flap actuator. (Ref. Table 17)

Table 17. Flap actuator measurements and corresponding extensions:

Actuator Position:	Left Outboard:	Left Inboard:	Right Inboard:	Right Outboard:
Actuator extension (inches):	3.4 inches	4.88 inches	4.99 inches	4.25 inches Actuator housing was partially molten.
Degree of extension	10°	14°	14°	15°

[15] The extension is the distance from the aft edge of the actuator body to the center of the rod end attachment-bearing bolt.

(4) Flap Tracks:

The flap tracks were found within the main wreckage. The tracks were visually examined at the accident site. (Ref. Table 18)

Table 18. Flap track observations:

Left Outboard:	Left Inboard:	Right Inboard:	Right Outboard:
N/A	Inboard track has soot missing and marks in metal of fore and aft track slots at forward end.	N/A	Inboard track was twisted and in an area of fire.
N/A	Outboard track has portion of the flap rib and rollers wrapped around track at ¾ extension	N/A	Outboard track has flap rib with rollers attached and the rollers are in the mid-range of the track. This fragment was burned, distorted, and beneath other debris.

(4) Flap Flexible Drive Shafts:

The flap flexible drive shafts were the subject of AD 2001-18-07 (dated 10/12/2001; effective date of October 12, 2001. The AD stated that the manufactured angles of the compressed wiring in each of the four drive shafts should be inspected, within 200 hours time-in-service (TIS) after the effective date, for correct diagonal wrap and the correct installation. The spiral winding of the four woven cables should all be oriented toward the center of the flap drive gearbox. (Ref. Figure 9.) This AD was accomplished on the accident aircraft on 10-29-2001. (Reference Attachment 4) The aircrafts had a total of 12,534.9 flight hours, and 17,966 flight cycles at the time of the AD inspection.

The four flap flexible drive shafts were located within the main wreckage; they were visually examined at the accident site. As found, the drive shafts for both inboard flaps and the left outboard flap had the spiral windings oriented toward the center of the flap drive gearbox. The drive shaft for the right outboard flap did not have the spiral windings oriented toward the center of the flap drive gearbox as required by AD 2001-18-07.

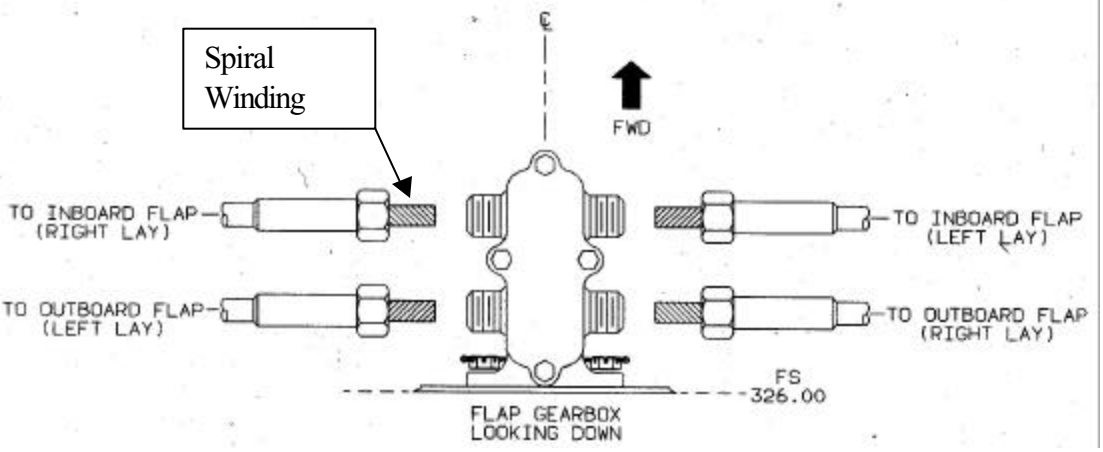


Figure 9. AMM figure, depicting the flap gearbox and flap drive cable orientations

1.6 RUDDER AND RUDDER TRIM SYSTEM:

The rudder trim actuator was found intact and attached to the vertical spar. The distance from the trim actuator body to the connecting (dog-bone) plate was 1.085 inches and from the body to the centerline of the rod end bearings was 2.35 inches. The cable was on the drum and was in the fourth groove from the forward end of ten grooves.

The rudder control bellcrank was found attached to the vertical spar and the control rod was attached.

The rudder trim knob the pedestal was found connected and intact. The Captain's and First Officer's rudder pedals were found separated from the pedal arms.

2.0 LANDING GEAR:

The landing gear handle was located within the main wreckage in the forward area of the flight compartment. The handle was contained within the Captain's lower sub-panel; it was found positioned to "gear down".

The left and right main landing gear were found contained within their respective wing enclosures. Both gear were found in the retracted positions; both oleo struts appeared to be fully extended. Access was cut through structure above the main landing gear and the actuators were found in what appeared to be the extended (gear-up) positions, with 8.25 inch extensions.

The knob in the leading edge of the left wing, for the hydraulic landing gear maintenance valve was found in the stowed position.

3.0 FUEL SYSTEM:

The structure from the area of the left fuel Shut Off Valve (SOV) was missing or heavily damaged by fire and the SOV was not identified. A partially molten fragment of the right fuel SOV was found near the remains of the right nacelle. The fragment included the SOV motor and attachment lever, without the valve body. As viewed with the motor away from the viewer and electrical connector at top, the lever was to the right of center-top.

Robert L. Swaim
Systems Group Chairman

Michael Hauf
Assistant Group Chairman

Attachment List

1. Cockpit Documentation
2. AMM 27-30-01, Page 202, Dated Oct 16/91, Elevator Control System (Effectivity: All), Figure 201
3. Listing of measurements from other Model 1900D airplanes.
4. Maintenance Record Showing AD 2001-18-07 Accomplishment

Attachment 1

Cockpit Documentation

1. Pedestal:

The cockpit center pedestal and power control quadrant were found within the main wreckage in the center of the flight compartment. The pedestal was found deformed and crushed on the First Officer's side. All of the power control levers were contained within the unit. The pitch trim control wheel was found connected to the control shaft rod and quadrant assembly, with out the index-marked facial plate. The positions of indications found at the pedestal were documented. (Ref. Table A)

Table A. Center Pedestal Measurements

Item:	Left Item Measurement:	Right Item Measurement:
Power Levers: The power levers (2) were found deformed into one unit, as far forward as possible. The forward portion of the slot in the sheet metal panel was severely deformed.	3.2 inches	3.2 inches
Propeller Levers: The prop levers were found deformed into each other, and were as far forward as possible. The forward portion of the slot in the sheet metal panel was severely deformed.	1.5 inches	1.7 inches
Condition (fuel) levers: The condition levers were found deformed into each other, and were as far forward as possible. The forward portion of the slot in the sheet metal panel was severely deformed.	3 inches	3 inches
Rudder trim shaft flat (knob missing).	4 O'clock	
Aileron trim:	3 degrees left wing down (Found with the number 3 below the indicator arrow.)	
Note: Lever measurements are from aft edge to the rear of the travel slot. All levers were grossly bent and measurements are approximate.		

2. Indicators:

The Captain's and First Officer's instrument panels were found within the main wreckage in the forward area of the flight compartment. Several of the Captain's indicators were found loose and not contained within the instrument panel; the remaining indicators were generally contained within the instrument panel. All of the First Officer's indicators were found contained within the instrument panel. All of the indicators were found with the front face window covered in blackened material. To determine what the indicators showed, the front face was lightly cleaned using alcohol-moistened wipes. Table B describes the indicators identified and the condition they were found in.

Table B: Captain's and First Officer's Indicators:

Indicators	Captain's (or #1) instruments and displayed value(s)	First Officer's (or #2) instruments and displayed value(s)
Clocks:	[Unrecorded] The clock was found within a section of the instrument panel; separated from the majority of the instrument panel.	8:58 The clock was found within the instrument panel.
Hobbs Meter (flight hour meter)	[Not applicable]	2270.4 flight hours. This meter was found loose in the wreckage, it was not contained within the instrument panel. The glass front face was missing and the meter was heavily sooted.

Altimeters:	[Illegible Display] Found loose in the wreckage and heavily sooted. The front face was unrecognizable.	Altitude - 1500 feet on numeric display Barometric setting 29.735 and 1007.3 millibars. The altimeter was found contained within the instrument panel. The pointer needle was broken, however it was contained within the indicator. The front face glass was intact but cracked. The code window shows red.
Vertical Speed Indicators:	[Illegible Display] The indicator is unreadable, the front face is covered with in melted glass, no pointer needle is present. The indicator was identified by the letters "speed" on the front face. No other letters or numbers were legible.	Needle frozen at -3500 feet per minute, which is the maximum downward indication on the scale. The vertical speed indicator was found contained within the instrument panel. Glass face was intact but cracked. The needle was partially melted against the inside face of the glass.
Cathode ray Tubes for EFIS displays:	[No display] Both units were separated from the instrument panel and without displays.	[No display] The attitude and horizontal situation indicators were both heavily damaged, missing faces, and crushed.

Airspeed Indicator (ASI)	Airspeed pointer needle: 184 knots Max airspeed Needle: 250 knots The front face bezel is intact, glass is shattered, and some internal moisture is present. The unit is heavily blackened and sooted. The instrument marking were barely visible through the glass. Both pointer needles are present. The part number and serial numbers were illegible.	Airspeed pointer needle: 277 knots Max airspeed Needle: 249 knots The front face was cracked and broken, both needles were intact. The dial face numerals were legible.
Radio Magnetic Indicators (RMI):	Compass: "illegible" below lubber line Number 1 Navigation Needle: Tail points to 220 degrees. Head points to 40 degrees. Number 2 Navigation Needle: Tail points to 345 degrees. Head points to 165 degrees. The Captain's RMI can assembly was crushed and torn, the front face bezel assembly is mostly missing, the remaining section of the bezel is melted and gray in color. The two VOR/ADF push buttons are both missing. The dial compass face is discolored and ash gray in color. The numbers on the compass face were readable in the following two locations: at the tail of the #1 pointer needle, and	Compass: 169 degrees below lubber line Number 1 Navigation Needle: Head points to 220 degrees. Number 2 Navigation Needle: Head points to 278 degrees. The RMI bezel and glass front face is missing . The compass card was heavily sooted covered with small pieces of blackened debris. The tip of the power off flag was partially positioned over the dial indicator, approx 1/8 inches. The two VOR/ADF push buttons , which should be located at the bottom right and left corners, are both missing.

	the tail of the #2 pointer needle. A data plate shows the number 28_____8553 and a number of 014.	
Comm Indicators	The Comm 1 indicator is severely damaged.	The comm 2 indicator was damaged, the front face had the glass missing, the toggle switch was missing, both large and small buttons were connected to the unit.
Nav Indicators	The Nav 1 indicator is severely damaged.	The Nav 2 indicator front face glass is broken and partially missing. The toggle switch is positioned to down. Both knobs were blackened and connected to the indicator.
Standby Attitude Indicator:	The indicator displayed 35 degrees pitch down and 50 degrees right bank. This indicator was found intact and contained within the instrument panel. The cage knob is bent, the outside glass face is intact (not broken) however, the inner glass is shattered into several pieces. The red flag (power) was in view. The indicator was removed from the instrument panel. The can assembly is slightly dented.	

Altitude alert panel	Severely damaged, with the face plate warped and heavily sooted

3. Engine Instruments:

The engine indicator panel was found in the cockpit and attached to the instrument panel. Most of the gauges were found loose and not contained within the panel. The Raytheon Aircraft Company (RAC) electrical wiring diagram was used to determine the indicator position based on the reference designator written on those wire tags that were attached. Table C describes the indicators identified and the condition that they were found in.

NOTE: There are two columns of engine gauges in the instrument panel. Table C identifies the "Number 1" as a gauge on the left and "Number 2" as a gauge to the right, unless otherwise indicated.

Table C. Engine Instruments

Engine Indicator		
ITT	Number 1 ITT: **Indication:** Could not be determined **Description:** The gauge was contained within the instrument panel. The front face of the gauge was severely crushed and missing the glass face.	Number 2 ITT: **Indication:** Could not be determined **Description:** The gauge was found separated from the instrument panel. The part number and serial number on the data plate is P/N 41-401-1, S/N 465. The glass face and needle are missing. The can assembly was dented in several places.
Torque	Only one Torque Gauge was found, and the panel position was not identified. **Indication:** Could not be determined **Description:** The case was dented, and the front face was sooted and cracked. The glass front face and the pointer needle and shaft were missing. The serial number was unreadable.	
Prop Rpm Two gauges were found, however, the position of either gauge could not be determined. Positions shown are for reference only and do not relate to panel position.	**Indication:** 1500 rpm. **Description:** Data tag shows "Aero Mach Labs", work order number shows 1655. Front face glass is missing. The face plate is warped and heavily sooted and broken in three places.	**Indication:** Could not be determined **Description:** The glass front is missing from the indicator, and the face plate is broken in several places, and heavily sooted. The pointer needle is missing, no apparent needle marks on the face. A number was found on the side of the indicator and reads "194108".

Turbine Rpm	Number 1 Engine Indicator **Indication:** Could not be determined **Description:** N1 RPM indicator has M102 wire tag, indicating the number 1 indicator. The glass was shattered and partially missing, the faceplate is heavily blackened and sooted. The can assembly was dented and deformed. There was a broken piece of the faceplate under the pointer needle. The head of the pointer needle was pointing to approximately 75%.	Number 2 Engine Indicator **Indication:** Could not be determined **Description:** The front part of this gauge was missing, including the glass face. The indicator face was slightly warped, and the needle was missing. The digital display glass was intact. The can assembly was mostly intact but loose wiring protruded out of the case. The wire tag attached reads M103, which indicates that this is the number 2 engine indicator.
Fuel Flow	Number 1 Fuel Indicator **Indication:** Could not be determined **Description:** Case heavily dented, blackened, and the glass is missing. The face was severely damage and unreadable. The pointer needle is melted. The number 2 fuel flow indicator was identified by the number on the wire tag, defaulting the position of this gauge to number 1 engine indication.	Number 2 Fuel Indicator **Indication:** The needle was present, but covered with debris and the shaft was loose. **Description:** This indicator was found separate from the wreckage and a wire tag was marked M111, indicating that this is the number 2 fuel flow indicator. The case was dented, the bezel was missing, and the glass was missing. The faceplate was heavily sooted. Serial Number was marked as 401080. The legible portion of the Part Number was 130-380010-(?).

Oil Temp / Pressure	Number 1 Oil Indicator **Indication:** Could not be determined **Description:** Case of the indicator is dented and deformed. A wire tag attached has M106 marked, indicating that this is the number 1 oil temp/pressure gauge. Glass face missing, the face plate is blackened, no pointer indicator, and the shaft is broken. A blackened and melted piece of debris was on the zero psi mark.	Number 2 Oil Indicator **Indication:** Could not be determined **Description:** Case of the indicator is dented and deformed. A wire tag attached has M107 on it, which indicates that this is the number 2 oil temp/pressure gauge. Glass face missing, the face plate is blackened, and slightly deformed. The PSI pointer needle indicated below bottom red radial approximately 50 PSI.

4. Switch Control Panels

Overhead Panel:

A partial overhead meter panel assembly was found within the wreckage and was severely damaged. The overhead light control panel was not found.

Circuit Breaker Panel:

The right hand circuit breaker panel was found within the wreckage, aft of cockpit area with severe impact and fire damage.

The under-floor circuit breaker panel was found within the wreckage with severe impact and fire damage.

Fuel Control Panel:

A partial fuel control panel was found within the wreckage; It was severely damaged, all of the meters were missing.

Sub Panels:

The cockpit sub panels were found in the wreckage in the area of the cockpit. The panels were removed from the wreckage prior to noting switch positions and loose or dislodged switch and lever indications may have occurred during the removal.

Captain's Sub-Panels:

Table D describes the switch and lever positions as found on the Captain's lower left sub-panel. Table E describes the switch and lever positions as found on the Captain's lower right sub-panel.

First Officer's Sub-Panels:

The lower left panel was found loose within the wreckage in the area of the cockpit. This panel was heavily sooted, deformed, and all of the lower right gauges were found missing. Table F describes the switch and lever positions as found. The lower right panel was found severely damaged, some meters were missing.

Audio Panel:

The audio panel was found attached to the instrument panel, however, it was severely damaged and no switch positions could be determined.

Center Display Panel:

The center display panel was found attached to the instrument panel, Table G shows the gauge indications as found.

Table D. Captain's Lower Left Sub-Panel:

Switch function	**Switch Position**
EXT PWR	Off
AC BUS – Left	Broken
AC BUS – Right	Broken
ENG AUTO IGNITION- Left	Broken
ENG AUTO IGNITION-Right	Off
Gang bar switches	All three positioned Off
ENG ANTI-ICE – Left	Off
ENG ANTI-ICE –Right	Off
ACTUATORS – Left	Standby
ACTUATORS – Right	Main
IGNITION AND ENGINE START –L	ON
IGNITION AND ENGINE START –R	ON
Avionics switch	Off
Bus Sense reset	Norm
Gen Tie Manual Close	Norm
PROP TEST	Off
AUTOFEATHER	Armed

Table E, Captain's Lower Right Sub-Panel

Switch function	Switch Position
ICE PROTECTION (section)	N/A
DEFROST AIR	N/A
LDG GR CONTROL	Down
WARN HORN	N/A
LANDING GEAR	N/A
DOWN LOCK REL	N/A

Table F. First Officer's Lower Left Panel

Switch/Gauge	Switch/Gauge Position
BLEED AIR VALVES Left	OPEN
BLEED AIR VALVES Right	ENVIR OFF
CABIN TEMP (gauge)	Gauge Missing
BLOWERS	HI
MAN TEMP	Normal
OVERSPEED WARNING TEST / STALL WARN TEST	Normal
ENG FIRE TEST (section)	Normal
Temp switch	Missing
Environmental mode switch	Manual

Table G. Cockpit Lower Center Display Panel

Flap Position Indicator:	The flap position indicator was found with the glass front face missing and position needle broken off. The center post was intact and had a fracture surface that was approximately the same width as the position needle. The position of the fracture surface was pointing in the direction of "flaps full down position of 35 deg." The faceplate of the indicator was intact and numbers and words were readable.
Cabin rate of climb	Unreadable
Cabin Altitude	50 feet/0 differential.

5. Oxygen Mask:

A relatively intact cockpit-style oxygen mask was found loose in the cockpit area.

6. Fire Handles:

The fire pull handles were not connected to the instrument panel.

7. Annunciators:

Various loose annunciators were found from the caution advisory panel, glareshield warning panel, and instrument panel. Most of the annunciators were severely damaged.

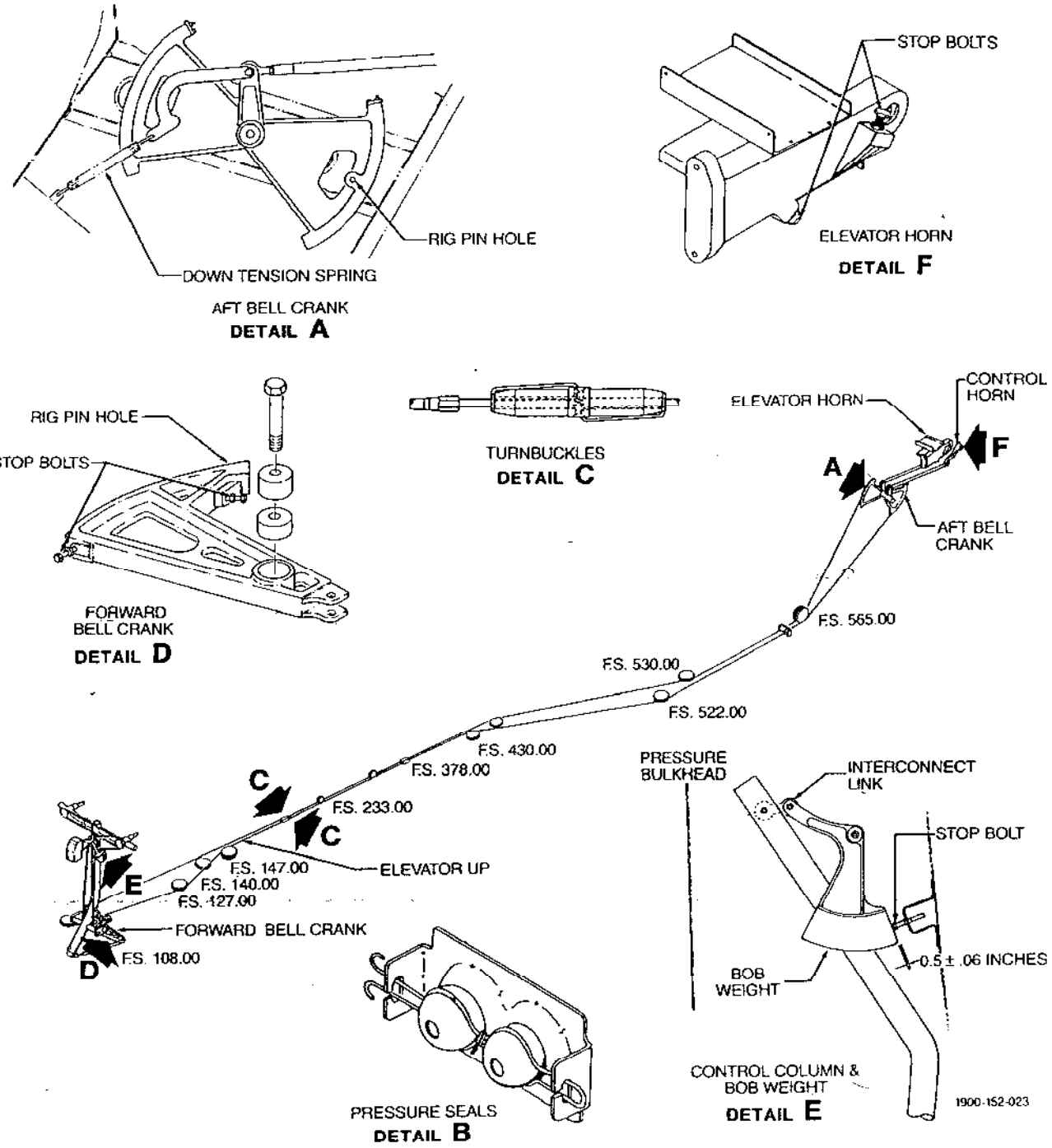
The TCAS display was crushed, heavily sooted, the face plate was hanging by a wire. The test buttons were melted, the on and off buttons were missing.

8. Compass:

The shell of the liquid (also known as “whiskey”) compass was found within the main wreckage in the cockpit area. The internal components were severely damaged and the gauge was unreadable.

Attachment 2

Airliner Maintenance Manual (AMM) 27-30-01, Page 202, Dated Oct 16/91, Elevator Control System



Elevator Control System (Effectivity: All)
Figure 201

Attachment 3

Control System Listing

ATTACHMENT 3, PAGE 2 OF 4

Swaim Bob

From: Ward Lorenda
Sent: Thursday, February 27, 2003 12:40 PM
To: Swaim Bob; Hauf Michael
Subject: FW: Turnbuckle Length for UE-167

ELEVATOR CO
FCD01-23-03.xls

-----Original Message-----
From: Aiken, James [mailto:James.Aiken@mesa-air.com]
Sent: Thursday, February 27, 2003 12:35 PM
To: 'wardl@ntsb.gov'
Subject: Turnbuckle Length for UE-167

Lorenda,
I looked up the turnbuckle length on Aircraft UE-167. The "ND TB" was miss-entered it should read 6.75 as corrected in this attachment.

<<ELEVATOR CO
FCD01-23-03.xls>>

Jim Aiken
Director of Safety, Air Midwest
316-944-2541

CO 01-23	CO 01-24	CO 01-25	CO 01-26	FCD 01-23			
ACFT	Date of D6	LOC of D6	CO / FCD	UP TB	DN TB	L UP STOP	L DN STOP
UE-6	09/02/2002	DUJ	01/24/2003	6 1/4	6 1/4	OK	OK
UE-13	10/28/2002	PFN	01/24/2003	6 1/5	6 3/4	1/8"	1/8"
UE-161	08/30/2002	DUJ	01/25/2003	6.81	6.3	OK	1/4"
UE-166	12/25/2002	DUJ	01/26/2003	6.5	6.32	OK	1/4.
UE-167	09/24/2002	HTS	01/23/2003	6 1/4	6 3/4	OK	1/8.
UE-174	08/20/2002	DUJ	01/23/2003	6 3/4	6.1/2	OK	1/8"
UE-182	07/07/2002	PFN	01/23/2003	6 3/4	6 1/4	1/4"	OK
UE-190	07/20/2002	DUJ	01/23/2003	6 1/3	6 9/10	OK	1/8"
UE-229	10/25/2002	HTS	01/24/2003	6.84	6.44	OK	1/2"
UE-237	10/07/2002	DUJ	01/23/2003	6.94	6.3	OK	0.25
UE-242	01/05/2003	DUJ	01/26/2003	6.4	6.7	OK	0.25
UE-244	11/04/2002	DUJ	01/26/2003	6.53	6.13	OK	0.25

ACFT	Date of D6	LOC of D6	CO / FCD	UP TB	DN TB	L UP STOP	L DN STOP
UE-3	11/18/2002	FMN	01/25/2003	6 7/16	6 1/8	OK	OK
UE-5	10/14/2002	LIT	01/23/2003	6 5/16	6 5/16	OK	OK
UE-15	08/24/2002	ICT	01/24/2003	6 1/2	6 1/4	OK	OK
UE-26	09/05/2002	DUJ	01/25/2003	6 3/8	6 5/8	OK	OK
UE-123	07/31/2002	PFN	01/23/2003	6 1/4	6 3/4	OK	OK
UE-126	12/28/2002	FMN	01/23/2003	6.5	6.5	OK	OK
UE-127	12/04/2002	LIT	01/24/2003	6 1/2	7	OK	OK
UE-131	08/18/2002	ICT	01/23/2003	6 3/16	6 9/16	OK	OK
UE-132	07/25/2002	FMN	01/23/2003	6 7/10	6 1/10	OK	OK
UE-133	08/03/2002	ICT	01/25/2003	6 1/2	6 1/2	OK	OK
UE-135	07/18/2002	DUJ	01/23/2003	6 5/8	6 1/8	OK	OK
UE-139	08/22/2002	PFN	01/23/2003	6 1/4	6 1/3	OK	OK
UE-140	09/27/2002	LIT	01/24/2003	6 1/3	6 1/4	OK	OK
UE-142	07/13/2002	FMN	01/23/2003	6 3/4	5 5/8	OK	OK
UE-143	12/30/2002	LIT	01/26/2003	6 1/4	6 1/2	OK	OK
UE-144	06/20/2002	DUJ	01/23/2003	6 1/4	6 1/4	OK	OK
UE-146	09/15/2002	FMN	01/23/2003	5 5/8	6 1/4	OK	OK
UE-155	11/23/2002	DUJ	01/23/2003	6.61	6.459	OK	OK
UE-159	11/20/2002	FMN	01/24/2003	6 1/16	5 7/8	OK	OK
UE-162	12/12/2002	PFN	01/24/2003	6.5	6.1	OK	OK
UE-163	07/30/2002	PFN	01/25/2003	6 1/2	6 5/8	OK	OK
UE-165	10/27/2002	LIT	01/26/2003	6 1/4	6 1/5	OK	OK
UE-171	06/10/2002	DUJ	01/23/2003	5 3/4	6 7/16	OK	OK
UE-173	10/11/2002	HTS	01/24/2003	6 5/32	6 1/2	OK	OK
UE-176	07/12/2002	PFN	01/24/2003	6 1/2	6 1/2	OK	OK
UE-178	06/29/2002	DUJ	01/24/2003	6 1/3	6 2/3	OK	OK
UE-213	10/27/2002	PFN	01/26/2003	6 3/4	7 1/4	OK	OK
UE-218	10/24/2002	PFN	01/25/2003	6 9/10	6 1/3	OK	OK
UE231	12/19/2002	DUJ	01/26/2003	6.55	6.23	OK	OK

ACFT	Date of D6	LOC of D6	CO / FCD	UP TB	DN TB	L UP STOP	L DN STOP
UE-138	10/04/2002	DUJ		6.55	5.9	OK	OK

R UP STOP	R DN STOP	NEED CO	Days out of D6	Adj last D6	STOP BOLT	Travel	REV 1
OK	0.2		142	N	NO	OK	OK
OK	1/8"		86	N	NO	OK	OK
OK	OK	X	146	Y	OK		
OK	1/4.		28	N	NO	NO	OK
OK	1/8.		120	N	OK	OK	OK
OK	1/8"		155	Y	NO	OK	X
OK	OK		169	N	NO	OK	X
OK	OK		156	Y	NO	OK	X
OK	1/2"		89	Y	NO	NO	OK
OK	0.25		107	N	OK	OK	OK
OK	0.25		24	Y	OK	OK	OK
0.25	0.25		79	N	OK	OK	OK

R UP STOP	R DN STOP	NEED CO	Days out of D6	Adj last D6	STOP BOLT	Travel	
OK	OK		65	N	OK	OK	OK
OK	OK		98	N	OK	OK	X
OK	OK		152	N	OK	OK	OK
OK	OK		140	Y		OK	OK
OK	OK		176	N	OK	OK	TS
OK	OK	X	25	Y	OK	OK	
OK	OK		51	Y	OK	OK	OK
OK	OK		157	N	OK	OK	X
OK	OK		151	N	OK	OK	TS
OK	OK		173	N		OK	OK
OK	OK		158	N	OK	OK	X
OK	OK		138	N	OK	OK	X
OK	OK		117	N	OK	OK	OK
OK	OK		153	N	OK	OK	TS
OK	OK		26	N	OK	OK	OK
OK	OK		217	N	OK	OK	OK
OK	OK		129	N	OK	OK	X
OK	OK	X	189	N	OK		
OK	OK		73	N	OK	OK	OK
OK	OK		53	Y	OK	OK	OK
OK	OK		146	N	OK	OK	OK
OK	OK		87	N		OK	OK
OK	OK		227	N		OK	X
OK	OK		103	N	NO	OK	OK
OK	OK		164	N	OK	OK	OK
OK	OK		226	N	NO	OK	OK
OK	OK		86	Y	OK	OK	OK
OK	OK		90	N	OK	OK	OK
OK	OK		53	N	OK	OK	OK

R UP STOP	R DN STOP	NEED CO	Days out of D6	Adj last D6	STOP BOLT	Travel
OK	OK	X	74	N	OK	OK

Attachment 4

Maintenance Record Showing AD 2001-18-07 Accomplishment

FORM 5M001 UnAirways/Express/ Air MidWest PAGE 1 of 1
DATE 10/29/01 AIRCRAFT MAINTENANCE RECORD ICT W/OE 05-1011039043

AIRCRAFT #: UX332 N233YV MAKE/MODEL: RSECHCRAFT MODEL 1900

AUDIT: 6 FILE:

ACFT F.H.M: 3465.8 ACFT T.T: 12534.9 CYCLES: 17766

DISCREPANCY NATURE OF ACTION

1 C/W AD 2001-18-07 IAW SB 27-3397 FLAP FL C/W AD 2001-18-07

EX SHAFT INSPECTION MRL/CTGY 27-20 / IAW SB 27-3397 FLAP FLEX SHAFT INSP

000 PT/SN: DATE: 10-29-01 MECH: INSP: N/A

2

PT/SN: THIS AMR HAS BEEN REVIEWED AND ALL GROUNDING ITEMS HAVE BEEN CORRECTED. ALL DEFERRED MAINTENANCE ITEMS HAVE BEEN TRANSCRIBED TO THE DOL. ALL AD'S HAVE BEEN COMPLIED WITH. ALL REQUIRED INSPECTION ITEMS ARE COMPLETE, AND ALL WORK WAS DONE IAW AIR MIDWEST, INC.'S MANUALS, PROCEDURES AND POLICIES. THE AIRCRAFT/ COMPONENT DESCRIBED HEREON IS AIRWORTHY.

SIGNATURE:

PT/SN: STAMP: MECH: DATE INSP: OCT 29 2001

4

PT/SN: MECH: INSP:

5

PERMANENT RECORD

PT/SN: DATE: MECH: INSP:

6

PT/SN: DATE: MECH: INSP: