DOCKET NO: SA-510

EXHIBIT NO: 9AC

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

BOEING CORRESPONDENCE REGARDING DIRECTIONAL UPSETS AND SERVO VALVE DESIGN

Boeing Commercial Airplane Group
P.O. Box 3707
Seattle, WA 98124-2207

(1)

January 12, 1995
B-U01B-15088-ASI

Mr. Greg Phillips, AS-40
National Transportation Safety Board
490 L'Enfant Plaza East SW
Washington DC 20594-2000

BOEING

Subject: USAir 737-300 Accident, N513AU/PP033 Near Pittsburgh, September 8, 1994 - System Data

Reference: a) Your letter to Rick Howes, December 22, 1994
b) Telecon Phillips/McGrew, Howes, January 4, 1995

Dear Mr. Phillips:

In the reference (a) letter you requested certain data to support the investigation of the subject accident. I am repeating each of your requests for information prior to each of our responses below. In reference (b), you agreed to delete item number 13 from the reference (a) letter, and that we could blockout information that identifies our customers in order to accommodate database agreements that we have with our customer airlines.

Information marked "PROPRIETARY" being forwarded to the NTSB by or with this correspondence is for the exclusive purpose of supporting investigative activities, is considered proprietary to The Boeing Company, and is being provided on a confidential basis. We do not authorize dissemination of this material to the public. The data provided should be returned to Boeing immediately following use by the NTSB, including any copies thereof which the NTSB may be required to make in the course of its review. Boeing does not authorize the NTSB to retain any portion of the materials being supplied.

1. Please provide a list of lateral and directional control system upsets (deviation from the intended flight path) involving the Boeing 737 series airplanes that resulted in a precautionary landing or report by the flight crew. All upsets from January 1, 1985 through the most current date possible should be reported. Boeing may elect to use the most complete source of data available (BOECOM reports or reliability and maintainability database) that can be searched by automated means. The list should include: circumstances of the upset, aircraft type, operator, date of upset and corrective action to the aircraft and component.

   Response: The information requested is provided in enclosure A. (Note: This enclosure includes information on upsets that occurred on dates earlier than 1985, because we were able to do an automatic data search on our reliability and maintainability data base that originated in 1970.)

2. Please provide a list of all known upsets involving the Boeing 737 series airplanes that resulted in deviation from the normal operation of the airplane as result of jamming of the main rudder power control unit servo valve or blockage of servo valve control ports. All upsets from January 1, 1985 through the most current date possible should be reported. Boeing may elect to use the most complete source of data available (BOECOM reports or reliability and maintainability database) that can be searched by automated means. The list should include: circumstances of the upset, aircraft type, operator, date of upset and corrective action to the aircraft and component.

   Response: Boeing is not aware of any such event. (Note: Boeing is aware of one jam event that occurred during the landing roll and thus did not involve and "upset" (i.e., a "deviation from the intended flight path"). A description of this event is provided in enclosure B. (Note: This enclosure includes information on an upset that occurred on a date earlier than 1985, because we were able to do an automatic data search on our reliability and maintainability data base that originated in 1970.)

3. Please provide a copy of the component qualification test report for the Boeing 737 series main rudder power control unit.

   Response: A copy of this report is provided in enclosure C.

4. Please provide a copy of the failure analysis for the Boeing 737 that supports the basis for the airplane's FAA Federal Aviation Regulation certification compliance.

   Response: A copy of this analysis is provided in enclosure D.

5. Please provide a listing of all usage of dual concentric slide hydraulic servo control valves used on Boeing aircraft. Along with this listing, please provide the input force available to each dual concentric servo valve used on the Boeing 737 series airplanes.

   Response: The information requested is provided in enclosure E.

6. Please provide a copy of any documentation that Boeing has that indicates that the main rudder power control unit was tested with particulate contamination as a design consideration.

   Response: From industry and our service experience, particulate contamination has been accommodated in the design by filtration of fluid in the hydraulic system with recommended intervals for filter replacement. Therefore, Boeing does not have any documentation of tests with high particulate contamination other than the test that is being developed for this investigation by the NTSB Systems Group.

7. Please provide a copy of any documentation that Boeing has that provides a failure analysis of the internal components (slides, summing levers, yaw damper system components, etc.) and any chip shear testing performed on the servo valve of the Boeing 737 series main power control unit.

   Response: Available information that you have requested is contained in enclosure D.

8. Please provide copies of all Boeing reports of examinations and findings related to the Continental Airlines B737 upset that occurred near San Pedro Sula Honduras, on April 11, 1994.

   Response: The information requested is provided in enclosure F.

9. Please provide copies of Boeing's changes to the B737 operational procedures concerning the yaw damper opertaion.

   Response: (Satisfied by letter B-U01B-15047-ASI, Purvis, dated December 13, 1994.)

10. Please provide copies of any visual aid or computer simulation model that depicts the Boeing 737 series directional control system, including the main rudder power control unit and servo valve.

    Response: A CATIA model of the main rudder power control unit (RPCU) installation is currently being developed by Boeing as a visual aid exhibit for the public hearing beginning January 23, 1995 in Pittsburg. Also, we are planning to include a cross-sectional model of the servo valve for the RPCU as an exhibit to the hearing. We are planning to bring a VHS video of each to the pre-hearing conference in Washington, D.C. on January 19, 1995 for your review.

11. Please provide any documentation that Boeing has concerning damage to the servo control valves of either single or dual slide design.

    Response: The information requested is provided in enclosure G. Additional information may be available at manufacture and overhaul agencies for servo control valves.

12. Please provide copies of all Boeing reports and findings and associated documentation concerning the British Airways, G-BNLY, B747-400 upset on departure from London's Heathrow Airport on October 7, 1993.

    Response: The information requested is provided in enclosure H.

(4)

If you have any questions, please contact Rick Howes, [redacted]

Very truly yours,

FLIGHT TEST

[redacted]

John W. Purvis
Director, Air Safety Investigation
Org. B-U01B, M/S 14-HM
Telex 32-9430, STA DIR PURVIS
[redacted]
Fax (206) 655-8533

Enclosures:

A. Boeing *Significant Items Report System (SIRS) Extract (1970-94) Lateral/Yaw Upsets*, January 12, 1995
B. Description of 737-200 Rudder "hard right" event, January 27, 1974
C. Bertea Corporation Qualification Test Report No. 1152, Rudder Power Control Unit Assembly for Model 737 Airplanes, Boeing Part No. 65-44861-1 and -2, dated November 14, 1968
D. Boeing *Failure Analysis of the 737 Rudder Control System,* Document No. D6-14072, Revision G dated July 25, 1988
E. Boeing data, *Dual Concentric Hydraulic Control Valves*, one sheet, and *Minimum Pilot Force Available at Control Valve Slide*, one sheet
F. Boeing Correspondence, component examination reports and FDR data for the CAL Upset, San Pedro Sula, Honduras, April 11, 1994
G. Boeing *Significant Items Report System (SIRS) Extract on 737 Servo Control Valve Damage*, January 12, 1995
H. Correspondence with Boeing for the BAB 747-400 Elevator Incident, October 7, 1993:
   (a) AAIB Letter EW/C93/10/3, David King to John Purvis, dated 11 April, 1994
   (b) B-U01B-14758-ASI with enclosures, Dated May 12, 1994
   (c) Telex correspondence between Boeing and British Airways
   (d) B-U01B-15020-ASI, Dated Nov 28, 1994
   (e) B-U01B-15028-ASI, Dated Dec 1, 1994
   (f) AAIB Letter EW/C93/10/026, T. J. Mountford to J. Purvis, Dated Dec 14, 1994

cc: Tom Haueter, AS-10 (letter only)

Boeing Commercial Airplane Group
P.O. Box 3707
Seattle, WA 98124-2207

(5)r

January 19, 1995
B-U01B-15103-ASI

Mr. Greg Phillips, AS-40
National Transportation Safety Board
490 L'Enfant Plaza East SW
Washington, DC 20594-2000

BOEING

Subject: USAir 737-300 Accident, N513AU/PP033 Near Pittsburgh, September 8, 1994 - System Data

Reference: a) Discussion Phillips/McGrew,Purvis,Howes January 19,1995
b) Boeing Letter B-U01B-15088-ASI dated January 12, 1995

Dear Mr. Phillips:

In reference to your question of January 19, 1995 (Reference a) regarding the public disclosure of the proprietary data submitted to you by our letter of Reference b, we provide the following instructions:

Item 1 (Enclosure A of Reference b): You may disclose the event summary table, less the column referencing the SIRS data. The SIRS provided as backup to the summary may not be made public, though you may condense or summarize the data included as it relates to the accident under investigation. Under no circumstances may you disclose the operators in the SIRS.

Item 2 (Enclosure B of Reference b): You may disclose the information contained therein.

Item 3 (Enclosure C of Reference b): This is supplier proprietary data. Any NTSB release of supplier data must be cleared separately with that supplier.

Item 4 (Enclosure D of Reference b): You may not disclose these data. You may condense or summarize the data included as it relates to the accident under investigation.

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Item 5 (Enclosure E of Reference b): You may disclose the information contained therein.

Item 6: You may disclose the information contained therein.

Item 7 (Enclosure D of Reference b): You may not disclose these data. You may condense or summarize the data included as it relates to the accident under investigation.

Item 8 (Enclosure F of Reference b): You may disclose the Boeing information contained therein. Any NTSB release of supplier data contained in this enclosure must be cleared separately with that supplier.

Item 9: You may disclose the information contained therein.

Item 10: You may disclose the visual aides provided.

Item 11 (Enclosure G of Reference b): You may disclose the cover sheet of this item. The SIRS provided as backup to the summary may not be made public, though you may condense or summarize the data included as it relates to the accident under investigation. Under no circumstances may you disclose the operators in the SIRS.

Item 12 (Enclosure H of Reference b): You may disclose the information contained therein.

If you have any questions, please contact Rick Howes ([redacted]
or me.

Very truly yours,

FLIGHT TEST

BOEING [redacted]

John W. Purvis
Director, Air Safety Investigation
Org. B-U01B, M/S 14-HM
Telex 32-9430, STA DIR PURVIS
[redacted]
Fax (206) 655-8533

cc: T. Haueter AS-10

(9)

737 SIGNIFICANT ITEMS REPORT SYSTEM (SIRS) EXTRACT (1970-94) LATERAL/YAW UPSETS

DATE	MODEL	CIRCUMSTANCES	MAINTENANCE ACTION
700106	200	A/C FISHTAILS LEFT AND RIGHT WITH A/P ON OR OFF	R&R MAIN RUDDER PCU
700112	200	AIRPLANE FISHTAILS AT CRUISE - Y/D OVERACTIVE	R&R MAIN RUDDER PCU
700129	100	SUDDEN HARD YAW/ROLL DUE TO HARDOVER Y/D	R&R Y/D COUPLER AND ADC
700409	200	Y/D HARDOVER JUST PRIOR TO TOUCHDOWN	UNKNOWN
700513	200	Y/D KICKS LEFT/RIGHT WITH AUTPOILOT ON/OFF	R&R MAIN RUD PCU
710105	200	UNCOM RUD INPUTS ON T/O & CLIMB - OK W. Y/D OFF	UNKNOWN
710111	200	IN CRUISE AT 31K, RUD KICKED SEVERAL TIMES	WATER FOUND IN Y/D COUPLER CONN.
710120	200	A/C HAD TWO INCIDENTS OF VIOLENT FISHTAILING	R&R Y/D COUPLER
710217	200	2 CASES OF SEVERE INFLIGHT RUD EXCURSIONS	R&R Y/D COUPLER
710314	200	Y/D DEFLECTION ON T/O	WATER FOUND IN Y/D COUPLER CONN.
710523	200	AFTER TURBULENCE, VIOLENT YAWING - OK W. Y/D OFF	R&R Y/D COUPLER
710703	200	AT 10K, LEFT RUDDER HARDOVER	R&R Y/D COUPLER
710806	200	Y/D INDUCED VIOLENT INPUTS	R&R Y/D COUPLER
710806	200	LATERAL OSCILLATIONS DURING/AFTER FLAP RETRACT	REPAIRED Y/D COUPLER
710916	200	Y/D CAUSES ERRATIC RUD INPUTS & FISHTAILING	R&R Y/D COUPLER
710926	200	Y/D GAVE FULL DEFLECTION ON T/O	R&R Y/D COUPLER
711015	200	IN CLIMB AT 3500, FULL RT RUD DEFLECTION	WATER FOUND IN Y/D COUPLER CONN.
711022	200	ON LDG FLARE, A/C WENT INTO UNCONTROL DUTCH ROL	R&R Y/D COUPLER
711031	200	A/P FISHTAILS WITH Y/D ENGAGED AT HIGH SPEEDS	R&R Y/D COUPLER
711210	200	Y/D ERRATIC ON APPROACH	R&R Y/D COUPLER
720202	200	SEVERE/VIOLENT RUDDER MOTION DURING CLIMBOUT	R&R Y/D COUPLER
720205	200	CREW REPORTED THREE VIOLENT YAWS	R&R Y/D COUPLER
720401	200	RUDDER KICKS, OSCILLATIONS, FISHTAILING	R&R Y/D COUPLER
720623	200	RUDDER KICKS, OSCILLATIONS, FISHTAILING	R&R Y/D COUPLER
720624	200	RUDDER KICKS, OSCILLATIONS, FISHTAILING	R&R Y/D COUPLER
720702	200	RUDDER KICKS, OSCILLATIONS, FISHTAILING	R&R Y/D COUPLER
720727	200	RUDDER KICKS, OSCILLATIONS, FISHTAILING	R&R Y/D COUPLER
720803	200	RUDDER KICKS, OSCILLATIONS, FISHTAILING	R&R Y/D COUPLER
720808	200	ON T/O, VIOLENT RUDDER INPUT DUE TO Y/D	R&R Y/D COUPLER
721207	200	IN CRUISE, HAD VIOLENT RUDDER HARDOVER	UNKNOWN
730104	200	AFTER LIFTOFF, APL EXPERIENCED VIOLENT YAW	UNKNOWN
730123	200	RUDDER KICKS, OSCILLATIONS, FISHTAILING	R&R Y/D COUPLER
730301	200	A/C HAS INTERMITTENT FISHTAILING	R&R MAIN RUDDER PCU

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737 SIGNIFICANT ITEMS REPORT SYSTEM (SIRS) EXTRACT (1970-94) LATERAL/YAW UPSETS

DATE	MODEL	CIRCUMSTANCES	MAINTENANCE ACTION
730527	100	REPEATED PILOT REPORTS OF Y/D DISCREPANCIES	R&R MAIN RUDDER PCU
730727	200	AFTER T/O, AIRPLANE FISHTAILS	R&R MAIN RUDDER PCU
730814	200	ON CLIMB AT 12K, APL YAWED VIOLENTLY LT/RT/LT	R&R Y/D COUPLER
730816	200	IN CRUISE AT 29K, MOD TO SEVERE Y/D MOTION	PUT APU ON NO.1 BUS - Y/D THEN OK
730816	200	IN CRUISE AT 29K, RUD SLOWOVER, THEN HARDOVER	R&R Y/D COUPLER AND ADC
730822	200	ON CLIMBOUT, RUD SLOWOVER, THEN HARDOVER	R&R MAIN RUD PCU
731114	200	ON LIFTOFF, Y/D PUT IN HARD LEFT RUDDER	R&R Y/D COUPLER, A/P ACCESS UNIT
731123	200	ON LIFTOFF, Y/D PUT IN HARD LEFT RUDDER	MULTIPLE COMPONENTS REPLACED
740111	200	REPEATED PILOT REPORTS OF A/C FISHTAILING	R&R MAIN RUDDER PCU
740127	200	ON TOUCHDOWN AT 100 KTS, A/C HAD HARD RT RUD	R&R MAIN RUD PCU (SHOT PEEN BALLS)
740619	100	AFTER FLAPS UP, APL ROLLED LEFT DUE TO Y/D H/O	R&R Y/D COUPLER + OTHER PARTS
760106	200	IN CRUISE AT 33K, HAD RUD KICK - HARD YAW/ROLL	UNKNOWN
760108	200	ON PREFLIGHT, HIGH PEDAL FORCES REQ'D	FOUND INPUT SHAFT JAM IN STDBY
760216	200	RUDDER KICK AT 11K - CAUSED HOSTESS INJURY	R&R MAIN RUDDER PCU
770826	200	ON TAXI, RUD PEDAL MOVED HALFWAY IN AND JAMMED	RUD PCU CONTAM W. PARTICLES
780207	200	AS GEAR RETRACTED, APL BANKED RT 30 DEG	NO DISCREPANCIES FOUND
780814	200	ON CLIMB AT 12K, VIOLENT YAW LEFT/RIGHT/LEFT	UNKNOWN
781007	200	AUTOPILOT ROLLS APL 10 DEG UPON ENGAGEMENT	R&R ROLL CHANNEL
781225	200	APL YAWS VIOLENTLY - OK WITH Y/D OFF	R&R Y/D COUPLER
800128	UNK	MAIN RUD PCU - FORTNER VALVE INCIDENT	MAIN RUD PCU OVERHAULED
800222	200	Y/D KICKS RIGHT WHEN PITCH AUTOPILOT ENGAGED	R&R MAIN RUD PCU
800303	200	AT 24K, 320 KTS, Y/D KICKED RUDDER HARD RIGHT	R&R Y/D COUPLER
800319	200	TWO TIMES, Y/D CAUSED HARD RIGHT RUD DEFLECT.	R&R Y/D COUPLER
801215	UNK	RANDOM NO-VIOLENT RUDDER KICKS	UNKNOWN
810427	200	AIRPLANE TURNED LEFT UPON AUTOPILOT ENGAGEMENT	R&R Y/D COUPLER
810715	200	AT 1800 FT, RUDDER DEFLECTED HARD RIGHT	Y/D COUPLER SUSPECTED
811115	200	TURNING Y/D ON CAUSES HEAVY YAW KICKS	UNKNOWN
821122	200	ON CLIMBOUT, A/C ROLLED VIOLENTLY RT W. A/P ON	R&R FCC
830303	200	A/C YAWED SEVERELY AFTER T/O - Y/D ON MEL	Y/D MISTAKENLY SWITCHED ON
830417	200	RUDDER FISHTAILS AND KICKS	MAIN RUD PCU UNDER INVESTIGATION
831109	200	AIRPLANE YAWED RIGHT ON TAKEOFF ROLL	R&R MAIN RUD PCU, Y/D COUPLER
831129	200	Y/D KICKS HARD WHEN SECOND "B" PUMP ON	UNKNOWN
840224	200	HEAVY LEFT WING WITH FLAPS SELECTED 10-15	UNKNOWN

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737 SIGNIFICANT ITEMS REPORT SYSTEM (SIRS) EXTRACT (1970-94) LATERAL/YAW UPSETS

DATE	MODEL	CIRCUMSTANCES	MAINTENANCE ACTION
840509	200	UNABLE TO TURN CONTROL WHEEL CW FROM NEUTRAL	SCREW JAM IN COPILOT'S TRANS MECH
840612	200	AUTOPILOT ROLLS APL 40 DEG LEFT SEVERAL TIMES	R&R WORN BRGS IN AIL QUADRANTS
840918	200	A/C YAWED RT, THEN JUMPED LEFT AFTER SNAP NOISE	UNKNOWN
851028	200	LEFT OUTBD FLT SPOILER FULL UP	R&R FLT SPOILER ACTUATOR
851124	300	AT 35K, Y/D KICKED ONCE	R&R AUTOPILOT ACCESSORY UNIT
851127	300	AT FL 330, Y/D KICKED FULL ONCE	R&R AUTOPILOT ACCESSORY UNIT
860110	300	AT CRZ, ON AUTO., UNSCHED LEFT, THEN RIGHT TURN	CHANGED Y/D COUPLER, "B" FCC
860123	300	CLIMBING THROUGH 15K, Y/D DEFLECTED FULL LEFT	REPLACED Y/D COUPLER
860127	300	AT CRZ, AIRPLANE EXPERIENCED ONE STRONG KICK	REPLACED AUTOPILOT ACCESSORY UNIT
860317	300	Y/D KICKS WHEN TURNED ON - RUD PEDALS PULSE	R&R MAIN RUDDER PCU
860409	300	ON DESCENT, Y/D WENT FULL RIGHT AND STAYED	R&R Y/D COUPLER
860420	300	AIRCRAFT HAD UNCOMMANDED RUDDER MOVEMENT	R&R AUTOPILOT ACCESSORY UNIT
860420	300	UNCOMM YAW MOVEMENT WHILE IN CRZ W. A/P ON	T-VALVE , ENGAGE SOLENOID, AND LVDT
860604	300	AT 1000 FT AFTER T/O, APL KICKED (LIKE Y/D)	CAP ON RUD PCU CRACKED - B HYD LOST
860806	300	AT 35K CRZ, AUTO ON, APL YAWED/ROLLED LEFT	R&R Y/D COUPLER AND CADC
860814	300	IN CLIMB AT 23.5K, "UNWANTED " YAW OCCURRED	UNKNOWN
860819	300	RUDDER TRIM RAN AWAY TO FULL RIGHT	R&R RUD TRIM MODULE
860820	300	UNCOM RUD MOVEMENT	REPLACED K17 RELAY (ENERGIZES Y/D)
860926	200	ON DESCENT, Y/D KICKED FULL LEFT TWICE	REPLACED Y/D (COUPLER?)
861022	200	Y/D RAN AWAY AND JAMMED FULL RIGHT	R&R Y/D COUPLER
861102	200	RANDOM AILERON KICKS WITH AUTOPILOT ENGAGED	MULTIPLE PARTS REPLACED
861121	300	ON AUTOPILOT, RUD TRIM RAN FULL LEFT	R&R RUDDER TRIM SWITCH
870114	200	AUTOPILOT TRANSIENTS - KICKS IN ROLL MODE	LOOSE CONNECTOR TIGHTENED ON INPUT
870220	200	AT 17K FT, FLT SPOILER ACTUATOR EXTENDED	SAFETY WIRE FOUND IN CHECK VALVE
870406	300	ON AUTOPILOT, RUD TRIM RAN AWAY TO 8 UNITS LEFT	SYSTEM CHECKS OK ON GROUND
870408	300	FULL Y/D DEFLECTION	PILOT TURNED OFF Y/D - ALL THEN OK
870422	300	AIRPLANE EXPERIENCED RUDDER KICK	R&R AUTOPILOT ACCESSORY UNIT
871006	300	ON AUTOPILOT, RUD TRIM RAN FULL LEFT	TRIM RECENTERED - NO FURTHER INCIDEN
871014	300	IN CRUISE W. AUTOPILOT ENGAGED, Y/D KICKED	UNKNOWN
880105	300	AT CRUISE, 2 CASES OF UNCOM RUDDER TRIM MOTION	UNKNOWN
880106	300	IN CRUISE AT 10K, RUD WENT FULL LEFT - OK Y/D OFF	R&R AUTOPILOT ACCESSORY UNIT
880107	300	RUD TRIM STUCK CAUSING VIOLENT DIVE TO RIGHT	R&R RUD TRIM SWITCH, MAIN RUD PCU
880205	200	FULL DEFLECTION Y/D ON ROTATION	R&R Y/D COUPLER

DATE	MODEL	CIRCUMSTANCES	MAINTENANCE ACTION
880411	200	EXCESSIVE YAW - AIR TURNBACK PENDING	UNKNOWN
880613	200	VIBRATION IN RUDDER	R&R MAIN RUDDER PCU Y/D T-VALVE
880714	200	WHEN AUTOPILOT ENGAGED, RUD KICKED LEFT	R&R MAIN RUD PCU T-VALVE
881110	200	RUDDER VIBRATES. STOPS WHEN Y/D TURNED OFF	R&R MAIN RUD PCU, Y/D COUPLER
881129	200	HARD LEFT BANK WITH AUTOPILOT IN CWS	R&R MAIN RUD PCU- NO DISCREP FOUND
890201	200	SEVERAL REPORTS OF A/C VIBRATION/SHAKING	R&R Y/D COUPLER, A/P ACCESS UNIT
890211	300	ON AUTOPILOT, AILERONS KICK PERIODICALLY	R&R AUTOPILOT COMPUTER
890705	400	SUDDEN A/C YAW AND BANK DUE RUNAWAY RUD TRIM	R&R MAIN RUD PCU
890829	200	RTO DUE UNCOM Y/D KICK ON TAKEOFF ROLL	R&R Y/D COUPLER
891112	200	UPON FLAP RETRACT, A/C YAWED SHARPLY L&R	REPLACED A/P ASSY SWITCH
900110	300	A/C TAKEN OUT OF SERVICE DUE YAW OSCILLATIONS	R&R MAIN RUDDER PCU
900205	300	ON CLIMB AT 13K, RUD TRIM RAPIDLY WENT 5 DEG	R&R RUD TRIM MODULE
900206	300	CREW REPORTED UNCOM RUD TRIM EXCURSION	R&R RUD TRIM SWITCH AND MODULE
900303	300	CREW REPORTS UNCOM RT RUD TRIM	REPLACED RUDDER TRIM SWITCH
900429	300	CREW FELT 2 ABRUPT KICKS ON RUD PEDALS	MAINT BLED MAIN RUD PCU
900830	300	A/C EXPERIENCED LATERAL OSCILLATIONS	LOOSE FASTENER ON RUD TRIM ACT MTG
901023	200	DLH FINDS MAIN RUD PCU INTERNAL LINKAGE INTERF.	MACHINED OFF INTERFERENCE
901101	300	DURING CLIMBOUT, RUD TRIM SWITCH WOULD STICK	REPLACED RUDDER TRIM SWITCH
901108	200	MAIN RUD PCU CTRL VALVE FROZEN DUE CORROSION	REPLACED VALVE
910124	300	UNCOM LEFT ROLL AFTER AUTOPILOT ENGAGEMENT	UNKNOWN
910128	200	A/C REQUIRES 8 UNITS OF LEFT AIL TRIM AT CRZ	UNKNOWN
910305	200	A/C YAWED/ROLLED VIOLENTLY TO STARBOARD	R&R MAIN RUD PCU
910311	200	AT CRZ, Y/D SHOWED FULL LEFT DEFLECTION	R&R MAIN RUD PCU, RERIG RUD SYS
910401	300	RUD TRIM WENT HARDOVER IN CRUISE	R&R RUD TRIM SWITCH PANEL
910425	500	ABRUPT RUD MOTION WITH HF TRANSMISSIONS, Y/D ON	UNKNOWN
910601	200	"B" AUTOPILOT INITIATES UNCOM BANK	R&R ROLL CHANNEL
910613	200	A/C WANTED TO ROLL RT - TOOK NEAR FULL LEFT AIL	R&R MAIN PCU Y/D T-VALVE
910712	300	ON T/O, SUDDEN RT YAW AND PEDAL MOVEMENT	R&R Y/D COUPLER
910726	200	AT V1, CAPT FELT A "KICK IN THE RUDDER"	NO DEFECTS FOUND
910903	300	UNCOM ROLL ON STANDBY FLAP EXTENSION	UNKNOWN
910904	300	OSCILLATING YAWING MOTIONS	R&R AUTOTHROTTLE COMPUTER
911113	300	"B" AUTOPILOT INITIATES UNCOM BANK	R&R ROLL CHANNEL
911128	400	EXCESSIVE WEAR IN Y/D SUMMING LINKAGE	REPLACED WITH NEW PARTS

(12)

DATE	MODEL	CIRCUMSTANCES	MAINTENANCE ACTION
920108	200	AT 1500 FT AGL, A/C YAWED SHARPLY	R&R Y/D COUPLER
920212	200	ON FINAL, RUDDER WENT FULL HARDOVER RIGHT	CONDITION STOPPED WHEN Y/D OFF
920212	200	Y/D ABRUPTLY MOVES RUDDER INTERMITTENTLY	UNKNOWN
920331	200	LARGE A/C ROLL DUE UNCOM NO. 1 SLAT EXTENSION	R&R STANDBY HYD SHUTOFF VALVE
920529	200	AFTER T/O, A/C EXPERIENCED VIOLENT SHAKING	R&R RUD PCU Y/D T-VALVE
920617	300	RUD TRIM RUNAWAY TO 12 DEGREES RIGHT	R&R RUDDER TRIM SWITCH MODULE
920629	300	RUD TRIM SWITCH RAN FULL RIGHT	REPLACED RUDDER TRIM SWITCH
920709	200	IN CRZ AT FL 310, Y/D WENT FULL LEFT	R&R AUTOPILOT ACCESSORY UNIT
920801	300	AT 800 FT AFTER GEAR RETRACT, A/C HAD SEVERE VI	R&R MAIN RUD&STBY PCUS, Y/D COUP
920804	200	LATERAL AUTOPILOT JERKED DURING CRUISE	MULTIPLE COMPONENTS REPLACED
920809	200	A/C ROLLED VIOLENTLY LEFT UPON FLAP RETRACTION	CABLE FOUND OFF OF PULLEYS
920820	300	AFTER T/O, HARDOVER Y/D INDUCED DUTCH ROLLS	R&R Y/D COUPLER
920908	200	UNCOM RESPONSES FROM THE Y/D SYSTEM	R&R MAIN RUD PCU, AUTO ACCESS UNIT
920914	400	A "HUMP" IN RUD PCU FUNC TEST	UNKNOWN
920924	500	AT 11K, 250 KTS, AUTO ON, LARGE DUTCH ROLLS	MULTIPLE COMPONENTS REPLACED
921011	200	ON AUTOPILOT, UNCOM ROLL OSCILLATIONS	MULTIPLE COMPONENTS REPLACED
921020	200	UNCOM ROLL LEFT, THEN RIGHT WITH OSCILLATIONS	R&R AIL FORCE LIMITER, CWS TRANS.
921027	200	ON AUTOPILOT, UNCOM ROLL OSCILLATIONS	MULTIPLE COMPONENTS REPLACED
921029	200	Y/D WENT FULL OVER LEFT/RIGHT ON THE GROUND	R&R Y/D COUPLER
921204	200	UNCOM RUD MOVEMENT/VIBES FELT IN RUD PEDALS	R&R MAIN RUDDER PCU
930104	300	FLT CONTROLS CHECK FINDS RUDDER BINDING	R&R MAIN RUDDER PCU
930225	200	AT FL 350, AUTOPILOT ENGAGED, HEAVY RUDDER ROLL	FLT NORMAL WHEN Y/D TURNED OFF
930225	300	RUDDER TRIM RAN TO FULL RIGHT	UNKNOWN
930315	100	ON CLIMB, A/C ROLLED LEFT	REPLACED BROKEN ABSA-1 CABLE
930318	300	Y/D KICKS LEFT IN FLIGHT	LUBED MAIN RUD PCU AND BUSHINGS
930419	200	UNCOM LH/RH RUD MOVEMENTS IN CRUISE	UNKNOWN
930423	500	ON APPROACH, VIOLENT LEFT ROLL	UNKNOWN
930427	300	AFTER AUTO DISCONNECT, A/C ROLLED RIGHT/LEFT	UNKNOWN
930613	200	ON T/O CLIMB, UNCOM YAW	R&R Y/D SOLENOID ENGAGE VALVE
930709	300	ON DESCENT, 290 KTS, RUDDER SUDDENLY KICKED RT	UNKNOWN
930726	200	AT CRZ, AUTOPILOT ON, APL YAWED VICIOUSLY	MULTIPLE COMPONENTS REPLACED
930802	200	UNCOM ROLL UPON FLAP EXTENSION FROM 15 TO 25	NO ANOMALIES FOUND
930822	200	AS A/C DESCENDED THRU 29K, Y/D WENT FULL LEFT/RT	REPLACED MAIN RUDDER PCU

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737 SIGNIFICANT ITEMS REPORT SYSTEM (SIRS) EXTRACT (1970-94) LATERAL/YAW UPSETS

DATE	MODEL	CIRCUMSTANCES	MAINTENANCE ACTION
931128	200	AT FL200, 280 KTS, Y/D WENT FULL OVER	R&R Y/D COUPLER + OTHER COMPONENTS
931204	300	AT CRUISE AT 33K, A/C HAD 2 ABRUPT YAWS	R&R RUD PCU Y/D T-VALVE
940111	200	FULL Y/D DEFLECT AT FL 230 AND FINAL (1000 AGL)	R&R Y/D COUPLER
940120	200	ON DESCENT, UNCOM FULL Y/D INPUTS 2 TIMES	R&R Y/D COUPLER
940122	200	FLT DIVERT DUE TO SEVERE A/C YAWING	R&R Y/D COUPLER, PCU Y/D T-VALVE
940317	200	ON T/O, UNCOM YAW LEFT	R&R RUD PCU Y/D T-VALVE
940409	200	Y/D WENT FULL LEFT ON T/O ROLL AT 100 KTS	R&R Y/D COUPLER, MAIN RUD PCU
940413	300	REPORTS OF RUD KICKS	UNKNOWN
940501	300	IN CLIMB AT 4500, 240 KTS, Y/D KICKED	NORMAL AFTERCREW TURNED OFF Y/D
940505	300	DURING DESCENT AT 170 KTS, UNCOM RUD DEFLECT.	R&R MAIN RUD PCU
940521	200	AT CRUISE, AIRPLANE WAS JOLTED HARD RIGHT	R&R AUTOPILOT ACCESSORY UNIT
940620	200	CREW REPORTED UNCOM RUDDER INPUTS	R&R MAIN RUD PCU
940718	200	DURING T/O & CLIMB, SEVERE YAWING WAS FELT	R&R Y/D COUPLER
940903	200	IN CRUISE AT FL 280, RECEIVED 3 RUDDER INPUTS	R&R Y/D COUPLER
940905	300	Y/D ABRUPTLY MOVES RUDDER BACK & FORTH	R&R Y/D COUPLER
940912	300	ON DESCENT, A/C ROLLED VIOLENTLY RIGHT	R&R MAIN RUD PCU
940916	500	ON DESCENT FROM FL060, Y/D KICKED & OSCILLATED	UNKNOWN
940920	200	ON FLAIR AT 30 FT, UNCO RT RUDDER INPUT	R&R MAIN RUD PCU
941024	200	INTER RUD KICKS IN CLIMB OR TURN- NO PEDAL MOVE	MULTIPLE COMPONENTS REPLACED
941123	500	FREQUENT UNCOM RIGHT TURNS ON AUTOPILOT	UNKNOWN
941124	500	UNCOM SHARP RIGHT TURNS WITH AUTOPILOT ON	UNKNOWN
941129	500	UNCOM RIGHT TURNS WITH AUTOPILOT ON	REPAIRED CONNECTOR TO NO. 2 DADC

SIRS REPORTS:

NO.1 THESE EVENTS ARE EXTRACTED FROM SIRS DATA, PERIOD 1970-87, REPORT DATE 10.11.94

NO.2 THESE EVENTS ARE EXTRACTED FROM SIRS DATA, PERIOD 1988-94, REPORT DATE 9.22.94

NO.3 THESE EVENTS ARE EXTRACTED FROM SIRS DATA, PERIOD 1988-94, REPORT DATE 10.11.94

NO.4 THESE EVENTS ARE EXTRACTED FROM SIRS DATA, PERIOD 1970-84, REPORT DATE 1.4.95

NO.5 THESE EVENTS ARE EXTRACTED FROM SIRS DATA, PERIOD 1985-87, REPORT DATE 1.3.95

NO.6 THESE EVENTS ARE EXTRACTED FROM SIRS DATA, PERIOD 1988-94, REPORT DATE 1.3.95

(14)

Aircraft Model: 737-200

Date: January 27, 1974

Information Reported to Boeing: The flight crew reported a "hard" right rudder at 100 knots on touchdown. The brakes were used to maintain the aircraft on the runway. After the aircraft stopped, the yaw damper was turned off - with no effect on the rudder position. System A was then turned off - with no effect on the rudder position. System B was then turned off - with no effect on the rudder position. The rudder subsequently "released" for no apparent reason. There was no mention in the report of any attempt by the flight crew to neutralize the rudder by opposing rudder pedal input. The operator's investigation reportedly revealed that this condition was caused by a shot peening ball, which had not been flushed out and had migrated into the servo valve. Upon disassembly the ball was found sheared in half. The shot peen ball caused the pilot valve to stick in the open position signaling the rudder to the "full" right position. The unit was given an intensive cleaning and inspection and returned to service. The operator reported that ball peening was accomplished prior to chrome-plate repair of PCU. Repair procedures were changed to eliminate the possibility of contamination. All PCU's repaired during the period when contamination was suspected possible were recalled for inspection and cleaning.

SIGNIFICANT ITEMS REPORT SYSTEM (SIRS) EXTRACT ON 737 SERVO CONTROL VALVE DAMAGE

DATE	MODEL	PAGE	DESCRIPTION
1.27.74	200	9	EVIDENCE OF SHOT PEEN BALL CONTAMINATION IN MAIN RUDDER PCU SERVOVALVE.
			SHOT PEENING WOULD HAVE PRECEDED CHROME PLATE REPAIR.
10.30.75	UNK	9	DURING MAIN RUDDER PCU OVERHAUL, BALL PEEN REMAINS FOUND IN DUAL VALVE AND CLOGGING UP A PORT HOLE OF SERVOVALVE
11.8.90	200	16	DURING MAIN RUDDER PCU OVERHAUL,HEAVY CORROSION HAD FROZEN/SEIZED
			THE MAIN CONTROL VALVE PRIMARY SLIDE IN THE NEUTRAL POSITION
			TO THE SECONDARY SLEEVE.

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Dual Concentric Hydraulic Control Valves

A/P Models	Valve	Elevator (Val. / PCU P/N)		Rudder (Val./ PCU P/N)		Aileron (Val. / PCU P/N)	
	Make	Main/inboard	outboard	Main/upper	lower	Main/inboard	outboard
707-???	Parker	N/A		60010-5001 through 5007/60000 (10-60815)		N/A	
727-???	Parker	68010-5001/68000 (10-60926)		59112/59100 (Single)			
737-100	Parker	65-44761		65-44861		65-44761	
737-200		65-44761		65-44861		65-44761	
737-300	Parker	65-44828-1,-2 / 65-44761 D/N		68010-5001 through 5007 / 65-44861		65-44828 -1, -2 / 65-44761	
737-400		65-44828-1,-2 / 65-44761 D/N		68010-5001 through 5007 / 65-44861		65-44828 -1, -2 / 65-44761	
737-500		65-44828-1,-2 / 65-44761 D/N		68010-5001 through 5007 / 65-44861		65-44828 -1, -2 / 65-44761	
747-100	Parker	93610/93600		/3822000 (NWL)	/3822000 (NWL)	N/A	N/A
747-200	Parker	93610/93600		/3822000 (NWL)	/3822000 (NWL)		
747-SP	Parker	93610/93600					
747-SR	Parker	93610/93600		/3822000 (NWL)	/3822000 (NWL)		
747-300	Parker	93610/93600		/3822000 (NWL)	/3822000 (NWL)		
747-400	Parker	93610/327400					
757-200		N/A		N/A		N/A	
767-200		N/A		N/A		N/A	
767-300		N/A		N/A		N/A	

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MINIMUM PILOT FORCE AVAILABLE AT CONTROL VALVE SLIDE

737 RUDDER PCU

Primary jam	40 lbs min
Secondary jam	40 lbs min
Dual jam	40 lbs min

737 ELEVATOR PCU

Primary jam	6.77 lbs min *
Secondary jam	861 lbs min **
Dual jam	861 lbs min **

737 AILERON PCU

Primary jam	6.77 lbs min *
Secondary jam	1091 lbs min **
Dual jam	1091 lbs min **

* Pilot can maintain control after worst case single jam via the adjacent PCU

** Determined by force for temporary application per FAR 25.145