

DOCKET No.: SA-521
EXHIBIT No. 7R

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

DC-8 MAINTENANCE MANUAL
[Chapter 27 - Trouble Shooting Procedures]
(Emery, Douglas Aircraft Co.)



MECHANICAL CONTROLS, PORPOISING ON AUTOPILOT - TROUBLE SHOOTING

APPLICABILITY: DC8-71 N8070U-99U AND N8177U

1. General

A. This procedure is in three parts.

- (1) Part 1 contains checks for the most probable causes.
- (2) Part 2 is a more extensive check covering everything short of disturbing flight control rigging.
- (3) Part 3 is a complete check involving rigging.

2. Special Tools and Materials

A. Special Tools

- (1) Cable tensionometer, 0 to 150 pounds capacity.

B. Materials - None required

3. Trouble Shooting

A. Part 1

- (1) Clean and lubricate elevator cable cabin pressure seals per MM/OV-23-27-00-23.
- (2) With airplane out of the wind (in hangar), gust lock on, check elevator controls for binding and roughness. Cause of any roughness or binding is to be located. Experience has shown that tab torque tube bearings inside the elevator inboard hinge fitting are very susceptible to binding and rough operation.
- (3) Check elevator control cable tensions, per MM/OV-23-27-30-03, and record them.
- (4) Check cable on elevator autopilot servo drum for binding or damage.
- (5) Check top and bottom surface contours of elevators outboard of tabs. Top and bottom surfaces to be flat and trailing edge should not bow up or down. Any deviations from flat surfaces create "fixed tab" effects. If deviations found do not tend to cancel themselves out, an elevator change should be considered.
- (6) Repeat check "5", but on all four elevator tabs.

B. Part 2

- (1) Check that elevator trailing edge forward of tabs fairs with tab leading edges. Correct any discrepancies.
- (2) Check control tab pushrods in elevators for clearance per MM/OV-23-27-33-17. Correct conditions not within limits.



2

- (3) Check that elevator servo support rig holes R and Q are aligned per MM/OV-23-27-30-03. Record any discrepancies.
- (4) Check elevator controls rigging per MM/OV-23-27-30-03. Record any out-of-tolerance conditions.
- (5) Remove the RH pilot seat and floorboards and check the MPT (Mach Pitch Trim) controls for evidence of binding. Operate the MPT to the extend position and check elevator controls for binding. Correct any binding.
- (6) Check end play (looseness) of the elevator load feel/centering mechanism shaft relative to the mechanism housing. If end play exceeds .010 inch the mechanism should be replaced. The mechanism can be removed, checked and reinstalled without disturbing its adjustment.
- (7) Check that elevator control system friction is within the limits of 27-30-04.

C. Part 3

- (1) Disconnect elevator control cables and control tab pushrods from tab torque tubes at the elevator inboard end. Check the torque tube bearings for binding or roughness. If bearings do not operate smoothly, replace the elevator hinge fitting. Rerig elevator controls.

NOTE: Rework removed fitting to within limits of 6F-8297.

- (2) Correct all discrepancies recorded during accomplishment of parts 1 and 2, preceding.

.....

END

DOUGLAS AIRCRAFT CO.
DC-8 SIXTY SERIES
 MAINTENANCE MANUAL

3

ELEVATOR AND TAB - TROUBLE SHOOTING

1. General

- A. If trouble shooting the elevator and tab system indicates that adjustment or replacement of components is required or that cable tensions require adjustment, the portion of the system that contains the component or cable must be completely adjusted (see Adjustment/Test).
- B. During the following trouble shooting procedures, the horizontal stabilizer must be in neutral position. Stabilizer is in neutral position when the dimension between the left jackscrew upper stop and drive nut upper stop mounting flanges is 11 15/32 ($\pm 1/16$) inches.
- C. Elevator is in neutral position when elevator trailing edge is 10 ($\pm 3/16$) inches below marked rivet on side of tail cone.

2. Trouble Shooting Elevators and Tabs

WARNING: BEFORE OPERATING TABS, MAKE CERTAIN THAT AREAS AROUND LEFT AND RIGHT ELEVATORS AND TABS ARE CLEAR OF PERSONNEL AND EQUIPMENT.

Possible Causes	Isolation Procedure	Correction
-----------------	---------------------	------------

- | | | |
|--|--|--|
| A. FRICTION IN SYSTEM; BINDING OF CONTROL SURFACES; NEUTRAL POSITION OUT OF RIG; EXCESSIVE LOOSENESS OF SURFACES | | |
|--|--|--|

NOTE: Under tail wind conditions with the gust lock off, it is possible to encounter an elevator locked condition. This is possible when the elevators are at the limit of travel and held in this position by wind force on the elevator and tab surfaces. Operating the gust lock control lever to the on position should relieve this condition. If condition remains, check freedom of movement (see Inspection/Check), then trouble shoot per the following instructions.

- | | | |
|--|--|---------------------------------------|
| (1) Excessive friction in mechanical control system or excessive play or lost motion in control column | Check elevator control system for excessive friction (see Inspection/Check). | Adjust or replace parts as necessary. |
|--|--|---------------------------------------|

DOUGLAS AIRCRAFT CO.
DC-8 SIXTY SERIES
MAINTENANCE MANUAL

4

Possible Causes	Isolation Procedure	Correction
A. FRICTION IN SYSTEM; BINDING OF CONTROL SURFACES; NEUTRAL POSITION OUT OF RIG; EXCESSIVE LOOSENESS OF SURFACES (Continued)		
(2) Binding control surfaces	Manually rotate elevator slowly from stop to stop and check for binding or interference of torque shafts in stabilizer stubs. Check tabs for structural binding or interference. Check tab pushrods and linkage for binding or interference.	Correct and replace parts as necessary.
(3) Elevator neutral position out of rig	Check elevator neutral position (see Inspection/Check).	Rig elevator system (see Adjustment/Test).
(4) Excessive looseness of surfaces	Check all surfaces for looseness (see Inspection/Check).	Replace worn bearings, bolts, or parts, as necessary.
	Check system cables for proper tension.	Adjust cable tension, (see Adjustment/Test).
	Check rigging position of elevator autopilot servo.	Position autopilot servo correctly.

B. CONTROL COLUMN CHATTER

(1) Load-feel mechanism needs grease	Disconnect load-feel mechanism from control column and determine if chatter stops.	If chatter stops, replace load-feel mechanism, (see 27-30-4 Maintenance Practices). Adjust elevator control system (see Adjustment/Test). If chatter does not stop, check for binding in control column assembly.
--------------------------------------	--	---

DOUGLAS AIRCRAFT CO.
DC-8 SIXTY SERIES
 MAINTENANCE MANUAL

5

Possible Causes	Isolation Procedure	Correction
C. LOW COLUMN FORCES AROUND NEUTRAL POSITION; INADEQUATE PITCH TRIM COMPENSATOR		
(1) Elevator or tab neutral positions out of rig	Determine whether surfaces are within neutral tolerances (see Inspection/Check).	Adjust as required (see Adjustment/Test).
(2) Load-feel mechanism improperly adjusted	With gust lock on and elevator in neutral position, move first officer's control column to neutral position (13 1/2 degrees forward of vertical. Check that control tabs are faired with elevator. Release control column and check that column moves forward to position control tabs up 1/2 ($\pm 1/4$) inch from faired position.	Adjust load-feel mechanism (see 27-30-4, Maintenance Practices).
(3) Pitch trim system improperly adjusted	With actuator in operational extend position and control column at neutral, measure horizontal forward force at centerline of control wheel. Force should be 30 1/2 (± 2) pounds.	Adjust pitch trim linkage (see Adjustment/Test).
	Remove and check elevator load-feel mechanism for axial looseness. Maximum allowable end play is 0.010 inch.	Remove lockwire and back off checknuts. Rotate adjustment nuts until no end play exists between load-feel spring rod. Tighten checknuts and replace lockwire. Install load-feel mechanism, (see 27-30-4, Maintenance Practices).

Jun 1/68

27-30-0
 CODE 1
 Page 103

DOUGLAS AIRCRAFT CO., INC.
DC-8 SIXTY SERIES
MAINTENANCE MANUAL

6

ELEVATOR AND TAB - INSPECTION/CHECK

1. General

- A. The linear dimensions for checking elevator travel are measured from the center of the elevator inboard trailing edge to the center of a marked rivet on the side of the tail cone. Angular dimensions for checking tab travel are measured by holding a rigging protractor on the rigging reference lines on the tab surface.
- B. The elevator is in neutral position when the elevator trailing edge is 10 ($\pm 3/16$) inches below the marked rivet on the tail cone. The control tab is in faired position when the tab trailing edge is aligned with the elevator trailing edge within $1/4$ degree. The geared tab is in faired position when the tab trailing edge is aligned with the elevator trailing edge within $1/2$ degree.
- C. The horizontal stabilizer is in the neutral position when the dimension between the stabilizer jackscrew upper stop mounting flanges is 11 $15/32$ ($\pm 1/16$) inches.
- D. Inspection/check procedures are identical for left and right elevator and tabs.

2. Tools and Equipment Required

NOTE: Equivalent substitutes may be used instead of the following listed items:

Item	Name	Number	Manufacturer	Use
A	Rigpin		Local	Hold control column in neutral position
B	Rigging protractor	5765013	Aircraft Mechanics, Incorporated	Measure angles of control surfaces

3. Inspection/Check Elevator and Tab

A. Check Elevator and Tab Travel

- (1) Make certain that horizontal stabilizer is in neutral position.

DOUGLAS AIRCRAFT CO., INC.
DC-8 SIXTY SERIES
MAINTENANCE MANUAL

7

- 2
- (2) Move gust lock control lever, located on pilot's control pedestal, to unlocked position.
 - (3) Insert rig pin through 13 1/2 degree rig pin hole in link and rig pin hole in control column. Check for following:
 - (a) Elevator is in neutral position.
 - (b) Control tab is in faired position.
 - (c) Geared tab is in faired position.

NOTE: Geared tab faired position tolerance should be balanced as close as possible between left and right geared tabs (if one geared tab trailing edge is up within the tolerance, the opposite geared tab trailing edge should be down within the tolerance).

 - (d) Looseness at elevator trailing edge does not exceed 13/64 inch.
 - (e) Looseness at control tab trailing edge does not exceed 3/64 inch.
 - (f) Looseness at geared tab trailing edge does not exceed 1/32 inch.
 - (4) Remove rig pin from control column and rig pin link. Check that column moves forward to new neutral position and that elevator control tabs move up 1/2 ($\pm 1/4$) inch and remain in this position.
 - (4a) Move gust lock control lever, located on pilots control pedestal, to unlocked position.
 - (5) Manually move elevator trailing edge down until stops contact and move right control column full forward. Check for following:
 - (a) Aft stops at lower end of control column contact.
 - (b) Control tab stops contact.
 - (c) Elevator trailing edge is 23 7/32 ($\pm 13/32$) inches below marked rivet on tail cone.
 - (d) Control tab is 8 1/2 ($\pm 1/2$) degrees above faired position.
 - (e) Geared tab is 4 3/4 ($\pm 1/2$) degrees above faired position.
 - (6) Manually move elevator trailing edge up until stops contact and move right control column full aft. Check for following:
 - (a) Forward stops at lower end of control column contact.
 - (b) Control tab stops contact.

DOUGLAS AIRCRAFT CO., INC.
DC-8 SIXTY SERIES
MAINTENANCE MANUAL

8

- (c) Elevator trailing edge is 12 1/4 ($\pm 13/32$) inches above marked rivet on tail cone.
- (d) Control tab is 26 1/2 ($\pm 1/2$) degrees below faired position.
- (e) Geared tab is 26 3/4 (± 1) degrees below faired position.

(7) Release control column.

B. Check Elevator and Tab System for Excessive Friction

NOTE: To eliminate effect of wind on control surfaces, elevator and tab friction check should be performed in hangar or in still air conditions.

- (1) Move gust lock control lever, located on pilot's control pedestal, to unlocked position.
- (2) Manually move elevator trailing edge up and then down. Check for following:

NOTE: Elevator trailing edge must be moved slowly to minimize effect of elevator dampers.

- (a) No binding or interference in elevator bus linkage.
 - (b) Elevator torque shafts have sufficient clearance where shafts pass through stabilizer stubs.
- (3) Move gust lock control lever to locked position.
 - (4) Attach a measuring tape to convenient point on instrument panel with extended end of tape resting over top of right control column so that column travel can be measured within 1/32 inch accuracy.
 - (5) Pull control column aft, then allow column to return slowly forward until centering force is zero and column stops moving. Measure and record position of column.
 - (6) Push control column forward, then allow column to return slowly aft until centering force is zero and column stops moving. Measure and record position of column.

Nov 1/67

Printed in U.S.A.

27-30-0
CODE 2
Page 603

DOUGLAS AIRCRAFT CO., INC.
DC-8 SIXTY SERIES
MAINTENANCE MANUAL

9

(7) If difference between positions recorded in steps (5) and (6) is greater than 1/2 inch, elevator system friction is excessive; proceed with following checks:

- (a) Check pressure seal tubes on elevator cables through pressure dome in aft fuselage section.

NOTE: Seal tubes must be clean and free of oil or grease. Seal grommets must have free-running fit on seal tubes throughout cable travel.

- (b) Check entire elevator cable system for fairlead misalignment, seized pulley bearings, excessive pulloff at pulleys, binding guard pins, or cables rubbing at cutouts.
- (c) Check that elevator servo drum is free to rotate when disengaged.
- (d) Check elevator load-feel and centering spring mechanism, located at lower end of right control column, for binding or interference.