NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, D.C. 20594

Airworthiness Group Factual Report – Addendum 1
Elevator Dampers Examination

February 23, 2023

A. ACCIDENT DCA22MA009

Location:	Brookshire, Texas
Date:	October 19, 2021
Time:	1000 central daylight time (CDT)
Aircraft:	McDonnell Douglas DC-9-87, Registration N987AK

B. GROUP

Chair: Tom Jacky
National Transportation Safety Board (NTSB)
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C. SUMMARY

On October 19, 2021, at about 10:00 am central daylight time, a McDonnell Douglas DC-9-87, N987AK, operated by 987 Investments LLC, overran the departure end of runway 36 at Houston Executive Airport (TME), Brookshire, Texas, after the crew executed a rejected takeoff. Of the 23 passengers and crew onboard the airplane, two passengers received serious injuries and one received minor injuries. A postcrash fire ensued, and the airplane was destroyed. The airplane was operating as a 14 Code of Federal Regulation Part 91 flight from TME to Laurence G. Hanscom Field Airport (BED), Bedford, Massachusetts.

The group met at the Boeing Equipment Quality Assessment (EQA) Laboratory in Seattle, Washington from December 8-9, 2022, to perform the examination of the airplane's elevator dampers.

The elevator dampers were documented as follows:

Unit	Part Number	Finnair P/N	Serial Number
Left-Hand Elevator Damper	5918125-501	5627115-266	No ID plate
Right-Hand Elevator Damper	5918125-501	5627115-197	EC175

The Mandatory Functional Assembly Test (Torque Test) was completed on each damper. Both units passed the Torque Test with no faults found.

Following the examination, all pertinent documents and photographs were provided to the parties.

D. DETAILS OF INVESTIGATION

The group met at the Boeing EQA Laboratory in Seattle, Washington to perform the examination of the airplane's elevator dampers. The test was conducted over two days – the first day to place the elevators dampers into a temperature (cold) chamber and the second day, after sufficient exposure to cold, to complete the actual testing.

Prior to the group meeting, the accident elevator dampers were shipped from the airplane salvage facility in Lancaster, Texas to the NTSB Western Pacific Regional Office in Federal Way, Washington. The NTSB group chair hand-carried the dampers from Federal Way to the Boeing EQA facility.

Another operator submitted two exemplar elevator dampers to test and verify the test set up rig. The dampers were sent directly to the Boeing EQA Laboratory.

The Mandatory Functional Assembly Test (Torque Test), as defined by the component Overhaul Manual (Component Maintenance Manual, CMM) Section 27-10-4, Paragraph 2.E. (Revision Date of Mar 01/2020), was performed on the elevator dampers. Prior to the group meeting, Boeing built a rig to test the elevator dampers per the Torque Test specification.

The examinations were accomplished as follows:

1.0 Activities of December 8, 2022

The group met to review the elevator damper testing rig and then perform the Torque Test on an exemplar elevator damper.

1.1 Test Set Up Verification

One of the exemplar units was placed in the laboratory's environmental chamber on 12/07/2022 and cold soaked at 32 degrees Fahrenheit overnight.

After the group's arrival, the damper was removed from the environmental chamber and attached to the test rig. See Figure 1. The damper was rotated on the test rig at 16 revolutions per minute (RPM) in the clockwise (CW) and counterclockwise (CCW) directions. The running torque was measured with a dial torque wrench held to the damper assembly crank arm while the damper was rotating.

Figure 1. The Elevator Damper Test Rig, with exemplar damper attached.

The torque measured 53 inch-pounds (in-lb) in both directions, within the acceptable limits of the test procedure. The group considered the test successful, and the test rig verified.

1.2 Initial Examination of Accident Elevator Dampers

The accident elevator dampers were removed from their shipping box. Overview images of the units were captured. See Figure 2.

Figure 2. The Accident Elevator Dampers at EQA Lab, with linkage arms removed.

Both units were visually examined. No visible defects or fluid leakage were noted on either unit. All safety wire and cotter pins were intact.

Both units came with a linkage rod attached to the clevis. Before the units were placed into the environmental chamber, the linkage rods were removed from both clevis' and placed in zip lock bags.

The elevator damper part and serial numbers were noted. The left-hand Elevator Damper was missing an identification plate; therefore, the serial number was unknown.

1.3 Placement of the Dampers into the Environmental Chamber

Both elevator dampers were placed into the laboratory's environmental chamber to be cold soaked at 32 degrees Fahrenheit at 9:38am Local Time on 12/08/2022. A thermocouple was taped to the housing on each unit. Channel one of the data acquisition units was attached to the right-hand damper assembly and channel two was attached to the left-hand damper assembly[1].

[1] The acquired data was checked to confirm the chamber temperature was kept at the appropriate temperature. Following the tests, the data was not kept.

2.0 Activities of December 9, 2022

The group re-convened to conduct the rotational Torque Test on the accident damper assemblies. Representatives from the NTSB, Boeing Air Safety (ASI) and Boeing Service Engineering were present.

The accident elevator dampers were removed from the environmental chamber after being cold soaked at 32+/- 6 degrees Fahrenheit overnight. The dampers were mounted on the test fixture, one at a time, to rotate the unit at 16 RPM. See Figures 3 and 4.

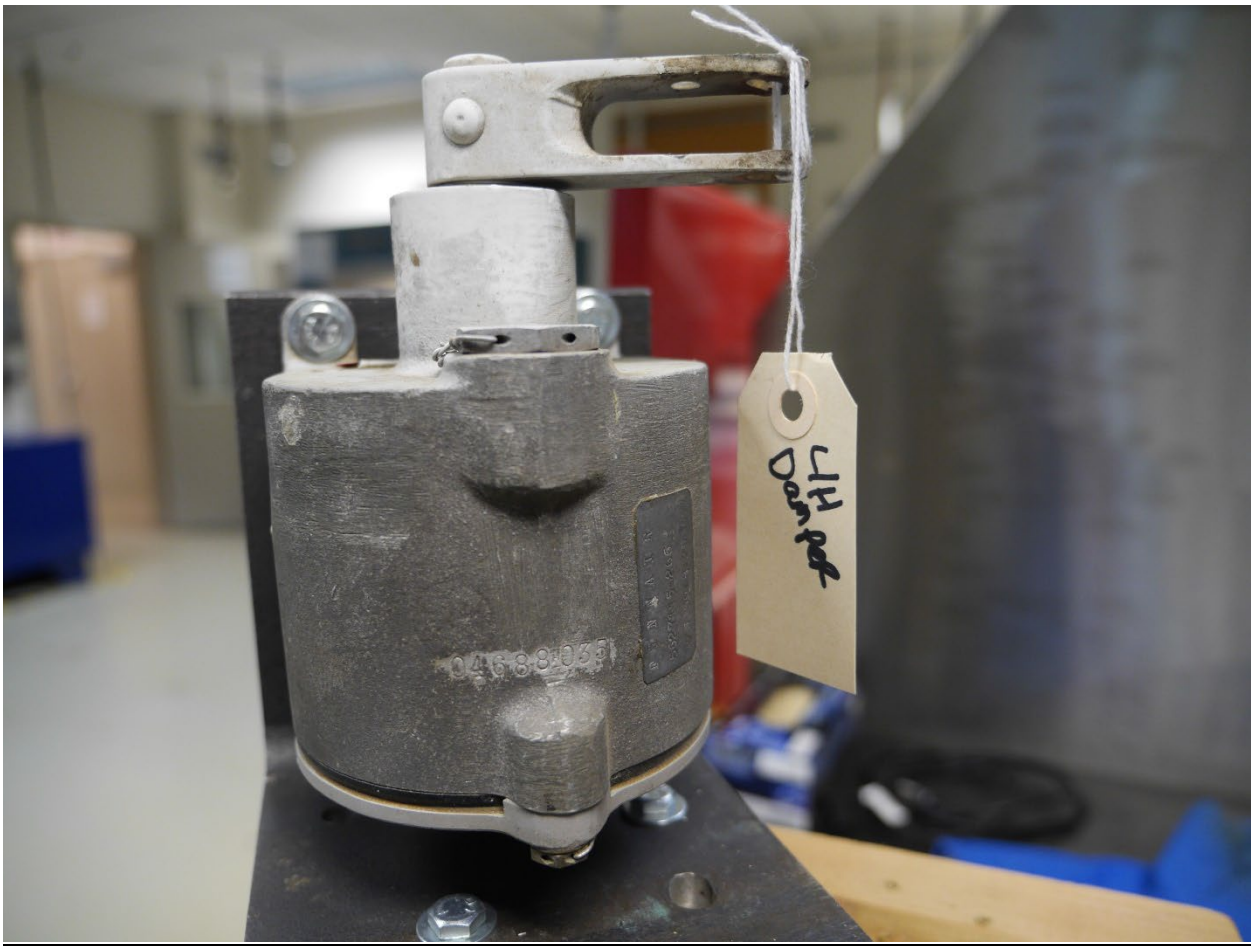

Figure 3. The Left-Hand Elevator Damper, attached to the test rig.

Figure 4. The Right-Hand Elevator Damper, attached to the test rig.

The Torque Test was then run on each damper assembly. The running torque was measured with a dial torque wrench (spring scale), held against the clevis, while the unit was rotated at 16 RPM in the CW and CCW directions.

To minimize the heating effects, the test readings were taken as quickly as possible, with each elevator damper individually removed from the environmental chamber and then immediately tested.

The testing was recorded on video. The group referred to the video recordings to determine the measured torque values, detailed in Table 1 as follows:

Table 1 - Measured Running Torque Values

Unit	**Torque (in-lb)**	
	Direction	
	CW	**CCW**
Right-Hand Elevator Damper	55 (initial), 48 (running)	48 (initial), 46 (running)
Left-Hand Elevator Damper	51 (initial), 46 (running)	68 (initial), 46-68 (running range)

For the testing, the initial torque value was determined as the maximum value measured during the first moments after the motor was started. The running torque value was considered as the average value once the initial torque value reached an equilibrium.

During testing, the right-hand elevator damper output shaft rotation was smooth.

During testing, the left-hand elevator damper output shaft had more friction felt at approximately the 11:00 to 12:00 o'clock position; see Figure 5.

Figure 5. The area of increased friction on the Left Elevator Damper, indicated by yellow dashed lines. Damper shown is an exemplar, not an accident unit.

According to the CMM for -501 elevator dampers, the torque results should be between 35 in-lb and 75 in-lb.

Based on the measured results, both elevator dampers passed the Torque Test.

At the end of the testing, the units were placed back into secure storage.

Tom Jacky
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