

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Aviation Engineering Division
Washington, DC 20594

February 28, 2002

ADDENDUM

to

AIRWORTHINESS GROUP CHAIRMAN'S FACTUAL REPORT

A. ACCIDENT: DCA00MA026

Location: Rancho Cordova, CA
Date: February 16, 2000
Time: 1951 Pacific Standard Time
Aircraft: Emery Worldwide Airlines Flight 17, Douglas Model DC8-71F, N8079U

B. SUMMARY

On February 16, 2000, at 1951 Pacific Standard Time, a Douglas¹ Model DC8-71F, N8079U, operated by Emery Worldwide Airlines (Emery), as flight 17, a cargo flight departing from Mather Field (MHR) in Rancho Cordova, California to Dayton International Airport (DAY) in Dayton, Ohio, crashed into an auto salvage yard while attempting an emergency return to MHR. Three crew members onboard received fatal injuries and the aircraft was destroyed.

C. DETAILS OF THE INVESTIGATION

1.0 Cargo Retention Hardware

The following sections document the condition of the cargo locks and aft cargo stops, that were recovered on scene. Note that these components are primarily intended to prevent the longitudinal movement of cargo containers (or pallets), once loaded onboard and secured.² The cargo locks are rated at 1.5g's in the forward and rearward directions, when up and locked.³ The aft stops are intended to prevent movement in the rearward direction only.

1.1 Aft Cargo Stops

Three "J" shaped hooks, commonly called aft stops, are mounted to the DC-8 cargo floor seat tracks, aft of the rear most cargo loading position (No. 18), and are intended to prevent movement of cargo in the rearward direction (i.e. towards the rear pressure

¹ Now known as The Boeing Company (Boeing).

² Cargo locks and aft stops also prevent the vertical movement of cargo containers (or pallets).

³ When not in use, or during loading operations, the cargo locks are stowed in a retracted (collapsed) position, i.e. below the roller /conveyor plane of the cargo system, installed on the main deck (floor) of the airplane.

bulkhead)⁴ during flight. The aft stops are mounted at Fuselage Station (F.S.) 1701, at the centerline of the fuselage and 23.75 inches left and right of centerline, i.e. left buttock line (LBL) 23.75 and right buttock line (RBL) 23.75 respectively. Refer to Figure I for an example of an aft stop, i.e. a digital photograph of the aft stop recovered from N8079U, at RBL 23.75.

Note: The aft stops engage the aft edge of a longitudinally loaded cargo container (or pallet), measuring approximately 88 inches wide x 125 inches in length. [Cargo containers loaded in the aft cargo position (No. 18) must be rotated 90° due to the taper of the rear fuselage, whereas cargo containers loaded in positions No. 1 through 17 are loaded laterally (i.e. 125 inches wide x 88 inches lengthwise).]

The aft stop, mounted at LBL 23.75, was fractured in two separate locations. The head (i.e. hook) was fractured and completely separated from its mounting base, as was a small piece from the forward left corner of the base. The aft stop experienced severe heat damage throughout, and minor impact damage to the upper left side of its head. However, no scratches or scoring were noted on the upper surface of the head.

The aft stop, mounted at the centerline of the fuselage, remained partially attached to its seat track. The aft stop was severely deformed at its forward left corner, that was bent upward and away from the seat track. No scratches or scoring were noted on the upper surface of its head. However, a short crack was noted on the rear surface of the stop, near the radius formed between its base and the vertical leg.

The aft stop, normally mounted to the seat track at RBL 23.75, was recovered intact and in good overall condition, however, separated from its seat track, that had been consumed by fire. The aft stop was discolored by soot and exhibited light scratches on the top of its head in the longitudinal (i.e. fore /aft) direction. See Figure I below.

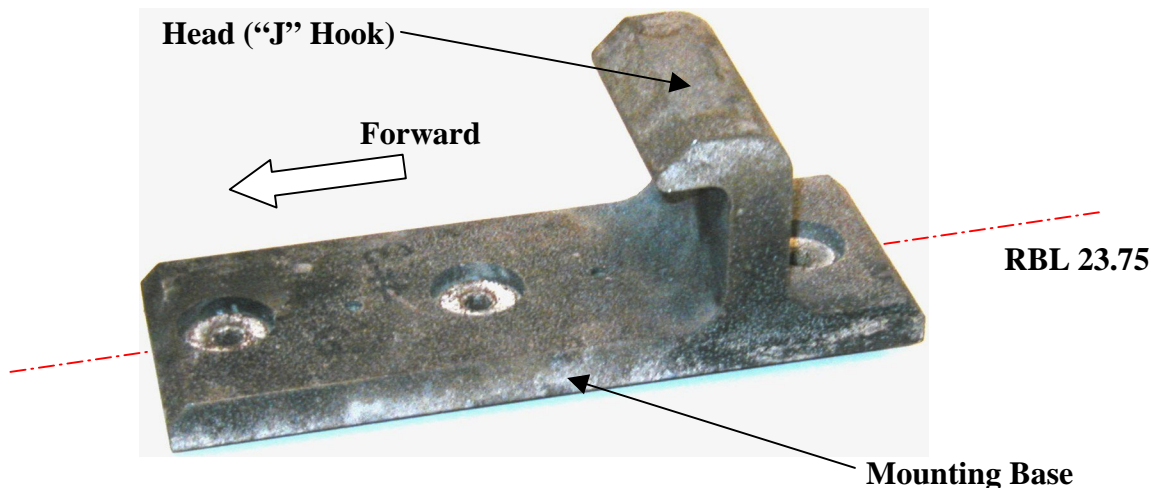


Figure I: Aft Cargo Stop, F.S. 1701, RBL 23.75

⁴ Located at Fuselage Station (F.S.) 1766. The space between the aft stops (F.S. 1701) and the rear pressure bulkhead (i.e. approximately 5.4 linear feet) is normally void of cargo.

1.2 Cargo Locks

A total of eighty-five (85) cargo locks are installed onboard the DC-8 aircraft, i.e. five (5) between each of the cargo loading positions No. 1 through No. 18, spaced at eighty-nine (89) inch intervals. The cargo locks are attached to the seat tracks at LBL 44.5, LBL 23.75, centerline, RBL 23.75, and RBL 44.5, beginning at F.S. 151 and ending at F.S. 1575.

Each cargo lock includes a folding locking mechanism, consisting of a forward (inner) and rearward (outer) facing pawl. When in use, the pawls are raised (and interlocked) to engage the cargo containers (or pallets) loaded directly fore or aft of each lock, and prevent cargo container (or pallet) movement in the forward, rearward, and upward directions. When loading or unloading cargo, the pawls are lowered to allow cargo containers (or pallets) to pass over the locks without interference.

Note that the inner pawl is spring loaded up and the outer pawl is spring loaded down. Therefore, the inner pawl holds the lock assembly in position when up and locked, and the outer pawl holds the lock assembly in position when stowed.

Refer to Figures II & III (below), for digital photographs of an undamaged cargo lock recovered from N8079U (unidentified location), shown in its up and locked position (Figure II), and when stowed (Figure III).

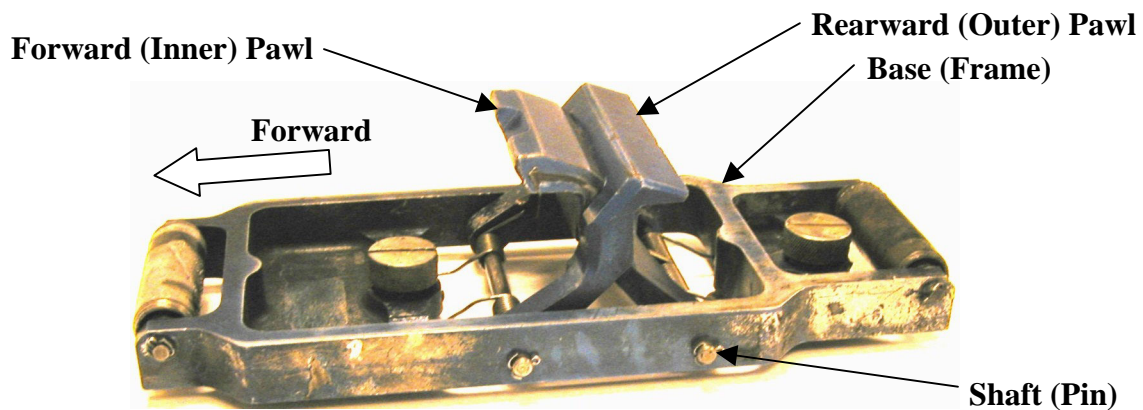


Figure II: Cargo Lock, "Up and Locked"

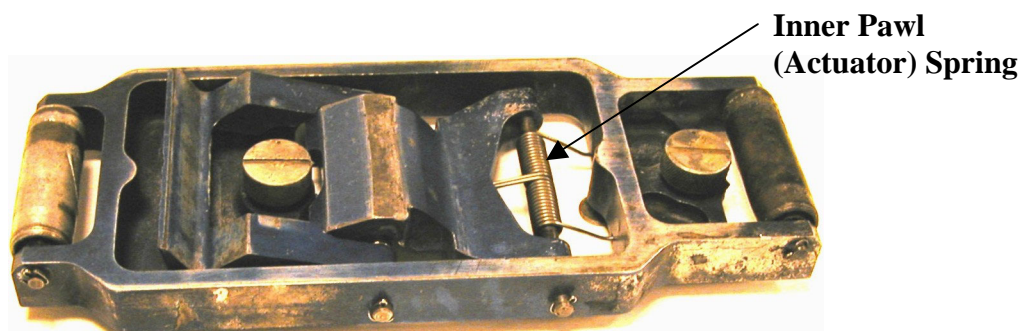


Figure III: Cargo Lock, "Stowed (Retracted)"

The remains of approximately one-third (28) of the cargo locks onboard⁵ were recovered. Although several of the cargo locks sustained only minor damage, most of the cargo locks were completely destroyed due to the breakup of the aircraft and /or post crash fire. In many cases, only remnants of a particular lock remained thereby making any determination regarding its position (i.e. up and locked vs. stowed) at the time of the accident impossible.

The cargo locks at F.S. 1575 (i.e. between cargo loading positions 17 & 18) were recovered, although heavily damaged. The cargo locks located at LBL 44.5 (left outboard), LBL 23.75 (left inboard), and centerline were all found in their stowed (retracted) positions. The centerline lock appeared undamaged. However, the base (frame) of the left outboard and inboard cargo locks were severely twisted, bent, and fractured in several locations, as were the seat tracks that they were originally attached to. The inner pawl of the left outboard cargo lock was not fractured on either of its legs that attach the pawl to its base frame. However, one leg of the inner pawl, on the left inboard cargo lock, was cracked on its upper surface. Both left hand cargo locks experienced severe heat damage, as evidenced by the wrinkled appearance of the locks, their sagging shape, the presence of re-solidified aluminum (once molten), numerous cracks, and the deposition of soot throughout. The right inboard (RBL 23.75) cargo lock was approximately 50% consumed by fire. Only the rear portion of the base and the inner pawl remained. Although, severely deformed due to heat, the inner pawl was not fractured on either of its legs. The right outboard (RBL 44.5) cargo lock experienced severe deformation and heat damage and could not be separated from its seat track, due to the presence of re-solidified aluminum where the inner pawl once existed. Although the body of the inner pawl had melted and re-solidified in the center of the cargo lock, the legs of the inner pawl remained attached to the base frame and were fractured (i.e. completely severed) at an angle of approximately 45° from the apex where each of the legs meet and the inner pawl actuator spring is inserted. The fractured inner pawl legs were found rotated upward and rearward, to a position where the inner pawl spring had relieved itself.

Note: According to Boeing, structural loads in excess of 1.5g's, acting upon the cargo locks (aft of the main deck cargo door)⁶ in the forward direction; typically result in the bending of the inner and outer pawl shafts, followed by the deformation of the base frame surrounding the shafts, and thereafter by the tensile failure of the inner pawl leg(s) if the loads are extreme enough. Whereas, loads in excess of 1.5g's, acting upon the same cargo locks, in the rearward direction, typically result only in the bending of the inner and outer pawl shafts and /or the deformation of the base frame surrounding the shafts. Conversely, the cargo locks installed forward of the main deck cargo door, i.e. between positions No. 1 and 2, are reversed to facilitate cargo loading /unloading operations from position No.1. Thus, the failure of these cargo locks would also be reversed with respect to the direction of loading.

Refer to Figure IV (below), for a digital photograph of a cargo lock (installation location unknown) where both inner pawl legs were found fractured, consistent with the description provided by Boeing for failures in the forward direction. Note: The missing inner pawl body

⁵ Includes three (3) cargo locks that were onboard as spares, as indicated by the spare parts kit for N8079U.

⁶ Includes those cargo locks installed in positions No. 2 through 18.

was not recovered with the rest of the cargo lock, and was therefore presumed destroyed by the post crash fire.

**Inner Pawl Fractures,
(2) Locations**

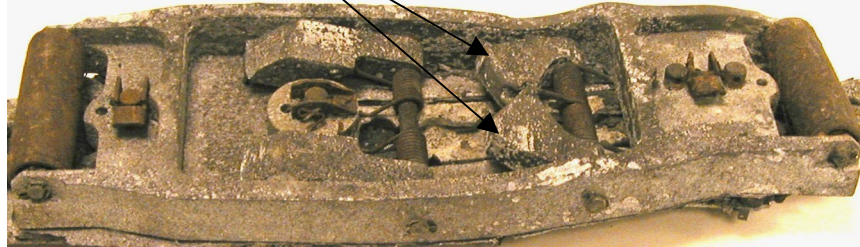


Figure IV: Cargo Lock, “Fractured Inner Pawl (Legs)”

Refer to Figure V (below), for a digital photograph of a cargo lock inner pawl (body), that was recovered separately (installation location unknown) and fractured similarly to the cargo lock shown in Figure IV.



**Actuator Spring
Receptacle (Hole)**

Figure V: Cargo Lock, “Inner Pawl (Body)”

The remains of three cargo locks were recovered at F.S. 1486 (i.e. between cargo loading positions 16 & 17). However, due to extensive fire damage in this area, no determination could be made regarding the relative seat tracks that the cargo locks were originally attached to. The cargo lock that was found furthest to the left had experienced significant heat damage and was severely twisted about its base frame. The lock was found in its stowed (retracted) position. One leg of the inner pawl was found fractured. No determination could be made regarding the positions of the remaining two cargo locks recovered at this station, due to the extent of fire damage that they experienced. Both locks were almost completely melted down. Only the steel shafts and associated springs, that normally attach the inner and outer pawls to their base frames, remained intact.

Of the remaining twenty (20) cargo locks recovered on scene, or portions thereof, fifteen (15) were recovered with fractured inner pawls. Fourteen (14) of which, were fractured

symmetrically about their legs (i.e. similar to Figures IV & V above), the fifteenth was fractured on one leg only. Two (2) cargo locks were found up and locked, and were undamaged. The remaining three (3) cargo locks were found undamaged, in their stowed (retracted) position, and not attached to any seat track, i.e. were recovered independently.

Note: The remains of all other cargo locks were recovered either attached to seat tracks or in the vicinity of seat tracks that had been compromised, due to the break up of the aircraft or post crash fire.

Kevin M. Pudwill
Aerospace Engineer