Explosive decompression, American Airlines, Inc., McDonnell Douglas DC-10-10, N103AA, Near Windsor, Ontario, Canada, June 12, 1972

Micro-summary: On climb, this McDonnell Douglas DC-10-10 experienced an opening of a cargo door, explosive decompression, and a main cabin floor collapse, disrupting the flight control system.

Event Date: 1972-06-12 at 1925 EST

Investigative Body: National Transportation Safety Board (NTSB), USA

Investigative Body's Web Site: http://www.ntsb.gov/

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NATIONAL TRANSPORTATION SAFETY BOARD

AIRCRAFT ACCIDENT REPORT

AMERICAN AIRLINES, INC.
McDONNELL DOUGLAS DC-10-10, N103AA

NEAR WINDSOR, ONTARIO, CANADA

JUNE 12, 1972

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D. C. 20591
REPORT NUMBER: NTSB-AAR-73-2

FILE No. 1-0004

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ADOPTED: FEBRUARY 28, 1973

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AIRCRAFT ACCIDENT REPORT

Adopted: February 28, 1973

AMERICAN AIRLINES, INC.
McDONNELL DOUGLAS DC-10-10, N103AA
NEAR WINDSOR, ONTARIO, CANADA, JUNE 12, 1972

SYNOPSIS

An American Airlines, Inc., McDonnell Douglas DC-10-10, was damaged substantially when the aft bulk cargo compartment door separated from the aircraft in flight at approximately 11,750 feet mean sea level. The separation caused rapid decompression, which, in turn, caused failure of the cabin floor over the bulk cargo compartment. The floor partially collapsed into the cargo compartment, disrupting various control cables which were routed through the floor beams to the rear engine and to the empennage control systems.

The separated door caused minor damage to the fuselage above the door opening and substantial damage to the leading edge and upper surface of the left horizontal stabilizer.

There were 56 passengers and a crew of 11 aboard the aircraft. Two stewardesses and nine passengers received minor injuries.

The National Transportation Safety Board determines that the probable cause of this accident was the improper engagement of the latching mechanism for the aft bulk cargo compartment door during the preparation of the airplane for flight. The design characteristics of the door latching mechanism permitted the door to be apparently closed, when, in fact, the latches were not fully engaged and the latch lockpins were not in place.

As a result of the investigation of this accident, the Safety Board made two recommendations to the Federal Aviation Administrator.

1. INVESTIGATION

1.1 History of the Flight

American Airlines, Inc., Flight 96, a DC-10-10, N103AA, was a scheduled passenger flight from Los Angeles, California, to LaGuardia Airport, New York, with intermediate stops at Detroit, Michigan and Buffalo, New York. Flight 96 departed Los Angeles International Airport at 1436 e.s.t.,[1] on June 12, 1972, 46 minutes after its scheduled departure. The delay was a result of passenger handling and air traffic control. Flight 96 arrived at Detroit at 1836. This segment of the flight was without incident.

Fuel, cargo, and passengers were loaded aboard the airplane at Detroit and its takeoff gross weight was computed to be 300,888 pounds, well under the maximum allowable. The last compartment to be secured prior to dispatch of the flight was the aft bulk cargo compartment.

The ramp service agent who serviced the aft cargo compartment had difficulty closing the door. He stated that he closed the door electrically. He listened for the motor to stop running and then attempted to close the door handle. This handle is designed to close the small vent door which is located on the cargo door, to position a lockpin behind a cam on each of the

[1] All times used herein are eastern standard, based on the 24-hour clock.

four latches and to open the circuit to the cockpit warning lights.

The agent could not close the handle with normal force, so he applied additional force with his knee. This caused the handle to stow properly, but the vent door was closed in a slightly cocked position. The agent brought this to the attention of a mechanic who gave his approval for release of the aircraft. The flight departed the ramp at 1911 with the door in this condition. According to the flight engineer, the cargo door warning light on his panel never illuminated during the taxi-out, or at any time during the flight. This light was designed to illuminate when any cargo door is not properly secured for flight.

Following receipt of clearance to Runway 03 Right, the flight took off at 1920. The first officer was flying the airplane. Flight 96 was cleared to maintain runway heading and to contact the departure controller who cleared it to climb to 6,000 feet and vectored it to intercept V-554. Upon interception, the flight was further cleared to continue climbing to Flight Level 210[2] and to contact the Cleveland Air Route Traffic Control Center (ARTCC).

About 1925, while the airplane was at approximately 11,750 feet altitude and climbing at 260 knots Indicated Airspeed (KIAS), the flightcrew heard and felt a definite "thud." Simultaneously, dust and dirt flew up into their faces, the rudder pedals moved to the full left-rudder position, all three thrust levers moved back to near the flight idle position, and the airplane yawed to the right. The captain reported that he lost his vision momentarily; he thought that a midair collision had occurred and that the windshield had been lost.

The captain immediately disengaged the autopilot and took control of the airplane. He remained on the controls for the rest of the flight. Nos. 1 and 3 engines responded to power application; however, the No. 2 engine thrust lever could not be moved. The airspeed was stabilized at 250 knots, and at this speed the aileron response was normal, elevator response was extremely sluggish, and directional control required continuous left aileron input. Rudder control was not available and the airplane remained in a right yaw. The captain declared an emergency, and Air Route Traffic Control cleared the flight back to Detroit via radar vectors.

At the time of the occurrence, most of the flight attendants heard a loud noise, observed "fog" in the cabin, and felt motion of the cabin air. They recognized the rapid decompression of the cabin air, and one of the first actions of most of the flight attendants was to see whether the passenger oxygen masks had deployed. The decompression of the cabin air through the aft cargo compartment door caused the cabin floor in the aft lounge area to fail downward and partially drop into the cargo compartment. No passengers were in this area of the cabin; however, two flight attendants, who were in their seats at the aft exits, were thrown to the floor and received minor injuries. Their injuries did not prevent them from performing their duties.

During the return flight to Detroit, the passengers were briefed on a possible crash landing and were given instructions for the emergency evacuation of the aircraft.

The airplane was radar vectored to the localizer course for an Instrument Landing System (ILS) approach to Runway 03 Left at the Detroit Metropolitan Wayne County Airport. At the captain's request for a long final approach, the controller planned for a 20-mile localizer course intercept. A slow descent was initiated and, according to the captain, because of limited elevator control, the No. 2 engine was secured. He applied power on the Nos. 1 and 3 engines to assist in pitchup control. The captain decided not to dump fuel because of the unknown damage in the empennage area. During the initial part of the final approach the airspeed was 150 knots and the sink rate was approximately 800 feet per minute. Extension of the landing gear and 35° flaps increased the sink rate to 1,500 feet per minute. Additional thrust increased the airspeed to 160 to 165 knots and stabilized the sink rate at approximately 800 feet per minute. The remainder of the approach was made in this

[2]Flight Level 210 indicates an altitude of 21,000 feet m.s.l. Flight level is written without the last two zeros.

profile. The captain stated that the aircraft's deck angle was extremely flat compared to that of a normal approach and that at touchdown, he had serious doubts if the landing gear was extended. He further stated that he used no stabilizer trim and that he and the first officer both had to apply back pressure to the controls to flare the airplane. The airplane landed at 1944.

The airplane touched down 1,900 feet down the runway and immediately started to veer to the right. The captain applied reverse thrust to engines No. 1 and No. 3 and applied full left aileron. As the aircraft veered further right, the first officer applied full reverse thrust to the left engine and brought the right engine out of reverse. This action provided directional control, and the airplane paralleled the right side of the runway for 2,800 feet before it began a gradual left turn back to the runway. The airplane came to rest approximately 8,800 feet from the runway threshold. The nose and left main landing gear were on the runway surface, and the right main landing gear was off the runway surface.

The captain ordered the emergency evacuation alarm activated after the airplane came to rest. The evacuation slides were deployed and all passengers and crew used the slides.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Other
Fatal	0	0	0
Nonfatal	2	9	0
None	9	47	

1.3 Damage to Aircraft

The cabin floor in the aft lounge area sustained major damage. The first nine transverse floor beams in the lounge area were fractured approximately 6 inches from the vertical struts near the left side of the compartment. These beams also failed in bending near the right side of the airplane, and allowed the floor to settle partially into the cargo compartment. There were no seats attached to this floor section; however, a circular bar installed near the aft end of the lounge tore loose. This bar came to rest in the left corner of the lounge, where the cabin floor deflection was the greatest. The deflection of the floor damaged and jammed a number of the engine and flight control systems cables. One cable to the left rudder and a pair of elevator cables were severed. In the cockpit area, the manual stabilizer trim handles were inoperative, and the rudder pedal torque tube and left rudder cable horn were separated. The aft cargo compartment door separated from the airplane and caused minor damage to the fuselage above the door and substantial damage to the leading edge and upper surface of the left horizontal stabilizer. The cargo door was recovered from a field several miles from the airport.

1.4 Other Damage

None.

1.5 Crew Information

The flightcrew and cabin attendants were qualified and certificated for the operation of this flight. (For detailed information, see Appendix B.)

1.6 Aircraft Information

The airplane was a McDonnell Douglas DC-10-10, registration No. N103AA, serial No. 46503. It had accumulated 2142:13 total flying hours and 8:47 hours since the last line maintenance. The most recent major airplane maintenance inspection was performed on April 26, 1972, at 1,825 hours' total time.

The airplane was properly certificated and had been maintained in accordance with company and Federal Aviation Administration (FAA) requirements.

The only recorded discrepancy to the cargo door closing mechanism occurred on March 3, 1972. The log entry noted that the door would not close electrically, and that it had to be manually latched. Corrective action consisted

of an adjustment to the door-closing switch to permit electric operation of the latches.

No Airworthiness Directive pertaining to DC-10 cargo doors was in effect at the time of the accident. However, McDonnell Douglas Service Bulletin 52-27, DC-10 SC 612, which pertained to the electrical wiring to the latch actuator, had been issued on May 30, 1972. The modification recommended replacement of the cargo door latch actuator wiring with heavier gage wire. American Airlines had not complied with this bulletin at the time of the accident nor was compliance mandatory. The reason for the issuance of this bulletin was stated in the bulletin as:

> *"Reason:*
>
> Three operators have reported failure of the electrical latch actuators to latch/unlatch the cargo doors. Latch actuator failure is attributed to an excessive voltage drop reducing the output torque to the actuator. This condition may prevent electrical latching/unlatching of the hooks. Failure to provide adequate torque necessitates manual latching/unlatching of the doors resulting in flight delays. Increasing the wire gage between the circuit breakers and the actuators will reduce the voltage drop and provide adequate torque to operate the latch hooks under all anticipated conditions."

1.7 Meteorological Information

The surface weather observations at Detroit Metropolitan Wayne County Airport, Detroit, Michigan, for a period prior to and following the accident were, in part, as follows:

1906—Special estimated 4,500 feet broken, 7,000 feet overcast, visibility 2 miles, restriction to visibility smoke and fog, wind 090° at 7 knots, temperature 56° F., dew point 70° F., altimeter setting 29.85.

1955—Estimated 4,500 overcast, 1-1/2 miles visibility, restriction to visibility smoke and fog, wind 140° at 6 knots, temperature 61° F., dew point 58° F., altimeter setting 29.85

1.8 Aids to Navigation

There were no reported malfunctions of the navigational aids during the emergency. Runway 03L, is equipped with a full Instrument Landing System, which was utilized by the crew for the approach.

1.9 Communications

All communications with Flight 96 were routine and in accordance with established procedures. There were no reported difficulties.

1.10 Aerodrome Ground Facilities

Detroit Metropolitan Wayne County Airport is located approximately 17 statute miles southwest of Detroit, Michigan. The geographic location is 42°13.1′ north latitude and 83°20.9′ west longitude, at a field elevation of 639 feet mean sea level. The airport is operated continuously. Runway 03 left is 10,500 feet in length, and 200 feet in width, of concrete construction, with all-weather markings. It is equipped with high-intensity runway lights with centerline lights and high-intensity approach lights. The approach lights are equipped with sequence flashing lights. The runway is also equipped with touchdown zone lights.

Firefighting and rescue equipment available were as follows:

2—Yankee Walters, 2,500 gallon tankers.
1—Yankee Walters, 3,000 gallon tanker.
1—Dodge Light Rescue Truck, 1,000 pounds dry chemical.
1—750 gallon pumper.
1—Dodge Rescue Van.

Ten firefighting personnel were available on 8-hour shifts.

1.11 Flight Recorder

The airplane was equipped with a Sundstrand Data Control Model 573 Flight Data Recorder.

It is a digital recorder with an associated data-acquisition system of the expanded parameter type. The recording medium is one-quarter inch magnetic tape, on which aircraft performance information is recorded serially in digital form or four sequential tracks covering 25 hours of aircraft operation.

The data recorder was operating normally up to the time the door opened. Information obtained from it confirmed the crew's testimony that the incident occurred at an altitude of 11,750 feet. However, the data recorded after the incident was largely aberrant, and little useful information was obtained. The aberrant recording was the result of inadequacies of the installation in this particular data recorder which caused acceleration loads to affect the performance of the recorder.

In addition to the flight data recorder, the aircraft was equipped with a Fairchild Model 100 cockpit voice recorder (CVR). The CVR tape was recovered intact, and a transcript of the pertinent communications is included in Appendix D.

1.12 Aircraft Wreckage

An examination of the airplane and of the aft cargo door which had separated in flight was conducted.

The cargo door hinge, door frame, and the four rollers on the door sill, which engage door latches upon closing were basically undamaged. The rollers were free to rotate and, except for two small gouge marks on the second roller from the front, they were undamaged.

The door actuator gear box was in place; however, the motor had separated from the door and was hanging by its electric wires. The actuator arm had separated and was not recovered. The door itself separated from the fuselage in flight, leaving approximately 80 percent of its exterior skin in place on the door hinge.

The door was found with the four latches nearly closed, with the lockpins not engaged, with the vent door overtraveled beyond the open position and with the door handle in the stowed position. The latches, which were filled with earth, were approximately 0.1875 of an inch from their fully closed positions, and the latch mechanisms were 0.35 of an inch from their over-center stop positions.

Preliminary examination of the screw-type actuator which operates these latches indicated that the length of the actuator measured between the centerlines of its attach bolts was less than its normal extended position.

The actuator was removed and taken to the manufacturer for examination and disassembly. It was determined that the electrical extend limit switch was closed. The gear train was operated manually until the extend limit switch opened. The fully extended actuator measured 11.777 inches, and the retracted measurement was 9.950 inches. The actuator, as recovered, measured 11.040 inches. The unit was given an electrical load test which consisted of loads of 1,500 pounds, 2,000 pounds, and 2,600 pounds. Voltage readings varied from 28 V DC to 13 V DC. When a load of 1,500 pounds was applied, the unit crept slowly with a voltage of 13 V DC and a current draw of 11 ampere. When 2,000 pounds were applied the unit crept with a voltage of 13 V DC and a current of 13.5 ampere. With a load of 2,600 pounds applied, the unit crept with 18 V DC and 17 ampere. The clutch setting was 2,900 pounds. All testing was performed with a new electrical motor installed. The original motor had separated from the actuator and was never recovered.

Examination showed that a high-compression force was transmitted from the latches through the irreversible latch linear actuator to the door structure. This was evident from the Brinelling of the upper side of the bushing on the actuator attach lug and from the damage observed on the actuator support bracket. This support bracket was in place on its attach structure; however, the two bolts which connected the bracket to the structure were sheared. A part of one bolt was still in the door skin which was attached to the airplane. The holes in the bracket and the attach structure were about 0.375 of an inch out of alignment at the outboard side of the bracket. Other evidence of relative motion between these parts was the successive chafemarks in the paint

of the support bracket where it fitted against the mount structure. These marks indicated a maximum relative motion between these parts of 1.05 inches.

The small vent door on the aft cargo door, the door handle, and the latch lockpins are interconnected. The system is designed to prevent the door from closing and the handle from stowing if the lockpins are not in place behind the closed latches.

The link from the door handle to the horizontal torque tube which controls the vent door and the lockpins had failed in tension near its lower end. The fractured ends were separated by several inches and could not be pulled together.

The horizontal torque tube was bent slightly, and it was out of its bearing on the forward end.

The vent door, which is attached to the torque tube, had overtraveled its normal open position and was jammed in place. The vent door guard had failed in the downward direction.

The linkage from the torque tube to the lockpin mechanism was intact, except that the pivot point was broken on the bellcrank which converts vertical push-rod motion (from the handle) to horizontal lock-tube motion. The forward end of the lock tube was bent outboard. The door frame was partially fractured in the area of this bend. The lockpins were withdrawn beyond their normal unlocked positions.

The cargo actuation and warning systems, the hydraulic power system, the main wheel brakes, the nose steering system, the empennage control, and the No. 2 engine control systems were examined.

The cargo door warning light system was found operable from the cockpit aft to the connector plug on the cargo door frame. None of the circuit breakers which control power to the cargo doors and warning systems was found tripped. The wiring to the door, the lock limit warning switch, the closed limit switch, and the closed limit warning switch were separated from their attachments on the door structure.

No discrepancies were found in the hydraulic power systems, or in the wheel brakes or steering systems. Although the left rudder pedal was jammed, the left brake pedal operated normally.

Operation of the various controls in the cockpit revealed the following:

1. The nose steering system was positioned approximately 10° left because of the left rudder pedal input signal. The system was operated from the control wheel with the torque link disconnected; this operated the nose steering system normally.
2. The elevator system was operable throughout its range; however, the input loads were higher than normal.
3. The stabilizer trim switches on the control wheel operated normally; however, the position indicator was inoperative.
4. The rudder trim control was operable to the right; however, the trim would not position the rudder to the left.

The collapse of the cabin floor damaged a number of the engine and flight control system cables which were routed through the floor beams in that area. The following damage was observed:

1. *Elevator Control System*

   The right hand elevator cables (No. 5 and No. 6) were preloaded downward by the collapsed cabin floor structure. The elevators were operable; however, higher than normal control forces were required.

   Both left-hand elevator cables were separated. The No. 4 cable pulled out of the left tension regulator, and the No. 3 cable pulled out of its swaged fitting to the elevator crank.

2. *Rudder Control System*

   The No. 2 (right) rudder cable was stretched taut by the collapsed floor structure and could not be moved. The rudder pedal mechanism had overtraveled its forward position and was jammed. The nose-left stop and the lower crank (cable No. 1)

on the rudder torque tube had both failed. The rudder itself was deflected, trailing edge right.

The rudder trim cables were also preloaded by the collapsed floor structure; however, there was limited response to rudder trim in the range from neutral to trailing edge right trim.

3. *Horizontal Stabilizer Trim*

The horizontal stabilizer could be operated up and down by the switches on either control wheel. There was no response from the alternate electrical trim switches on the pedestal.

Both left-hand manual trim suitcase handle cables had failed, and both right-hand cables were preloaded. In order to trim the stabilizer manually with these handles, both handles must be functioning.

The horizontal stabilizer position indicator drive crank shearpins were sheared, and the stabilizer position indicator cables (No. 135 and No. 136) had failed.

4. *No. 2 Engine Controls*

The No. 2 engine throttle, fuel shutoff, and firewall shutoff cables had all failed. The hydraulic, fire, and fuel firewall shutoff valves were in their midpositions.

1.13 Fire

There was no fire.

1.14 Survival Aspects

The accident was survivable.

All crewmembers and passengers exited the airplane through six of its eight emergency exits. All escape slides for these exits functioned normally.

The nine passengers and the two cabin attendants who sustained injuries were examined at a local hospital for possible fractures and internal injuries. The injuries consisted of contusions and lacerations of extremities and sprained ankles. One passenger suffered a dislocated finger and another passenger a facial injury from being struck by a floor hatch during the decompression. All other injuries were friction burns sustained when the passengers slid down or exited the bottom of the evacuation slides.

The events from the time of decompression until emergency evacuation are as follows:

The Decompression

The decompression manifested itself to the passengers and flight attendants as a muffled explosive sound and a white-gray fog which formed throughout the cabin. The door to the cockpit and the door of the galley lift opened, and several ceiling panels in the center of the cabin fell down. A floor hatch in the aisle next to seat 4H flew up and struck a passenger in the face.

The chief flight attendant, who was standing in the forward service area, was thrown from this area. The two flight attendants seated at the two aft exits were thrown to the floor, which had partially collapsed into the baggage compartment below. The circular standup bar on this collapsed floor section was torn loose from the floor.

Of the eight flight attendants, five reported that their first thought was to reach for oxygen masks. The automatic release for the oxygen system is preset to operate at 14,000 feet, and, since the airplane was below that altitude, the system did not actuate. One flight attendant at Exit 2L obtained a walk-around oxygen bottle and called the cockpit on the intercom system to tell the crew that the damage was in the rear of the airplane. The chief flight attendant and the flight attendant stationed at Exit 1R, went to the cockpit for instructions at various times.

Passenger Preparation

The chief flight attendant, upon instructions from the captain, told the other flight

attendants to prepare the cabin for an emergency landing. She obtained an estimate of available preparation time (8 to 10 minutes) and proceeded, with the aid of the emergency checklist, to brief the passengers by means of the public address system. The other flight attendants demonstrated the brace position to the passengers, pointed out exit locations, gave instructions for use of the emergency escape slide and collected personal belongings and shoes. A number of passengers reported that the emergency instruction card was very useful in determining their nearest exit location.

Passengers seated adjacent to the collapsed floor section were relocated, as were several of the passengers seated in the vicinity of the fallen ceiling panel. The two flight attendants assigned to Exits 4L and 4R were relocated to the jumpseats in the forward service area.

Evacuation

During the landing rollout of the airplane, several other ceiling panels fell down. When the airplane came to a stop, the cabin lights went out, the emergency lighting system illuminated, and the emergency evacuation signal was activated by the cockpit crew. There was no delay in opening of the six exit doors (three on each side of the fuselage). The two rear exits, 4L and 4R, were not used because of the collapsed floor section in that area. The evacuation slides deployed automatically although two slide packs fell inside the cabin and had to be kicked out. Most passengers reportedly needed no encouragement to leave the airplane and were waiting near the doors for slide deployment. The evacuation proceeded smoothly except that two elderly female passengers had to be helped through exits by a flight attendant, and one passenger's path was obstructed by a fallen ceiling panel.

The evacuation was estimated by the flight attendants to have been completed in 30 seconds.

1.15 Tests and Research

The manufacturer conducted a test to determine if the airplane could be pressurized with the vent door open and the nylon baggage curtain acting as a seal enveloping the vent door cage. Another test was conducted to determine the force necessary to stow the aft baggage door locking handle by forcing the handle linkage overcenter to an apparent door-locked position without the lockpin engaged.

The first test revealed that the curtain as a seal could maintain approximately 5 p.s.i. differential pressure. Above 5 p.s.i., the curtain was sucked into the vent door cage and pressurization was lost.

The second test revealed that the force required to stow the handle was approximately 120 pounds. When the door linkage was forced overcenter, the locking pins did not engage. It was noted further that the sliding lock tube was deflected, and the cap end made contact with the cockpit door warning indicator actuating arm. The indicator switch can be actuated with less than one-eighth inch travel of the actuating arm.

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

The initiating factor of this accident was the in-flight opening and separation of the aft cargo door.

Structural damage to the door verified that the latches were not overcenter when the door opened in flight. The two fasteners which attached the door latch actuator to the door had both failed in shear. Part of one of the bolts was found in the piece of door skin which remained on the airplane—an indication that this failure occurred in the air, and not when the main portion of the door impacted the ground.

Forces transmitted back through the linkages from the door latches are the only means by which the actuator and supporting bracket could be loaded in flight. These latch loads are transmitted back through the actuator only if the

actuator linkages are not overcenter. Thus, the evidence indicates that the latch actuator did not extend far enough to drive the latches beyond the overcenter position, and that pressurization forces on the door were transmitted back through the latch linkage to the actuator support bracket. According to the manufacturer, the dimension between the latch crank and the overcenter stop should have been 0.47 inch for this particular actuator extension. With a 0.47 inch displacement, a 4.5 p.s.i. pressurization differential across the door would have been sufficient to fail the two fasteners which had an ultimate shear strength of 6,600 pounds. The manufacturer noted that the 4.5 p.s.i. figure was an approximation, since redundancy of the system, tolerances, deflections, and variances in rigging can all affect the load transmitted through the mechanism.

When the door latches are fully closed, actuation of the door handle moves a lockpin in place behind a cam on each latch. These pins then prevent the latches from opening for any reason. The lockpins could not have been engaged in this case since the latches did not attain their fully closed positions, and the door handle should not have stowed. The agent who operated the door said that the door handle did not close normally. He had to force the handle closed with his knee, and the vent door, which is also operated by the handle, did not then close properly.

A subsequent test of the door mechanism demonstrated that the door handle could actually be stowed without the lockpins in place if a force of 120 pounds was applied to the handle. Deflection of the mechanism permitted this to happen. The same deflection might have permitted the pilot indicator switch to make contact, which, in this system, prevents illumination of the cockpit warning light. Thus, the crew had no warning that the door mechanism was not functioning properly. Such a switch contact was also observed in the test conducted at the manufacturer's facility.

The increasing pressure differential between the pressurized bulk cargo compartment and the outside atmosphere during the climbout loaded the latches, which eventually caused failure of the fasteners which secured the actuator support bracket to the door structure. The latches were then sprung open, which permitted the door to blow open. The combination of airloads and impact of the door with the aircraft fuselage caused the door structure to fail, and most of the door separated from the airplane.

The loss of the aft cargo compartment door resulted in a rapid loss of pressurization in that compartment. This particular cargo compartment was not equipped with pressure relief vents to the passenger cabin above it, as were other cargo compartments on the airplane. Thus, the loss of the door caused the full differential pressure between the pressurized passenger cabin and the atmosphere to be exerted on the cabin floor over the compartment. This loading failed the floor support structure, and the cabin floor collapsed downward into the cargo compartment.

The collapse of the floor resulted in the loss of much of the control of the empennage control surfaces; although the airplane was designed with considerable redundancy in its flight control systems, the control cables from the cockpit to the empennage control actuators are routed through the cabin floor beams over this cargo compartment. The cabin floor displacement and floor beam deformation either severed or severely impaired the operation of these cables.

The Board believes that the lack of pressure relief vents in this cargo compartment represents a significant hazard; sudden loss of pressurization in this compartment should not jeopardize the safety of the flight. If complete venting is not feasible, even partial pressure relief might reduce the cabin floor displacement and the attendant interference with critical flight controls.

In this case, the crew reported, and the investigation confirmed, that the captain's left rudder pedal deflected to and jammed beyond its normal maximum forward position, affording no rudder control from the cockpit. The crew also reported that the airplane yawed to the right. The left rudder cable was found broken, permitting slack in the right rudder cable. The weight and force of the cabin floor deflected

the intact right rudder cable downward, putting a right signal into the rudder control valve system. There was no impairment of aileron control and the crew used approximately 45° left aileron to counteract the right yaw.

The crew reported that extremely heavy control forces were necessary for pitch control. Two elevator control cables were separated and two remained intact; however, the downward loading of the floor on the cables made the use of increased forces necessary to move the control yoke.

The crew reported that the stabilizer trim control was lost. Examination of the system did not confirm this statement. The stabilizer trim indicator was inoperative because of a broken cable. The manual stabilizer trim on the pedestal (suitcase handles) was inoperative because the cables to the left handle were separated. To operate the stabilizer trim manually with the suitcase handles, both handles must be functioning. One handle positions the control valve and the other controls the direction of operation (up or down). It was not confirmed which valve was inoperative because of cable separation. The normal operation of the stabilizer trim is by the trim switches on the captain's and the first officer's control yoke. These switches functioned normally when checked.

The crew reported that they secured the No. 2 engine during the descent into Detroit. Examination revealed that the cable to the fire shutoff valve was separated. The cables to the No. 2 engine thrust lever and fuel shutoff valve were also separated. Therefore, the Board believes that the engine was shut down when the cables separated and that no control of the engine existed from the cockpit subsequent to cable separation.

The descent and approach to the Detroit Metropolitan Wayne County Airport were successfully made under these conditions. The problems which manifested themselves during the landing and rollout as described by the crew were high approach speed (160 to 165 knots) to counteract high sink rate, no rudder control, 45° left aileron to counteract right yaw, no left brake, and uncertain nosewheel steering capability.

The crew stated that when the landing gear and 35° flaps were extended at 150 KIAS airspeed, the sink rate increased to 1500 to 1800 feet per minute and, in order to stabilize at a normal sink rate, an airspeed of 160 to 165 KIAS was necessary. At this airspeed, the airplane had an abnormally shallow deck angle and at touchdown, application of control forces by both the captain and first officer was required to flare the airplane.

Subsequent to touchdown, the airplane yawed to the right and directional control was maintained only by asymmetrical reverse thrust. Since the captain was applying left aileron, the first officer applied the asymmetrical reverse thrust. As the airplane decelerated and the right rudder displacement became less effective, the airplane began a gradual left turn toward the runway. This turn was due to the full left deflection of the rudder pedal which activated the nosewheel steering 10° to 12° to the left.

Rudder trim, although limited, was available. The trim cables reposition the neutral setting of the rudder control valves. The rudder actuator had a right displacement signal from the cable system; this was in the same direction as the trim signal. The trim wheel functioned normally to the right; however, it was necessary for the pilot to use both hands to move the trim wheel to neutral because the floor was binding the cables.

The three hydraulic systems remained intact. There was no leakage of fluid or loss of pressure. When the auxiliary pumps were turned on, pressure was built up in both brake systems. When the two pedals were depressed, both brake gages registered pressure. The report of no left brake was in all probability caused by the pilot's inability to actuate the pedal, as the rudder pedal was overextended to the left, which necessitated a long awkward reach.

The manner in which the flight attendants handled the emergency was indicative of excellent training and a highly professional attitude. This was evident in their immediate recognition of the possible need for supplemental oxygen, the

leadership exhibited by the chief flight attendant in directing the other flight attendants and in staying abreast of the airplane's progress, in preparing the passengers for an emergency landing and evacuation, and in the prompt and elaborate briefing given the passengers.

Several individual, impromptu decisions had to be made by the flight attendants because of the various unknown facets of the situation. For instance, the proximity of the passengers to the collapsed floor section prompted flight attendants to move all occupants from that area. Several passengers were moved from the vicinity of fallen ceiling panels. A flight attendant briefed one of the male passengers near her door in the operation of this exit, just in case she would not be able to operate it after landing. Another flight attendant instructed two foreign passengers on the bracing position and the location and use of their exit because she noticed a lack of comprehension on the part of these persons when emergency instructions were given. Prior to the landing, all flight attendants were seated, and the chief flight attendant had reported to the captain that the emergency checklist had been completed and that the cabin was prepared for emergency landing.

The evacuation was initiated when the emergency evacuation signal was activated from the cockpit. The evacuation alarm produced a favorable influence on passenger behavior. All attendants reported that they were not quite ready at their stations when the first passengers appeared, and many of them had to be held back to give the slides time to deploy. This was especially true in the case of the slides from the overwing exits which require 17 seconds to inflate fully.

Two slide packs fell onto the cabin floor and had to be kicked out of the door. This is not unusual, however, since the motion of the door, in traveling to its full open position, constantly alters the position of the package in relation to the door sill. A slight delay or premature release of the package may cause it to fall on the door sill instead of outside.

Injuries were sustained by nine passengers. Most of the passengers were unable to maintain a "feet first" position while sliding down the center of the double occupancy surface and were not able to stabilize themselves because they could not reach the raised sides. As a result, some passengers were injured at the end of the slide.

2.2 Conclusions

(a) *Findings*

1. The crewmembers were properly certificated for the operation.
2. The airplane was operated in accordance with FAA and company regulations and procedures.
3. The airplane was within the gross weight and center of gravity limits.
4. The aft bulk cargo compartment door opened in flight and separated from the airplane.
5. Relief vents were not installed between the passenger cabin and the aft bulk cargo compartment to minimize the pressure loading on the cabin floor in the event of a sudden depressurization of the cargo compartment.
6. The loss of pressure in the cargo compartment created a pressure differential of sufficient magnitude to cause the cabin floor and its supporting structure to fail.
7. The cabin floor displacement and floor beam deformation into the cargo compartment severed some of the cables and severely impaired the operation of others to the No. 2 engine and empennage flight controls.
8. Stabilizer trim was available, although the stabilizer indicator was inoperative. The crew was not aware of that, and they did not use trim for the approach and landing.
9. There were no malfunctions of the three hydraulic systems, the airplane's brake system, and the nosewheel steering system.

10. The cargo door latches were not latched overcenter; this condition was attributed to low voltage to the latch motor.
11. A service bulletin to correct this condition was in effect at the time of the accident, but the recommended modification had not been incorporated.
12. The ramp service agent forced the door handle closed without the lockpins in place. Although the door was not then properly closed, deflection of its locking mechanism permitted the pilot indicator switch to make contact which turned the cockpit warning light off.
13. The preparation of the passengers for an emergency landing and the subsequent evacuation were well executed.
14. The Board commends the flightcrew for the manner in which they successfully coped with the unusual in-flight emergency. Additionally, the Board commends the flight attendants for their actions which are indicative of excellent training and a high professional attitude.
15. The emergency evacuation alarm system was very effective.
16. The width of the double occupancy emergency slides made it difficult for the evacuees to stabilize their sitting positions during the descent, which caused injuries to them when they reached the bottom of the slide.

(b) *Probable Cause*

The National Transportation Safety Board determines that the probable cause of this accident was the improper engagement of the latching mechanism for the aft bulk cargo compartment door during the preparation of the airplane for flight. The design characteristics of the door latching mechanism permitted the door to be apparently closed, when, in fact, the latches were not fully engaged and the latch lockpins were not in place.

3. RECOMMENDATIONS AND CORRECTIVE ACTION

As a result of the investigation of this accident, the Safety Board on July 6, 1972, issued two recommendations (Nos. A-72-97 and 98) directed to the Administrator of the Federal Aviation Administration. Copies of the recommendation letter and the Administrator's response thereto are included in Appendix F.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JOHN H. REED
Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ LOUIS M. THAYER
Member

/s/ ISABEL A. BURGESS
Member

/s/ WILLIAM R. HALEY
Member

February 28, 1973

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INVESTIGATION AND HEARING

1. Investigation

The Board's Chicago field office received notification of the accident at approximately 2045 c.d.t., on June 12, 1972, from American Airlines Flight Dispatch Office at Chicago's O'Hare Field. An investigator from the Chicago Field Office was on the scene at approximately 0330 c.d.t. on June 13, 1972. Investigators from Washington and the New York Field Office arrived on the scene on the morning of June 13, 1972. Working groups were established for Operations, Human Factors, Structures, Systems, Maintenance Records, and Flight Recorders. Parties to the Investigation included: American Airlines, Inc., the Federal Aviation Administration, Allied Pilots Association, and McDonnell Douglas Aircraft Corporation.

2. Hearing

There was no public hearing.

3. Preliminary Report

A preliminary report on this accident was issued by the Safety Board on August 22, 1972.

CREW INFORMATION

Captain Bryce McCormick, aged 52, was employed by American Airlines on May 26, 1944. He holds Airline Transport Pilot Certificate No. 105096, with ratings in the Douglas DC-6/7, DC-10, Boeing 727 and 707, and the Convair 990-type aircraft.

He had passed his most recent examination for an FAA first-class medical certificate on December 24, 1971, without any physical waivers and his company physical examination on October 29, 1971. He had accumulated 24,048 hours of flying time as of June 12, 1972, of which 5:51 hours were flown on this flight. He had acquired 56 total hours in the Douglas DC-10 aircraft. He had completed ground school and flight training in the Douglas DC-10 and had passed his flight proficiency rating check on March 30, 1972. His most recent line check had been performed on April 24, 1972.

First Officer Peter Whitney, aged 34, was employed by American Airlines on September 8, 1965. He holds Airline Transport Certificate No. 1621264.

He had passed his most recent examination for an FAA first-class medical certificate on January 21, 1972, without any physical waivers and his company physical examination on May 26, 1972. He had accumulated 7,947 hours of flying time as of June 12, 1972, of which 5:51 hours were flown on this flight. He had acquired 75 total hours in the Douglas DC-10 aircraft. His most recent proficiency check in the Douglas DC-10 had been on March 30, 1972.

Flight Engineer Clayton Burke, aged 50, was re-employed by American Airlines on March 15, 1954. He holds Flight Engineer Certificate No. 1208279.

He had passed his most recent examination for an FAA medical certificate on December 15, 1971, without any physical waivers, and his company physical examination on December 14, 1971. He had accumulated 13,898 hours of flying time as of June 12, 1972, of which 5:51 hours were flown on this flight. He had acquired 45 total hours in the Douglas DC-10 aircraft. His most recent proficiency check in the Douglas DC-10 had been on March 30, 1972.

Chief Flight Attendant Cyda Smith was employed by American Airlines on May 28, 1968. She completed her DC-10 training in May 1971 and her most recent emergency procedure training on May 11, 1972.

Stewardess Beatrice Copland was employed by American Airlines on July 30, 1970. She completed her DC-10 training in March 1972 and her most recent emergency procedure training on June 14, 1971.

Stewardess Janice Hickingbottom was employed by American Airlines on April 24, 1969. She completed her DC-10 training in October 1971 and her most recent emergency procedure training on May 23, 1972.

Stewardess Colleen Maley was employed by American Airlines on May 20, 1971. She completed her DC-10 training in January 1972 and her most recent emergency procedure training on May 16, 1972.

Stewardess Sandra McConnell was employed by American Airlines on March 23, 1969. She completed her DC-10 training in October 1971 and was scheduled for emergency procedure training on June 13, 1972.

Stewardess Charlotte McGhee was employed by American Airlines on May 27, 1971. She completed her DC-10 training in November 1971 and her most recent emergency procedure training on May 22, 1972.

Stewardess Carol Stephens was employed by American Airlines on May 16, 1972, and graduated from American Airlines Stewardess School on May 16, 1972.

Stewardess Marlene Saydeh was employed by American Airlines on May 7, 1970. She completed her DC-10 training in March 1972 and her most recent emergency procedure training on May 8, 1972.

AIRCRAFT HISTORY

The airplane was manufactured by McDonnell Douglas as a DC-10-10. The registration number was N103AA, serial number 46503. It was received by American Airlines from the manufacturer on July 28, 1971. It had accrued 2,142 hours of flying time at the time of the accident.

N103AA was powered by three General Electric CF6-6D gas turbine engines. The No. 1 engine, serial number 451208, was installed on February 17, 1972, and had a total time of 820 hours. The No. 2 engine, serial number 451180, was installed on March 19, 1972, and had a total time of 920 hours. The No. 3 engine, serial number 451298, was installed on May 19, 1972, and had a total time of 177 hours.

The airplane records indicate that N103AA had been maintained in accordance with all company procedures and FAA Directives.

TRANSCRIPTION OF PERTINENT COMMUNICATIONS FROM COCKPIT VOICE RECORDER, DOUGLAS MODEL DC-10-10, N103AA, AMERICAN AIRLINES FLIGHT 96 WINDSOR, CANADA, JUNE 12, 1972

LEGEND

CAM	Cockpit area microphone voice or sound source
RDO	Radio transmission from N103AA
-1	Voice identified as Captain
-2	Voice identified as First Officer
-3	Voice identified as Second Officer
-?	Voice unidentified
LC	Local Control Detroit Metropolitan Airport
DE	Departure Radar East Metropolitan Airport
QGR	Cleveland ARTC Center, Windsor Radar Controller
ARE	Arrival Radar East Metropolitan Airport
*	Unintelligible word
#	Nonpertinent word
%	Break in continuity
( )	Questionable text
(( ))	Editorial insertion

INTRA-COCKPIT		AIR GROUND COMMUNICATIONS	
SOURCE & TIME	CONTENT	SOURCE & TIME	CONTENT
0018:47.5			
CAM-1	Are you ready, uh, Page, uh Page?		
CAM-2	Oh, thank you		
CAM-1	Wanna try one?		
CAM-2	All right sir, thank you		
CAM-1	I'll bring it up to a stop here		
CAM-2	Okay		
CAM-1	It's still position and hold for us on the air		
CAM-3	Okay, we've got an anti-skid to go		
		0019:14.0	
		LC	American ninety-six maintain runway heading, contact departure, cleared for takeoff
CAM	Sound of heavy click		
		0019:19.0	
		RDO-1	American ninety-six is cleared for takeoff
CAM-3	Checklist complete		
		LC	To maintain runway heading
		RDO-1	To maintain runway heading
0019:26.0			
CAM-1	'kay, you can take it with the rudders		

INTRA-COCKPIT		AIR GROUND COMMUNICATIONS	
SOURCE & TIME	CONTENT	SOURCE & TIME	CONTENT
CAM-2	Okay		
CAM	Sound of engine noise level increases		
CAM-1	He said maintain heading		
CAM-2	Yeah		
CAM-1	Yeah		
CAM-1	Okay, you got it		
CAM-2	Okay		
CAM-?	(ninety) eight point six		
CAM-1	Get your hand on the wheel		
CAM-?	* *		
CAM-2	I got cha *		
0019:48.0 CAM-1	Vee one		
CAM-1	Rotate		
CAM-2	(Your forward main gear up)		

INTRA-COCKPIT		AIR GROUND COMMUNICATIONS	
SOURCE & TIME	CONTENT	SOURCE & TIME	CONTENT
CAM-1	(Okay, then your forward gear has a long ways to go)		
		0020:11.5	
		LC	American ninety-six maintain runway heading contact departure one eighteen four
		RDO-1	One eighteen four maintain runway heading American, eh, ninety-six
CAM-?	* * * *		
		0020:32.5	
		RDO-1	And American ninety-six, your frequency, we're off Detroit Metro
		DE	American ninety-six Detroit departure radar contact climb and maintain six thousand
		0020:42.0	
		RDO-1	Okay, you want us to climb and maintain six thousand, American, uh, ninety-six
		DE	Roger American ninety-six turn heading zero six zero
		0020:50.5	
		RDO-1	Right to zero six zero, American ninety-six
CAM-1	Okay, you got 'em?		
CAM-2	Yeah		

INTRA-COCKPIT		AIR GROUND COMMUNICATIONS	
SOURCE & TIME	CONTENT	SOURCE & TIME	CONTENT
CAM-2	Flaps, up		
CAM	Sound of flap lever		
		0021:23.0 DE	American ninety-six turn right heading zero nine zero
		RDO-1	Right to zero nine zero, American ninety-six
CAM-1	Zero nine zero, you got it?		
CAM-2	Slats, up		
CAM	Sound of click		
CAM-1	Whoever designed that thing, I'll tell yah, he- - ooh		
CAM-2	They're really something to behold, huh?		
CAM-?	* * * *		
CAM-3	Gear handle to *		
CAM	Sound of click		
		0022:15.0 DE	American ninety-six, turn right heading one one zero, join ah Jay five five four when ya intercept

INTRA-COCKPIT		AIR GROUND COMMUNICATIONS	
SOURCE & TIME	CONTENT	SOURCE & TIME	CONTENT
		RDO-1	Okay, ah, take over on Victor ninety-four when we intercept, American ninety-six and, ah, six thousand still our altitude?
		0022:33.0 DE	Okay, ah, I'll have something higher for ya here in just a moment and that'd be Vic Jay five five four to resume normal navigation on ((pause)) Jay fifty-four to American ninety-six, climb and maintain, ah, flight level two one zero
0022:45.5 CAM	Sound of warning horn		
		RDO-1	Okay, ah, climb two one zero American ninety-six, we're out of, ah, fifty-five hundred now
		0022:54.0 DE	And would you verify were you issued Jay five five four? I misunderstood you I believe
CAM-2	Yeah, flight plan route		
		0022:58.5 RDO-1	That is correct, ah, take over on five five four and inter- and, ah, flight plan route American, ah, ninety-six
		RDO-1	Two clicks
0023:07.5 CAM-1	Call for 'em Page and I'll try to set 'em up for you, okay?	0023:07.5 DE	American ninety-six can call Cleveland Center now on frequency one two six point four, good day
CAM-2	Thank you		

INTRA-COCKPIT		AIR GROUND COMMUNICATIONS	
SOURCE & TIME	CONTENT	SOURCE & TIME	CONTENT
		0023:13.0 RDO-1	Ah, repeat that frequency, I'm sorry
		DE	One two six point four. Twenty-six four, good day now
		0023:18.0 RDO-1	Good day sir
CAM-2	(I can do this) but I'll be late		
CAM-1	Okay, I expect you to do it when I'm a few minutes late		
CAM-2	Thank you		
		0023:37.0 RDO-1	Good evening Cleveland Center, American flight ninety-six is out of, ah, seven thousand now for two one zero
0023:45.0 CAM-3	I'm giving you three seven (to get ten)		
		0023:47.0 QGR	American ninety-six squawk code, ah, one one zero zero and ident maintain flight level two three zero report reaching
		0023:58.0 RDO-1	Okay, one one zero zero and ident and report reaching two one zero American ninety-six
CAM-2	Two three zero		

INTRA-COCKPIT		AIR GROUND COMMUNICATIONS	
SOURCE & TIME	CONTENT	SOURCE & TIME	CONTENT
		0024:05.0 RDO-1	Ah, correction was that two three zero?
		QGR	Two three zero American ninety-six report reaching
		0024:10.5 RDO-1	Okay, American ninety-six
		QGR	Ninety *
0024:28.5 CAM-1	(There) goes a big one up there		
0024:32.5 CAM	Sound of high amplitude noise		
CAM-?	Ah, #		
0024:35.0 CAM-1	What the hell was it? (I wonder?)		
CAM-?	Whistle ((similar to human voice))		
0024:35.5 CAM	Sound of fire warning horn begins at same time with altitude warning horn		
0024:39.0 CAM-1	Well pass the warning fire		

INTRA-COCKPIT		AIR GROUND COMMUNICATIONS	
SOURCE & TIME	CONTENT	SOURCE & TIME	CONTENT
CAM-2	Which one?		
0024:42.5 CAM-3	We've hit something		
CAM-2	We've lost ((pause)) lost an engine here		
0024:46.5 CAM-1	Ah, which one is it?		
CAM-3	Two		
CAM-1	(Is pitch hold grabbing on?)		
CAM-3	Number one is still good		
CAM-3	And, ah, Captin * we'll have to * * * to check out this		
CAM-2	Okay, we apparently ((pause)) Master Warning, this board's got an engine fire over here. Yeah we got the engines, one and three		
CAM-2	Do we have, ah, hydraulics?		
CAM-1	No		
CAM-1	I've got full rudder here		

INTRA-COCKPIT		AIR GROUND COMMUNICATIONS	
SOURCE & TIME	CONTENT	SOURCE & TIME	CONTENT
CAM-1	Yeah		
CAM-3	Hydraulic pressure's okay		
CAM	((Female voice)) Is everything all right up here?		
		0025:16.5 RDO-1	No! Ah, Center, this is American Airlines flight ninety-six, we got an emergency
CAM-2	You go back to the *		
		0025:22.0 QGR	American nine six roger returning back to Metro
CAM-1	Yeah		
		0025:25.0 RDO-1	Ah, negative, I want to get into an airport that's in the open. Where's one open?
		NOTE:	From this time to landing only random pertinent transcriptions made
		0025:29.0 QGR	American ninety-six start right turn heading 'll be one one seven zero, maintain one zero thousand, go ahead
		RDO-1	Right turn to one zero thousand?

INTRA-COCKPIT		AIR GROUND COMMUNICATIONS	
SOURCE & TIME	CONTENT	SOURCE & TIME	CONTENT
		0025:37.0 QGR	Right turn heading one eight zero, maintain ten thousand, go ahead
		0025:48.0 QGR	American ninety-six, Cleveland
		0025:51.0 RDO-2	We got one seven zero heading sir and, ah, maintaining twelve thousand
		0025:54.5 QGR	Nine six roger, type of emergency?
		RDO-2	Yeah, yes sir
		RDO-1	We have a control problem, we have no rudder, got full jam, we've had something happen, I don't know what it is
		0026:06.5 QGR	American nine six, understand ((pause)) cleared to maintain, ah, niner thousand, altimeter two niner eight seven be, ah, radar vector back toward the ILS course runway three, you want the equipment to be standing by?
		0026:22.0 RDO-2	'Kay sir, ah, ah, say again the heading and we'll let down slowly to niner thousand

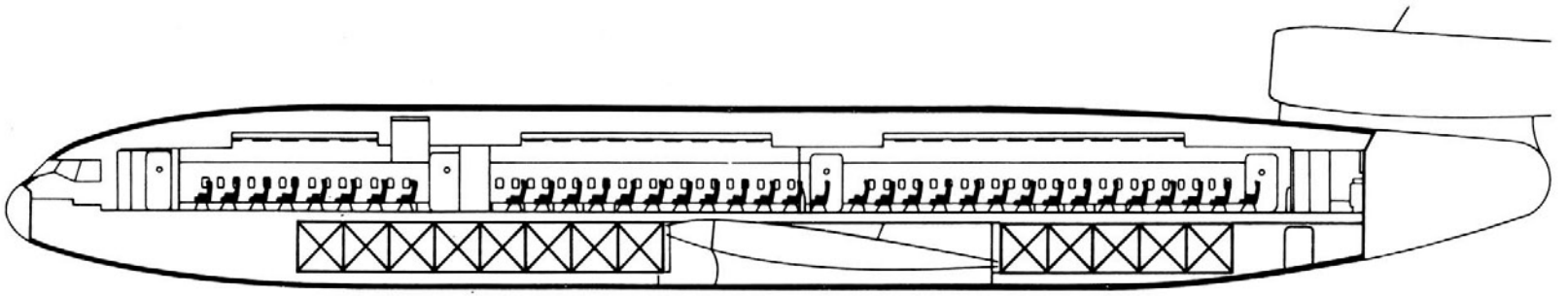
INTRA-COCKPIT		AIR GROUND COMMUNICATIONS	
SOURCE & TIME	CONTENT	SOURCE & TIME	CONTENT
		0027:21.0 RDO-1	Okay now, we've got, ah, problem I got a hole in the cabin, I think we've lost number two engine, we've got a jammed rudder full left rudder and we need to, ah, get down and make an approach I guess Detroit Metro would be the best and, ah, can you vector us around?
		0027:42.5 QGR	American nine six roger turn further right now heading'll be two zero zero
		0028:25.0 RDO-1	I have no rudder control whatsoever so our turns are gonna have to be very slow and cautious
		0028:31.0 QGR	Understand
0028:33.0 CAM-2	Okay we've got full control on this though, however, so I guess we're slow enough so we can probably use differential directions with engines, thank goodness it's one and two we've got ((pause)) one and three		
		0028:54.0 QGR	American nine six continue descent to five thousand feet say the altitude now

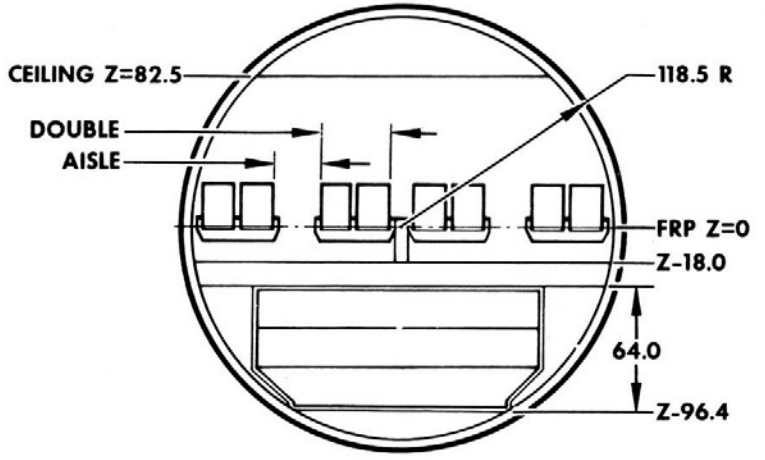
INTRA-COCKPIT		AIR GROUND COMMUNICATIONS	
SOURCE & TIME	CONTENT	SOURCE & TIME	CONTENT
		0028:58.5 RDO-2	Twelve thousand to five
		0029:57.0 QGR	Nine six altitude now
		0029:58.5 RDO-2	Ah, eleven thousand two hundred
0031:12.5 CAM-1	Okay. Give me about fifteen on the flaps now, watch it carefully		
0032:06.0 CAM-3	We'll be landing about two hundred ninety two thousand		
		0032:45.0 RDO-2	We're out of eight seven hundred for, ah five thousand right?
		0032:48.5 QGR	American nine six roger turn back right now heading'll be two eight zero
		0034:28.5 QGR	American ninety-six now cleared to maintain three thousand
		0034:34.0 RDO-2	Three thousand

INTRA-COCKPIT		AIR GROUND COMMUNICATIONS	
SOURCE & TIME	CONTENT	SOURCE & TIME	CONTENT
		0035:13.0 QGR	American ninety-six Metro approach one two one five – one twenty-five fifteen go ahead
		0035:18.5 RDO-2	Thank you one twenty-five one five
0036:08.5 CAM-2	We've got a nice rate of descent even if we have to touch down this way we're doing well		
		Note:	Detroit Metro arrival east
		0036:30.0 ARE	American ninety-six, Detroit
		0036:32.0 RDO-2	Loud and clear sir, and we're through five thousand five hundred four three
		0036:45.5 ARE	American ninety-six, turn right heading three six zero, descend and maintain three thousand vector to the ILS three left final approach course, altimeter two niner eight five, visibility one and one half, breaking, clear for all types of aircraft
		0036:57.0 RDO-2	I think you heading now to three thousand

INTRA-COCKPIT		AIR GROUND COMMUNICATIONS	
SOURCE & TIME	CONTENT	SOURCE & TIME	CONTENT
0038:40.0 CAM-1	Well gimme the gear		
0039:39.0 CAM-1	Okay, here we're coming into the ILS, I'm gonna start slowing her down, give me twenty-two on the flaps		
0040:59.0 CAM-1	All right we got the green lights		
		0041:10.0 ARE	American ninety-six, you're two and a half miles from the marker, contact the tower one two one point one, good night
		0041:15.0 RDO-2	Good night, sir
		0042:23.5 LC	American ninety-six cleared to land
		0042:26.5 RDO-2	American ninety-six cleared to land
0042:42.0 CAM-1	Give me thirty-five on the flaps		
0043:38.0 CAM-1	I have no rudder to straighten it out with when it hits		

INTRA-COCKPIT		AIR GROUND COMMUNICATIONS	
SOURCE & TIME	CONTENT	SOURCE & TIME	CONTENT
0043:53.5 CAM-2	Okay, now engines off at your discretion		
0044:55.0 CAM-1	SHUT 'EM DOWN		

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AISLE
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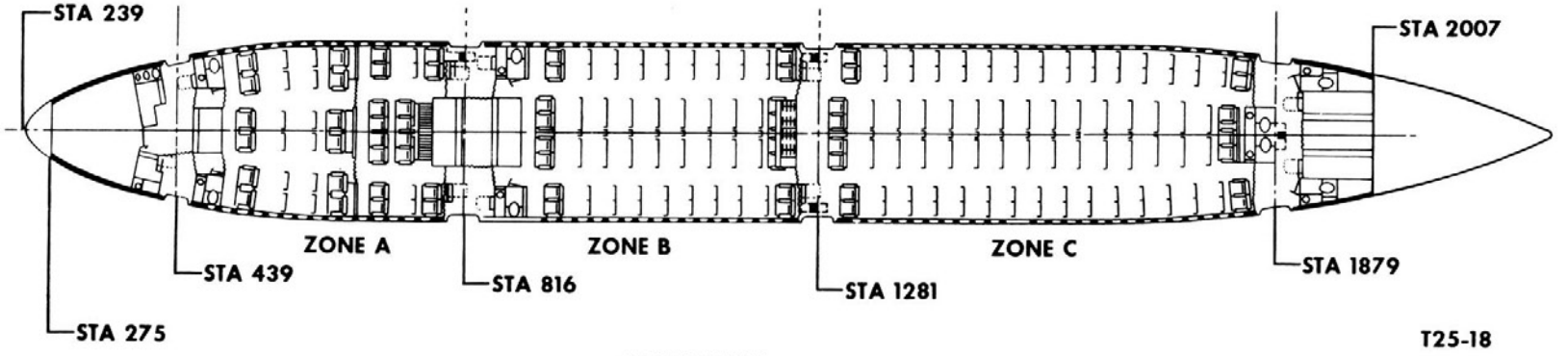
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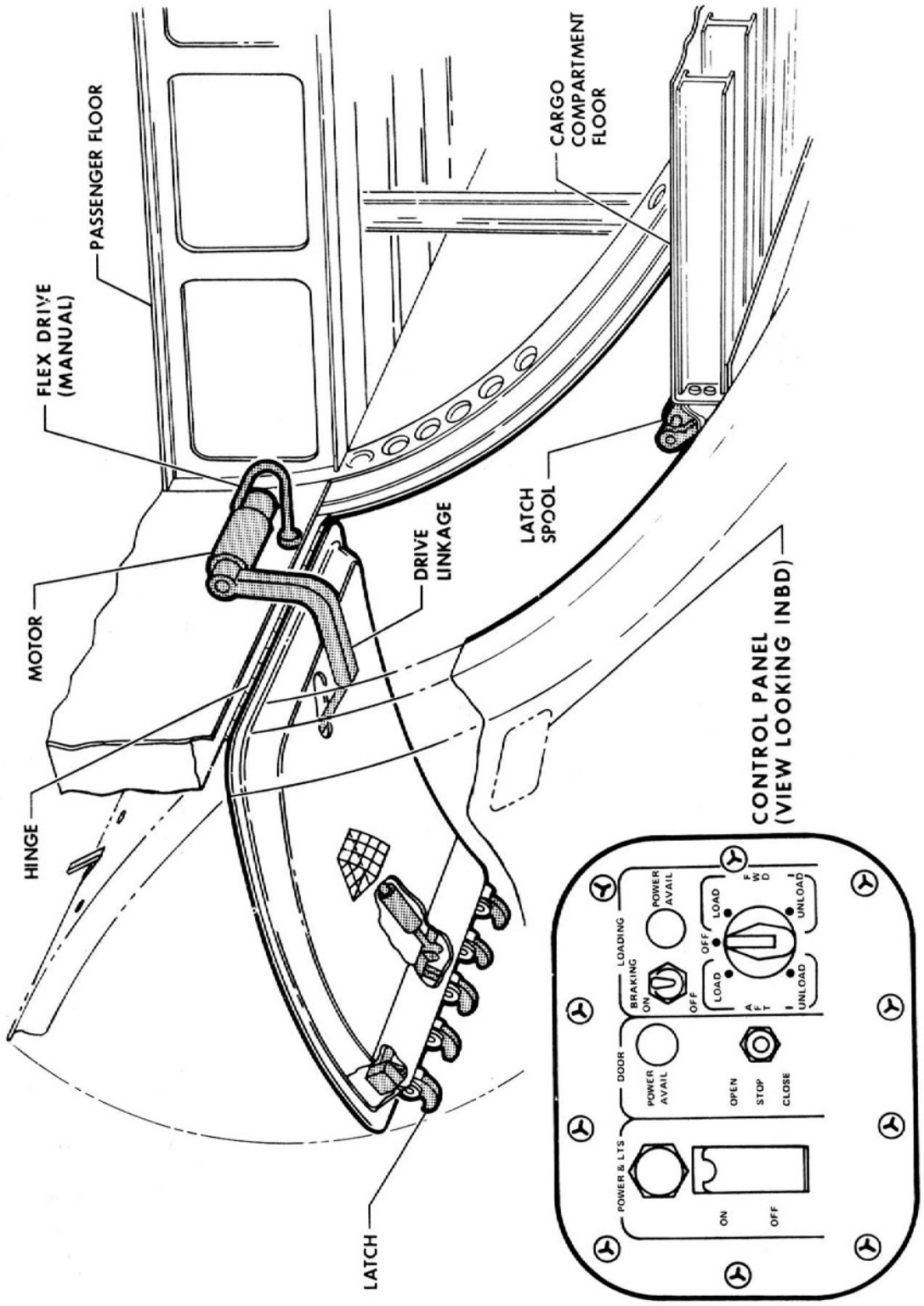
STA 2007
ZONE A
ZONE B
ZONE C
STA 439
STA 816
STA 1281
STA 1879
STA 275
T25-18

FLOOR PLAN


PASSENGER FLOOR
FLEX DRIVE (MANUAL)
CARGO COMPARTMENT FLOOR
MOTOR
DRIVE LINKAGE
LATCH SPOOL
HINGE
CONTROL PANEL (VIEW LOOKING INBD)
LATCH
POWER & LTS
ON
OFF
DOOR
POWER AVAIL
OPEN
STOP
CLOSE
LOADING
BRAKING
ON
OFF
POWER AVAIL
OFF
LOAD
UNLOAD
LOAD
UNLOAD
AFT
FWD

CARGO DOOR

UNITED STATES OF AMERICA
NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: July 6, 1972

Adopted by the NATIONAL TRANSPORTATION SAFETY BOARD
at its office in Washington, D. C.
on the 23rd day of June 1972.

FORWARDED TO:

Honorable John H. Shaffer
Administrator
Federal Aviation Administration
Washington, D. C. 20591

SAFETY RECOMMENDATIONS A-72-97 & 98

The National Transportation Safety Board is investigating an accident involving an American Airlines McDonnell Douglas DC-10-10, N103AA, which occurred shortly after takeoff from Detroit Metropolitan-Wayne County Airport on June 12, 1972.

The aft left-hand cargo door opened while the aircraft was at approximately 12,000 feet. The cabin floor over this cargo compartment then failed as a result of depressurization loading, and the floor dropped partially into the cargo compartment. This displacement of the floor caused serious disruption of the control cables which are routed through the floor beams to the empennage control systems and the engine controls. With the exception of the right rudder pedal cable, all of the cables on the left side of the fuselage broke. The cable runs on the right side were also damaged–the cable guides tore from their attachments to the floor beams, and the cables were deflected downward by the floor structure.

Preliminary investigation has revealed that the door latches were not driven fully closed, and the lock-pins which should have prevented the latches from opening were not in place. The reason these door latches were not driven over center to the fully closed position has not yet been determined. However, although the Safety Board believes this was relevant and a contributing factor, we are more concerned over the failure of the door safety features to preclude dispatch with an unlocked door. The design of the door should have precluded the dispatch of the aircraft with this door improperly closed. With the lock-pins not engaged, a small vent door on the cargo door should have remained open, preventing normal pressurization of the aircraft. Also, the vent door handle should not have stowed.

However, tests conducted at Douglas Aircraft Company have demonstrated that the vent door can be closed, and the handle stowed, without the lock-pins engaged. Apparently, some combination of deflection of the operating mechanisms and tolerances permitted such operation when a force of approximately 120 pounds was applied to the operating handle. During these tests our investigator observed bending of the sliding lock-tube which caused the cap end of the tube to make contact with the pilot indicator switch actuating arm. This arm moves through a very small arc to actuate the switch, and the Board believes that a similar contact on the accident aircraft door probably actuated the switch and gave the pilots a door safe indication on the annunciator light panel.

Finally, the Board believes that sudden loss of pressure in this cargo compartment for any reason should not jeopardize the safety of the flight. In this case, the loss of the door and resultant cabin floor failure caused an unwanted rudder input, severely restricted the elevator control available to the crew and disrupted the No. 2 engine controls.

We are aware of the inspection procedures currently in effect to ensure safety of operations of the DC-10 as well as the existing safety features of the door design. Nevertheless, in order to preclude the recurrence of similar accidents, the Safety Board recommends that the Federal Aviation Administration:

1. Require a modification to the DC-10 cargo door locking system to make it physically impossible to position the external locking handle and vent door to their normal door locked positions unless the locking pins are fully engaged.

2. Require the installation of relief vents between the cabin and aft cargo compartment to minimize the pressure loading on the cabin flooring in the event of sudden depressurization of the cargo compartment.

Members of our Bureau of Aviation Safety will be available for consultation in the above matter if desired.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20590

OFFICE OF
THE ADMINISTRATOR

7 JUL 1972

Honorable John H. Reed
Chairman, National Transportation Safety Board
Department of Transportation
Washington, D.C. 20591

Dear Mr. Chairman:

This is to acknowledge your Safety Recommendations A-72-97 and 98 issued on 6 July 1972 which included recommendations resulting from an inadvertent cargo door opening reported on a Douglas DC-10-10 airplane.

All operators of DC-10-10 airplanes are currently performing 100 hour functional checks on the cargo door system and will incorporate necessary modifications in accordance with McDonnell Douglas Service Bulletins 52-27 and A52-35 within 300 hours. These modifications pertain to improvements in the inspection and operation of locking and vent mechanisms.

Additional modifications to the cargo door locking and pressurization systems are being considered as part of a continued investigation effort. While a preliminary investigation indicates that it may not be feasible to provide complete venting between cabin and cargo compartments, your recommendations will be considered with respect to further action taken.

Sincerely,

/s/ J. H. Shaffer
Administrator

These recommendations will be released to the public on the issue date shown above. No public dissemination of the contents of this document should be made prior to that date.

Reed, Chairman, McAdams, Thayer, Burgess and Haley, Members, concurred in the above recommendations.

/s/
By: John H. Reed
Chairman

GOP 860-723